# EFFECTS OF LITERAL AND METAPHORICAL LANGUAGE USE ON ACOUSTIC AND PERCEPTUAL MEASURES OF CHORAL TONE

by

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# DISSERTATION ABSTRACT

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Researchers have demonstrated that imagery and odorants can influence the physiological and psychological state of humans (Dayme, 2009; Hongratanaworakit, 2009; Song et al., 2014). Singers' "physiological state and concept of sound all have an effect on the activity of laryngeal muscles" (Dayme, 2009, p. 51). As the vocal tract changes the sound is filtered through the altered resonator to amplify or suppresses different harmonics, thus changing the tone quality perceptually and objectively (spectrum analysis) (Bozeman, 2015; McCoy, 2020). While these topics have been researched separately, to the researcher's knowledge, there has been no research on the effect of scent inhalation on choral tone quality or language preference within the current context.

The purpose of this study was to examine singer preference and understanding of instructional prompts related to tone quality. A secondary purpose of the study was to determine what effects the experimental conditions had on choral tone. Treatment conditions included:

- Sing as if you are performing (control);
- For every inhalation, inhale slowly and deeply with an open throat (metaphorical language condition);

- For every inhalation, imagine you are inhaling the aroma of a fragrant rose (semi-direct/literal language condition);
- Choose your favorite prompt. It can be the imagery of the rose or thinking about an open throat, or a combination of both (singer preference condition);
- For every inhalation, inhale the aroma of the fragrant rose (experiential condition).

Results indicated an overall singer preference for a combination of both literal and figurative language. Singer interpretation of figurative language used in this study was varied. The experimental conditions had varying effects on choral and individual tone as perceived by singers. Expert panel ratings of choral tone were not significant. Acoustic measures indicated significant differences in long-term average spectrum results for most experimental condition pairings.

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TABLE OF CONTENTS

Chapter Page

Chapter Page

Chapter Page

Chapter Page

# LIST OF TABLES

Table Page

Table Page

Table Page

# LIST OF FIGURES

Figure Page

# CHAPTER ONE

## Introduction

### Prologue

Physiological understanding of the larynx can be traced back to Greek physician Aelius Galenus (129–199 A.D.) (Kennedy-Dygas, 1999). Human dissections began in the first half of the third century in ancient Greece. Human dissections were conducted by Herophilus of Chalcedon and Erasistratus of Ceos (Von Staden, 1991). By Galenus' time, human cadaver anatomical activities were prohibited and would not resume until the early 14th century (Ghosh, 2015). Like Aristotle before him, Galen conducted his dissections and vivisections on animals to learn and teach. Physicians in Alexandria, including Galen, collected and summarized knowledge of the larynx acquired from ancient physicians' prior work with human cadavers (Ghosh, 2015). Galen identified the intrinsic and extrinsic muscles of the larynx and named the *glottis* (Kennedy-Dygas, 1999). When human dissection resumed in Italy in the early 14th century additional structures of the larynx were discovered.

While there was knowledge of the structure of the vocal mechanism, there was not understanding of the functions within that mechanism until the nineteenth century (Jahn & Blitzer, 1996). Manuel Garcia is generally credited as being the first to view a functioning human glottis. Garcia used mirrors and the light of the sun to see the vocal mechanism in action, this tool was a laryngoscope (Stark, 1999). Nonetheless, there were earlier iterations of laryngoscopes by Leveret, Benjamin Babington, and Phillipp von Bozzini (Burkle et al., 2004; Jahn & Blitzer, 1996).

Starting in the mid-nineteenth century, teachers of voice began to use anatomy and physiology of the vocal mechanism to inform their teaching. Voice science, or vocology, "in its

most narrow definition entails approaching the voice through the lens of the scientific method" (Harris, 2019, p. 47). Prior to the discoveries related to the vocal mechanism around 1850, the apprentice-master relationship dominated voice teaching in which "the goal was to conserve, not to evolve" (Kennedy-Dygas, 1999, p. 23). There was a shift in singing pedagogy in the years surrounding 1850 in which some argued for vocal pedagogy based in science while others advocated for traditional vocal pedagogy passed on over time from teacher to student (Kennedy-Dygas, 1999).

According to Lillis (2021), the debate on language use in teaching instruction continues to this day. "Whether it is preferable to use an imagery-based or a scientific-based instruction is still a topic for debate today as it was in Garcia's time," (Lillis, 2021). This dichotomy in language use for singing instruction can be seen in the following quotations from vocal pedagogy texts. The first example uses imagery-based language:

> Really bring your mind into your lips as they touch–imagine your two lips as two slices of bread making your favorite sandwich. Imagine the vibrations as your favorite sandwich filling: peanut butter and jelly, mozzarella, honey, tuna. Focus on the taste of the filling of your sandwich as you hum (Linklater, 2006).

This second example uses scientific-based instruction. Here, vocal pedagogue, Cornelius Reid (1950) uses humor to point out his disagreement with scientific language. He points out that the singer cannot use scientific knowledge satisfactorily when working on parts of the voice in which the singer has no direct control, citing vocal fold vibration and segmentation. His tongue-and-cheek argument against scientific knowledge in some contexts is illustrated below:

> Imagine a voice lesson where the teacher looks through the laryngoscope and after duly considering the situation, solemnly informs his student, 'Your vocal cords are vibrating

> along their full length which is an incorrect position for the pitch you are singing. Only permit them to vibrate at their outer edges for the higher tones and shorten the length of the vibrating surface. Then you will find your production will be freer and easier. This way you will learn to produce more beautiful tones.' (Reid, 1950, p.172)

In direct response to Lillis' article mentioned above, Brown (2021) proposed that this historical debate is in fact a false dichotomy. Brown argued that synthesis between the two contrasting viewpoints can be achieved by incorporating teaching strategies utilizing both figurative language and voice science.

In the next sections, figurative language will be explored to better understand its use within the context of singing. Firstly, metaphor will be discussed, followed by imagery, and finally the two will be examined within the context of singing instruction.

**Metaphor**

> A metaphor is not merely a linguistic expression (a form of words) used for artistic or rhetorical purposes; instead, it is a process of human understanding by which we achieve meaningful experience that we can make sense of. A metaphor, in this 'experiential' sense, is a process by which we understand and structure one domain of experience in terms of another domain of *a different kind* (Johnson, 1987).

Researchers, linguists, and education philosophers use different interpretations and definitions for the terminology commonly used when addressing imagination (i.e., imagery, metaphor). Aristotle believed metaphors were based in analogy in which implicit comparisons are made, labeled as *comparison theory of metaphor* by cognitive scientist Andrew Ortony (1979). Aristotle viewed metaphors as primarily language flourishes which could potentially be ambiguous or obscure thus masking definition.

Whereas metaphor can be understood as a rhetorical or linguistic device, for the purposes of this study metaphor is interpreted as conceptual. This theory is also referred to as cognitive metaphor theory (Tissari, 2001). Cognitive/conceptual metaphors equate metaphor to "understanding and experiencing one kind of thing in terms of another" (Lakoff & Johnson 1980, p. 13). In conceptual metaphor theory there is a source domain and a target domain. Each domain has an image schema associated with it. When a metaphor is employed, the source domain supplies the reasoning to interpret the target domain (Lakoff & Johnson, 1980). Lakoff and Johnson use the example "THEORIES ARE BUILDINGS" to demonstrate how expressions from one domain can be applied to concepts in another. Expressions used in the BUILDINGS domain such as *construct,* or *foundation* can be applied to the THEORIES domain. When one domain is applied to another there are "used" parts of the metaphor, in the above example we "use" *foundation*. The same figurative metaphor also has "unused" parts such as the stairs, the railings, and the individual rooms. Metaphors are classified as figurative or imaginative when they employ language that falls "outside the domain of normal literal language," i.e., the "unused" parts are employed in the metaphor (p. 63).

Image schemata can be described as a container for which many actions can fall within. Jason Begy, a specialist in game studies and communication studies (2013), used the example of cooking to explain image schemata. Cooking is a set of actions defined by the food that is being prepared. Cooking is the umbrella term for which many actions fall under (i.e., using a microwave, stove, or oven; whipping the crème; braising the carrots; tasting to see if more seasoning is needed). Cooking was described as a high-level image schema for which many general concepts apply, not one specific action. A schema as defined by Johnson is a structure in which experience can be organized for comprehension (1987). Metaphorical projection relies

on structural similarities between image schemata of the target and source domains (Begy, 2013).

***Experiential Metaphor***

Metaphors can be categorized further: "an experiential metaphor is a structural metaphor wherein both the source and target domains are similar experiential gestalts…" (Begy, 2013). When the whole makes more cognitive sense than the parts alone, it can be defined as a gestalt. An example of a gestalt is the act of jumping, when jumping is broken down into its individual actions, it is harder to make sense of the action (Begy, 2013; Lakoff & Johnson, 1980). "Structuring our experience in terms of such multidimensional gestalts is what makes our experience coherent" (Lakoff & Johnson, 1980, p. 94).

Thus far metaphors have been discussed using figurative language examples. Experiential metaphors can also be discussed using activities, or experiences. Experiential metaphors are discussed here within the context of video games. This comparison is used in the current context to orient the reader to the concepts employed by Rusch and Begy so their ideas can later be applied to a common experiential metaphor used in singing instruction.

Game designer and researcher Doris Rusch explains experiential metaphor as, "Oh my, this feels exactly like (insert appropriate experience here)!" (2009, p. 5). Rusch has examined video games for the presence of experiential metaphors, i.e., the experiential associations gamers have when playing a game. Rusch cites two examples: that of a grappling hook sequence in *God of War II (GoWII)* and gameplay in *Tetris* (Pazhitnov, 1985). Rusch compares the grappling hook sequence in *GoWII* (Santa Monica Studio, 2007)–where one relies on timing to carefully swing from the safety of one position to a new position while one has the fear of falling with each grapple to the next spot–to the experience of change in life. Begy (2013) labels this *the*

*transition gestalt,* where both the grappling hook and transition in life have in common stability and uncertainty. Rusch also cites Janet Murray comparing *Tetris* to life:

> "[*Tetris* is the] perfect enactment of the overtasked lives of Americans in the 1990s – of the constant bombardment of tasks that demand our attention and that we must somehow fit into our overcrowded schedules and clear off our desks in order to make room for the next onslaught (…) Tetris allows us to symbolically experience agency over our lives…." (Murray, 1997, pp. 143–144, as cited in Rusch, 2009, p. 6).

Begy (2013) defines the affective dimension of gaming as the "experience of playing a game" (p. 3). It is tied to the emotional response of the player, how and what they feel while playing. After defeating the Ender dragon in *Minecraft,* the player is treated to seven minutes and 42 seconds of a philosophical poem written by novelist Julian Gough (Mojang, 2015). The scrolling text displays dialogue between two unknown speakers, somewhat resembling dialogue between ancient Greek philosophers. The experiential metaphor employed is "and the universe said I love you because you are love." The target source domain is love and the target domain is the player. The player understands love in terms of "you," the player.

**Imagery**

As with metaphor, mental imagery employs the use of imagination. Imagery has been defined as perceptual processing without a stimulus being perceived (Nanay, 2018), "a mental image occurs when a representation sensation of the type created during the initial phases of perception is present, but the stimulus is not actually being perceived; such representations preserve the perceptible properties of the stimulus and ultimately give rise to the subjective experience of perception" (Kosslyn et al., 2006, p. 4).

Simulation of experiences, or motor imagery, can be used to mentally practice a skill

(Tan et al., 2010). Davies (2019) describes motor imagery as using the same processes one would use to perform the skill, but the signal stops before it reaches the muscles involved. Motor imagination is also involved when humans anticipate actions of other people. Cocks et al. define mental practice as "the conscious action of systematically and repeatedly imagining objects and movements without physically seeing or performing them with the intention of improving performance," (2014, p. 263). This imagination can be interpreted as simulation of the experience. Fisher describes imagining in the form of simulation as "the neuronal re-enactment of perceptual, motor, and introspective states acquired during experience with the world, body, and mind" (Fisher, 2017, p. 253).

Nanay (2018) categorizes imagery as being conscious or unconscious, voluntary or unvoluntary, and the individual experiencing the imagery can both feel or not feel the presence of the thing being imagined. Vendler categorizes similar imagination activities as subjective and objective (1979). According to Vendler subjective imagining is the act of imagining a situation, in objective imagining the person doing the imagining puts themselves in the experience. Vendler uses the idea of eating a lemon to demonstrate the difference. When you "imagine eating a lemon" there is association with sour taste. It is a vicarious activity in which we can experience the activity through the eyes of another individual. This is contrasted with "imagine yourself eating a lemon" in which Vendler associates the concept of a pinched face (p. 161). "In the objective case I fancy to see (or hear) what/would look (or sound) like in a given situation, whereas in the subjective case I fancy to experience what it would be like to be in such a situation" (p. 161).

***Imagery and learning***

Imagery can be used as an educational tool for learning via instructions. It is often used to teach observable phenomenon such as dancing, playing sports, conducting surgery, or playing an instrument (Cocks et al., 2014; Fuks & Fadle, 2002). As an example, it is common for teachers of wind instruments to use in combination both mental imagery and information based in scientific knowledge (Fuks & Fadle, 2002). Fisher compared the use of imagery in dance to analogy "in which attributes, relations and organizing principles of a gestalt entity are echoed, reflected or applied to the body and its movements" (Fisher, 2017, p. 259). Imagery functions as a tool to help map "aspects of the world to the body via analogy" (Fisher, 2017, p. 267).

Similarly to Vendler's objective/subjective classification of imagery Fisher (2017) classified imagery as: (1) direct imagery, *imagining oneself in the situation*; (2) indirect imagery, *imagining a situation from outside the body*; (3) an overlap of the two, *direct and indirect imagery*); (4) semi-direct imagery, *the combination of an external image and an internal image;* and/or (5) motor imagery, *possessing movement qualities that involve oneself or others.* When anatomical imagery is utilized, as in somatic practices, it is a form of semi-direct imagery.

An example of direct and indirect imagery in dance would be "travel across the space as if you are flowing water" (Fisher, 2017, p. 264). Depending on the focus of attention, semi-direct imagery could be "imagine floating in a gently flowing river, the water soothing your muscles and carrying away all tension (Fisher, 2017, p. 264).

**Metaphor & Verbal Imagery in Teaching Singing**

Imagery plays an important role in traditional voice pedagogy (Welch & Sundberg, 2002). Vocal pedagogue William Vennard explained imagery as a figure of speech that is used when literal language is difficult to understand, whereas metaphor involves imagery with implied comparison (1967). D. Brian Lee (2018), co-host of *The Voice Culture Podcast*, defined verbal

imagery use in singing instruction as a teaching concept meant to help singers reach a goal until habitual technique is obtained, in which case the imagery is no longer needed. Lee advocated using imagery to trigger a reflexive response (i.e., imagining the vowel creation happening below the vocal folds; when singing high notes, widen your neck at the base). Another use of imagery Lee advocated is the perception that occurs after doing something well. He defines this as something that cannot be given by the teacher, but instead is self-generated and spontaneous.

An instructor of voice can use a semi-direct anatomical image with the aim of effecting tone in singers, e.g., "sing with an open throat." The singing teacher may also choose imagery that incorporates experiential components than can be transferred to singing, such as the motor-affective image of inhaling the aroma of a fragrant rose. Imagined inhalation of the fragrance of a rose to effect singing is a reoccurring image in singing pedagogy (i.e., Albrecht, 2003; Bozeman, 2015, 2017; Daniel, 1993; Hines, 1982; McKinney, 1994; Miller, 1996, 2002, p. 78; Rundus, 2009; Sway, 1958).

"In the twenty-first century, vocal anatomy and voice science are an important part of singing teachers' knowledge, and most singing teachers would place themselves somewhere between 'imagine inhaling the perfume of a rose' and 'feel your arytenoids working!'" (Shelwell, 2009, p. ix).

Jacobsen, who examined verbal imagery use by experienced high school choral directors, defined verbal imagery within the context of the choral rehearsal as "mental pictures created through spoken figures of speech, vivid descriptions, metaphor, simile, analogy, and poetic or figurative language" (2004, p. 18). For the purpose of this this study, the terms metaphor and imagery were used interchangeably as one umbrella term for experiential, emotional, figurative language.

### *Figurative Language in Solo Voice Instruction*

Instructors of voice have long used imagery as a tool to elicit change in vocal sound. In the oral tradition of singing, pedagogical techniques—such as the use of imagery, are passed on from one generation of voice instructors to the next (Mitchell et al., 2003). In addition to voice lessons, metaphorical language is also commonly employed in choral rehearsals (Bruwell, 2006). Many aspects of singing happen internally, such that the singer cannot see what is occurring in the body. Imagery is often employed to help students visualize gestures that happen inside their body that cannot be seen or felt (McKinney, 1994).

### *Verbal Imagery in the Choral Setting*

Margaret Daniel, professor of voice and vocal studies at the University of Louisiana at Lafayette, advocates application of voice studio techniques, such as the use of imagery, to the choral ensemble. Daniel encourages choral directors to use imagery to impact tone. Daniel provides the following suggestions for use with choral singers: “inhale as if beginning to yawn” “blowing up a little balloon in the throat while inhaling” “trying to raise or lift the upper back molars while inhaling;” “imagine that their noses are hollow and open in the back where the nose attaches to the face” “the mental concept of projecting the tone behind the eyes” “inhale slowly as if sucking through a straw” and “ask the students to inhale through the nose as if smelling a rose” (p. 31). “The greater the repertoire of imaginative suggestions offered by a teacher, the greater the communication will be with the student and the greater the student’s progress will be in achieving a beautiful singing tone” (Daniel, 1993, pp. 29–30).

Teacher of voice D. Brian Lee (2018) encourages teachers of singing to be open minded and flexible. That open-mindedness can include using imagery to teach singing. Imagination can be a tool to incite student thinking and experimentation with the aim of fostering agency (Lee,

2018). Sharon Paul, director of choral activities at the University of Oregon, advocates for the use of diverse imagery and scientific terms in the choral rehearsal to connect with singers' diverse backgrounds and interests (Paul, 2020).

As will be demonstrated in the next section, imagery used by teachers of singing can be based in knowledge of vocal anatomy and physiology or created spontaneously using abstract ideas or concepts not based in reality. Jacobsen (2013) advocates for the use of scientifically informed imagery, "even as we continue to fashion new connections through precise imagery, let us strive to be purposeful, methodical, physiologically correct, and pedagogically sound in our communication as we teach our choirs to understand and apply functional vocal realities that result in the production of healthy, beautiful choral sound" (p. 32). Further, Jacobsen cautions choral directors about employing the use of imagery that is used for multiple purposes such as for vocal function and expression. Brown (2021) also advocates a scientifically informed use of imagery for teacher singing. Brown encourages teachers to consider the purpose, type, and accuracy of the imagery with regard to current scientific understandings.

### *Problematic Nature of Verbal Imagery in Teaching Singing*

Bauer (2013) praises the use of imagery to effect sound, while cautioning practitioners about possible misinterpretations of the meaning of the imagery:

> The use of imagery can contribute to effective teaching. Metaphorical mental images are often suggested by teachers to evoke some desired result from the singer. Those images might be associated with sensations in the body—qualities of sound, moods, or any other imaginative suggestions. They are often colorful, as when one asks for a more "golden" or "velvety" tone when seeking a richer tone. There is nothing scientific about these words, but they might indeed elicit a richer tone. Such images require the singer to make

> the leap from imagining to producing. Some singers can do this, buy many cannot. Because imagery is elusive and sometimes difficult to replicate, it might lack dependability, consistency, or specificity. Imagery often describes a result rather than the cause, so it might be more meaningful *after* the desired effect has been experienced rather than as a vehicle for finding it. Also, imagery directives can give the wrong message. …There is an inherent potential for misinterpretation. For instance, while it may be true that singer feels sensation in the face when resonating well, directing the student to *place* the voice there, or anywhere, might result in spurious manipulation of the vocal tract in an effort to guide the voice to a certain place…" (Bauer, 2013, p. xvi–xvii).

While imagery can be useful for instructive purposes, it can also cause confusion due to individual interpretations of imagined concepts. Voice pedagogue Margaret Daniel advocates the use of imagery for solo and choral voices, but also warns of the potential downfalls, "…unfortunately, an imaginative suggestion that works for one student will not necessarily work for all students. Likewise, an idea that produces the desired quality of space or energy in one lesson may not produce the same result in the next" (Daniel, 1993, p. 29–30).

Lee (2018) warns of the dangers of over-generalizing, "because something has 'worked' for a large number of singers, it becomes singer lore that you breathe through your hoo-hoo, shoot the high notes out of your crown, bear down poopingly for loud singing, and direct 'air' to all sorts of strange place" (2018, p. 95). To complicate matters further, one student may interpret an image literally while another interprets the image as metaphorical (Hildegard & Cattley, 1991). "The problem is that some singers will confuse imagery with reality and base their technique on a concept that was useful as an image but dangerous as a core belief" (Michael, 2015, p. 417).

## Rose imagery in singing

Common to literature on choral singing and even more prevalent in solo singing literature and "a suggestion to be heard in nearly every studio in Italy" is the image of inhaling deeply as if to smell a fragrant rose (i.e., Albrecht, 2003; Bozeman, 2015, 2017; Daniel, 1993; Hines, 1982; McKinney, 1994; Miller, 1996, 2002, p. 78; Rundus, 2009; Sway, 1958). In a singing context, rose imagery has been associated with the opening of the throat (Bozeman, 2017). "The Italian school pedagogic literature maintained that 'inhaling through a smile' or as if 'inhaling the fragrance of a rose' opens the throat" (Bozeman, 2015, p. 183). Richard Miller (vocal pedagogue) advocated use of rose imagery to obtain the *gola aperta,* the open throat.

## Rose Symbolism

As demonstrated previously, imagery may be interpreted literally or symbolically. Because the popular imagery of rose aroma inhalation has been used to elicit changes in singing, rose symbolism is explored here.

Rose symbolism is varied and complex. It has been linked to humanity, transformation, beauty, royalty, the Virgin Mary, Christianity, love, courtly love, socialism, spring, passion, life, the life cycle, joy, personal longing, creation, sexual organs, and woman personified (Bullock-Kimball, 1987; McClure & Wells, 1990; Seward, 1955, 1989). Rose symbolism has been interpreted as literal, allegorical, tropological, and anagogical (Bullock-Kimball, 1987).

### *Rose Imagery as Experiential Metaphor in Teaching Singing*

Using metaphor interpretation concepts from Lakoff & Johnson (1980) and Begy (2013) the rose imagery used in singing can be interpreted as follows. The source domain is imagined inhalation of the fragrance of a rose. The target domain is the image schemata of singing. While one cannot predict individual reactions to this experiential metaphor, we can infer as to possible

reactions. The rose might be interpreted as a flower that has fragrance, open to interpretation by the interpreter's experiences with roses, or flowers if roses have not been interacted with experientially, and rose symbolism. Singing can be interpreted as the acts of motivation (mind-body connection), respiration, phonation, resonation, and articulation (Rosine, 2021). The structural similarities between both gestalts can be interpreted as both physical act (inhalation, possibly even holding the rose) and affective (experiencing emotional connection to the rose/flower).

The use of imagination by teachers to refine singing has been discussed. Next, tone quality will be examined in order to better understand imagery use within the context of singing instruction and how it may change the timbre of the singer's voice.

## Tone Quality

### *Definition*

McKinney lists the following characteristics as important to a perceptually good tone; "1. freely produced, 2. pleasant to listen to, 3. loud enough to be heard easily, 4. rich, ringing, and resonant, 5. energy flows smoothly from note to note, 6. consistently produced, 7. vibrant, dynamic, and alive, 8. flexibly expressive" (1994, p. 77). Margaret Olson (2010) defines well-produced tone quality as generally having an even vibrato rate, is freely produced, and is resonant. Richard Miller (1996) describes perceptually good tone quality as being well-balanced and resonant on every pitch and on every vowel. For the purposes of this study, perceptually good tone quality was defined as consistent, clear, free, rich, ringing, and resonant. This definition is a combination of perceptual tone quality characteristics used by vocal pedagogues to describe good tone quality. The researcher created this definition using descriptions from McKinney (1994), Miller (1996), and Olson (2010).

Historically, this desired tone quality in Western classical singing has been labeled as *Chiaroscuro*, meaning having a balance of bright and dark qualities.

***Gola Aperta (Open Throat)***

Though previously discussed in terms of the rose imagery used in singing instruction, the semi-direct anatomical image of the open throat will be explored further. This open throat concept is commonly found in vocal pedagogy books (i.e., Bauer, 2013; Bozeman, 2015, 2017; Dimon, 2018; Hines, 1982; Jordan et al., 2017; McCoy, 2020; Miller, 1996; Shewell, 2009; Vennard, 1967). The open throat contributes to a desirable perceived tone quality in classical western singing (Bozeman, 2017; Mitchell & Kenny, 2004; Vennard, 1967). Mitchell et al. (2003) interviewed expert singing pedagogues to explore the term open throat in relation to vocal pedagogy, terminology, perceived physiology, and sound quality. Using data acquired through interviewing instructors of voice, researchers created a list of the four most commonly used terms within the study for portraying an open throat; "open throat, throat widening, retraction and space in the back" (p. 28). Throat widening and retraction could be perceived as having movement qualities, and thus labeled as semi-direct imagery with motor affect. The terms open throat and space in the back could be interpreted as lacking movement qualities.

The image of inhaling deeply as if to smell a fragrant rose has been associated with a lifting sensation in the roof of the mouth (Daniel, 1993; Jordan, 2011). In a pedagogic resource for choral teachers, Jordan (2011) explains that forward resonance can be found by singing "melodies as if you smell a horrible odor. Wrinkle your nose a bit. After singing this way several times, return to your "regular" singing voice. You will notice a difference in your sound" (p. 51). On nostril dilation:

> [D]ilating and activating the nostrils is associated with inhalation, which in turn tends to

> open the throat…The action of these muscles is related to the soft palate and opening the throat in singing. Compressing the nostrils tends to be associated with depressing and collapsing the palate; dilating the nostrils and sneering, which are associated with inspiration, tend to raise the palate and dilate the pharynx. Think of sneering and smelling something pungent, and notice how this enlivens and dilates the nostrils and even helps to open the throat" (Dimon, 2018, p. 75–76).

***Altering Tone Quality***

*Chiaroscuro* is achieved through a convergent resonator shape (*voce chiusa*) as opposed to a divergent shape (*voce aperta*). Further, active vowel modification, in the form of subtle resonator adjustments, is used to avoid dramatic shifts in tone quality as the voice moves from one register to another (Bozeman, 2014). In addition to the convergent resonator shape and active vowel modification, Bozeman (2015) advocated a lowered larynx. He recommended using as convergent a resonator shape as the vowel and pitch will allow.

Phonation begins at the vibrating mechanism, the vocal folds, which close to initiate phonation. This adduction is controlled by laryngeal tension, exhalation air pressure, subglottic pressure, and "the intent or concept of the desired sound as conceived by the speaker or singer" (Dayme, 2009, p. 13). The pharynx can change shape enabling an alteration of overtones which in turn affect vocal quality. As tension is introduced to the pharynx in the form of constrictor muscles, the size of the resonating chamber reduces. This reduction in resonating space can lead to sounds that are not optimal in Western classical singing. Pharyngeal "adjustments are governed by the imagination which influences the adjustment of the muscles of the pharynx to produce different qualities" (Dayme, 2009, p. 51).

The pharynx and the mouth can be seen as cavities with flexible and movable walls. They

> therefore have a range of resonant frequencies, which amplify some of the sounds from the larynx. The pharynx amplifies the bass (250–500 Hz), and the mouth the treble (700–2500 Hz). Each vowel is formed in two zones of frequency reinforcement, or *formant*, abbreviated as F1 and F2. F1 is associated with the pharynx. F2 is associated with the mouth. The frequencies of F1 and F2 are related to the size of their respective resonators (Calais-Germain, 2013, p. 470).

### *Singer's Formant Cluster*

Space can be adjusted in the vocal tract through manipulation of the velum, laryngeal position, lips, jaw, tongue, glottis size, and the pharyngeal constrictor muscles. Further, the density of the surface walls in the vocal tract can amplify or decrease harmonics present in the source sound (Bozeman, 2015).

Preference for the presence of the singer's formant in overall choral tone is subjective. "The singer's formant can be helpful when an ensemble is singing with an orchestra. Some argue, however, that the singer's formant is not desirable in choral singing on the basis that it can be destructive to blend if only some singers have this formant" (Davids & LaTour, 2012, p. 77).

## Measuring Change in Tone Quality

### *Acoustical Measures*

Decibel level (dB) is used to objectively measure sound pressure level (Basner et al., 2014). The subjective measure of sound pressure level is intensity, or the subjective loudness of the sound (McKinney, 1994). The minimum amount of variation required for a perceptual change in the volume of the sound is labeled as the just-noticeable difference (JND) or difference limen (DL); for human perception the JND level is set at 1dB (Benesty, 2008).

The filter that is placed on the vibrations of the vocal folds through the resonator can be seen visually using spectrum analysis (McCoy, 2020). A perceptually darker sound coincides with an increase in lower formant frequencies on a spectrogram. “All formant frequencies decrease uniformly as the length of the vocal tract increases” (Titze, 2000, p. 179). Formants are the resonance, or reinforced natural oscillation, in the vocal tract (Titze, 2000) not to be confused with the singer’s formant cluster which is a peak in intensity levels in the spectrum at formants 3, 4, and 5 that allow a singer to be heard over a symphony orchestra (Sundberg, 2003). Researchers have used a range of 2.4–4.3 kHz as the area “in and around the ‘singers’ formant’ frequency region” (Daugherty et al., 2019, p. 357). The singer’s formant is approximately around 2.9KHz (Hodges, 2020). Further, human hearing is the most sensitive in that singer’s formant range of 2.0 to 4.0 kHz (Hunter & Titze, 2009; Masterton et al., 1969).

### *Long-term Average Spectrum (LTAS)*

LTAS has been used by researchers to demonstrate change in the spectral energy of singing, (i.e., vocal timbre or tone) (Brunkan, 2012; Grady & Cook-Cunningham, 2020; Grady & Gilliam, 2020; Manternach & Daugherty, 2017; Rossing et al., 1987). “LTAS data convey frequency (hertz) and amplitude (sound pressure level) averaged over time. These data provide an acoustic measure of sound quality and, through graphic presentation, a visual display of spectral differences between conditions” (Grady & Gilliam, 2020, p. 291). LTAS can demonstrate where concentration of spectral energy occurs along the frequency spectrum (Lee et al., 2008).

## Summary

In summary, metaphor and imagery have been used interchangeably to discuss figurative language use in teaching singing (Jacobsen, 2004). Teachers of singing have historically used

language both based in scientific reality and have used figurative language as an aid in teaching (Lillis, 2021). Common figurative language used in both vocal and choral pedagogy resources is the image/metaphor of smelling the aroma of a fragrant rose. The rose imagery used in singing has been associated with the concept of the open throat. The open throat is associated with the subjective concept of good tone quality. The definition of good tone quality in the Western classical style used in this study is a combination of overlapping aspects used by vocal pedagogues to define good tone (McKinney, 1994; Miller, 1996; Olson, 2010). To objectively measure change in tone, LTAS can be used.

# CHAPTER TWO

## Review of Literature

### Introduction

This review of literature presents related empirical research on figurative language, tone (quality, manipulation, and measurement), and visual and olfactory stimuli. Imagery will be examined as it pertains to training and performance, both within singing and in other disciplines. Tone quality characteristics, and methods to change tone through vocal tract manipulations, will be discussed within the context of solo and choral singing. Research will also be presented on measuring tone quality both in objective and subjective terms. The final sections are comprised of information on sniff function, scent inhalation, and visual and olfactory effects of roses on human physiology and psychology.

### *Imagery and the Brain*

Between 1970 and 2000 there was debate between the fields of philosophy, neuroscience, artificial intelligence, and cognitive science over how mental imagery is represented in the brain, i.e., propositional, or depictive (Pearson 2019; Pearson & Kosslyn, 2015). Pearson and Kosslyn (2015) claimed that based on empirical evidence the debate can now be resolved, “humans can represent information in multiple ways, and that such representations can be used flexibly in working memory or during mental imagery” (p. 10089). Imagery can be interpreted as recall of a personal experience, mimicry of another human’s experience, or the interpretation may translate nonhuman image content into human form.

The term visual imagery has been used as an umbrella term by researchers to represent different visual-based imagery tasks. Pearson (2019) listed imagining a stationary object, rotating an imaginary object, and imagining a physical task as utilizing different areas of the brain with

all being classified as visual imagery.

Imagery can incorporate all the senses including smell, hearing, sight, touching, feeling, gustatory perception, and kinesthesia (proprioceptive sense) (Emmons & Chase, 2006). Further, imagining is not necessarily visual, it can be purely verbal (Holt, 1964). Imagery intensity varies by individual and for those that experience an injury, there may be a loss of control of that intensity (Davies, 2009). At the far ends of the image intensity spectrum are aphantasic individuals who do not experience imagery and at the other end of the spectrum is hyperphantasia, which is where the individual experiences extremely vivid images (Davies, 2009).

## Imagery in Performance and Skill Learning

### *Figurative Language in Other Disciplines*

Imagery usage is often found in sports and sports therapy where it is common for an athlete to visualize aspects of their performance (direct imagery) without overt physical movement–this is called mental rehearsal or mental simulation (Driskell et al., 1994). In mental rehearsal the "…motor system is going through the same processes as it would if you were actually doing these things, but the signal gets stopped before it reaches your muscles" (Davies, 2019, p. 14) Several researchers have studied imagery in sports linking imagery to improvement of physical performance of the skill being imagined (Martin et al., 1999). Mental imagery in athletics is often used to enhance performance or to aid in skill acquisition. In one study, researchers examined imagery use in figure skating, gymnastics, squash, soccer, ice hockey, and football (Hall et al., 1990). Researchers reported that visual and kinesthetic imagery use was utilized more by athletes as the competition level increased.

Observable phenomenon, such as dancing and conducting surgery, can employ imagery as

an educational tool (Cocks et al., 2014). In dance instruction imagery is used to assist in creating an interpretive framework for students (Hanrahan & Salmela, 1990). Imagery can be used to teach dance technique, accuracy, alignment, or to assist with overcoming performance anxiety. The imagery selected for instruction can address affective, physical, and cognitive learning. Types of imagery are impacted by sensory modality, perspective, and content.

Dancer-researcher Vicky Fisher described imagery use in dance as embodied analogy "in which attributes, relations and organizing principles of a gestalt entity are echoed, reflected or applied to the body and its movements" (2017, p. 259). Imagery impacts the learner's understanding of the world and their body within the world. Fisher classified imagery as: (1) direct imagery, *imagining oneself in the situation*; (2) indirect imagery, *imagining a situation from outside the body*; (3) an overlap of the two, *direct and indirect imagery*); (4) semi-direct imagery, *the combination of an external image and an internal image;* and/or (5) motor imagery, *possessing movement qualities that involve oneself or others.* When anatomical imagery is utilized, as in somatic practices, it is a form of semi-direct imagery.

### *Imagery Research in Music Instruction*

Imagery use in music instruction has been examined by researchers (i.e., Barten, 1992, 1998; Burwell, 2006; Carter, 1993; DeSantis et al., 2019; Funk 1982; Jacobsen, 2004; Jestley, 2011; Parker, 2012; Sheldon, 2004; Spieker, 2017; Woody, 2002). DeSantis conducted semi-structured interviews with professional singers ($N = 6$) of Western classical music (DeSantis et al., 2019). Singers in the study reported using imagery for performance anxiety, character development, and vocal technique. In a 2002 study, Woody asked instrumental performance faculty members to contribute imagery or descriptive metaphors for performance of three musical excerpts. The instructors were asked to create imagery aimed at helping a student to

perform a passage more expressively. Woody (2002) classified participant responses into three categories: those that include context-free motion, those with contextual motion, and those that involved mood (which depicted emotional characteristics). Of these categories, mood descriptions were the most commonly provided. Woody noted that some responses from participants included more than one category, the example cited was "laughing and skipping like children" (p. 221).

Barten, a psychologist engaged in music research, examined motor-affective metaphor usage in music instruction (1998). Barten reported that motor-affective properties are frequently used in music instruction. Motor-affective metaphors and expressions are those that embody the music and possibly suggest extramusical contexts (human or nonhuman acts, attitudes or tendencies, movement, or action). These metaphors are a mixture of "motional" and affective qualities. Barten labeled imagery with movement and affective characteristic, such as Woody's example "laughing and skipping like children" as moto-affective metaphor. Barten posited that the widespread metaphor usage in music instruction is a result of it being easier to express music using metaphor rather than labeling it.

***Imagery Use in Voice Instruction***

Instructors of voice may employ differing language strategies (imagination-based language such as the use of metaphors, literal language, and/or a combination of both) for effecting change in tone quality in singers. The juxtaposition between metaphor and literal language has been used by Burwell (2006) in research exploring language preference of voice practitioners and individuals receiving vocal training. Burwell (2006) examined verbal language use in music lessons at a university in the United Kingdom. Burwell defined teaching language as either metaphorical or literal. "Metaphorical, as distinct from literal, was taken as the umbrella

term for experiential, emotional and figurative language" (p. 336). Burwell reported a greater frequency of metaphorical imagery use in instructors of singing than with instrumental teachers.

Chen (2006) examined verbal imagery in singing instruction. Four voice teachers at a university were observed conducting singing lessons and then interviewed. Within the context of this study, verbal imagery was used every five to nine minutes. Chen reported more verbal imagery use with less advanced students. Chen categorized verbal imagery into four groups, here they are presented in terms of frequency of use by teachers in the study (most–least): non-musical conceptual imagery, physiological imagery, physiological-object imagery, and musical conceptual imagery. Imagery has also been studied in choral instruction.

Clements (2008) analyzed imagery use in 21st century voice instruction. Clements came to the conclusion that "Imagery, no matter how creative, cannot take the place of accurate, technical instruction. However, imagery when used correctly can take dry, scientific instruction and bring it to life by emphasizing specific pedagogical ideals and making them current, creative, and entertaining for the student" (Clements, TBD, p. 51). Like Brown (2021), Clements advocates establishment of an imagery vocabulary with the student. Further, the teacher must be aware of the student's current image vocabulary. When creating the image, he suggests being as specific as possible in order to avoid misunderstanding while basing the imagery in voice pedagogy tenants (posture, respiration, phonation, resonation, and articulation).

Directional imagery, imagery that is directed upwards or downwards, has been examined in pedagogic singing literature by Moorcroft (2007). Singers can employ the use of directional imagery to assist with singing goals (i.e., breath, resonance, vocal energy) including performance anxiety and improved posture. Directional imagery is linked to the singing mechanism for example, the upward imagery has been paired with the lifting of the soft palate. Moorcroft

cited numerous examples of vocal pedagogues linking directional imagery to concepts in singing. Moorcroft also linked the use of directional imagery to its use in Eastern meditation.

### *Imagery Use in Choral Instruction*

Gumm (2016) surveyed choral directors who were members of the American Choral Director Association (ACDA) regarding teaching style. Conductor style priorities were examined in 2015 and compared to a similar ACDA survey conducted in 1990 with high school conductors of choir. Gumm reported similar priorities among choral conductors of both surveys, one such priority was the use of metaphors and imagery within the context of performance artistry. "Every choral director uses descriptive language to paint evocative pictures for the chorus. Imagery is practiced instinctively to inspire and to inform interpretation. Its use need not be limited, however, to the enhancement of interpretation. Imagery can also help alleviate anxieties and increase concentration" (Emmons & Chase, 2006, p. 265).

Skoog (2004) assembled a list of exercises using images and metaphors to be disseminated to choral educators via the *Music Educators Journal*. The exercises were all aimed towards developing a healthy choral tone in the Western classical style. Skoog lists imagery as helpful to creating an open, tension free throat when suggesting the beginning of a yawn, a raw egg in the mouth that must not crack, hot food on the tongue, and the feeling of being surprised.

Patterson (2009) observed and recorded rehearsals of three choral directors working with both a beginning and an advanced choral ensemble. All three directors were deemed to be highly successful on the bases that their choirs had been chosen to perform at the Texas Music Educators convention in 2009. Imagery employed by choral directors in rehearsals during 1.61%–5.63% of the instructional time. Patterson reported the highest frequency of imagery use in the collegiate choir and 8$^{th}$ grade treble choir. The lowest frequency, 0.36% occurred with the

church choir. The use of imagery was individualized with one choir director using imagery more with their advanced ensembles, and the other utilized verbal imagery relatively evenly between both levels of ensembles.

In a related study, Broomhead (2006) video recorded three choral directors in rehearsal, all of whom were selected on the basis of their superior high school festival ratings. Broomhead studied the langued used in instruction and then created instructional language categories. The seven categories were student-initiated input, teacher inquiry, referential, demonstration, teacher feedback, detailing, and conducting. The referential category included the use of figurative language by instructors.

**Imagery preference**

Imagery preference has also been examined by researchers (i.e., Barten, 1992; Sadoway 2021; Spieker, 2017). Barten (1992) observed group lessons (instrumental and vocal) and conducted interviews with music faculty ($n$ = 8) and students ($n$ = 23) at a music conservatory to examine metaphor usage in music instruction. Barten observed moderate to frequent metaphor usage in group lessons. Interviews with participants ($N$ = 31) revealed "that nonliteral language is important in all stages of learning and regardless of music" for some, while others said, "that use of images is valuable mainly in the instance of 'program music'" (Barten, 1992, p. 94).

Spieker (2017) examined figurative language use by instrumental music educators. Recordings of novice and master music educators rehearsing an ensemble for 45 minutes were examined for use of figurative language. Spieker reported a higher frequency of figurative language use with master teachers ($M$ = 10.88, $SD$ = 39.27) than with novice teachers ($M$ = 2.63, $SD$ = 9.13) (p. 8). Further, when music educators were questioned as to the importance of figurative language it was reported the master music educators "valued the teaching tool

slightly more than novice teachers" (p. 1).

Voice practitioners, singing instructors, choral conductors, speech-language pathologists, voice instructors, and speech instructors comprised the participants ($N = 218$) for a study in which the researcher examined the relationship between literal and metaphorical language in voice therapy and training (Sadoway, 2021). Sadoway reported student/client language preference to slightly favor metaphorical language over literal language (52%). Of those students/clients, there was a small correlation between singer preference in learning using metaphorical language as opposed to literal language use (statistical data were not reported). Only 8% of students/clients strongly preferred literal language. Sixteen percent of students/clients strongly preferring metaphorical language. Practitioner preference slightly favored literal language (54%). Seventy-six percent of all participants were reported as desiring a strong use of both types of language. When clients/students were combined with practitioners Sadoway reported both types of language, with equal distribution (50%) between language types as the favored communication type between clients and practitioners. The researcher suggested the training for use of both types of language in speech language pathology clinics and in the voice studio with the aim of using balanced and diverse language with students/clients. She advocated communication between science and art fields to better create educational experiences for students.

Brown (2021) encouraged vocal instructors to use co-construction to appropriately choose imagery that best suits individual students' learning styles. Students may become overly focused on mechanics if too much scientific information is given, "…similarly, a visual image may suit student *a*, whereas for student *b* a verbal metaphor may prove more beneficial. Therefore, I argue that for imagery to maintain its utility not only must it be grounded in current

scientific understanding, but it must also be applied personally through use of co-construction (student-teacher collaboration at all stages of lesson planning, teaching and performance)" (Brown, 2021, p. 7). Fuks & Fadle (2002) reported that it was common for teachers of wind instruments to use a combination of information based in scientific knowledge and mental imagery.

## Tone Quality Characteristics

### *Open Throat*

Findings from Mitchell and Kenny (2004) suggest an open throat is important to the production of perceptually good sound in Western classical singing. Researchers interviewed expert singing pedagogues to explore the term "open throat" in relation to vocal pedagogy, terminology, perceived physiology, and sound quality. Researchers cite the following as the four most commonly used terms to portray an open throat; "open throat, throat widening, retraction and space in the back" (Mitchell et al., 2003, p. 169). The singing pedagogues ($N = 15$) in this study reported adherence to the following schools of thought with regard to open throat pedagogy; Estill ($n = 7$), Richard Miller (n = 7), Janice Chapman ($n = 5$), and their own experience singing or studying ($n = 7$). Richard Miller used the term "open throat," Janice Chapman prefers the use of the term "collar," and the Estill method uses the term "retraction." Twenty percent of participants preferred the term "open throat" as the definition for open throat, 20% preferred the term "retraction," 13% thought both terms could be used interchangeably, and 47% of participants favored different terminology.

Terminology brought forth by participants included "produce a free sound," "engagement of the collar," "depth in the sound," and use of the student's own language. Fourteen of the 15 participants linked sound qualities to an open throat such as free, even/consistent, warm, more

balanced, or coordinated, and open. When asked how participants would teach the open throat concept to a new student several techniques were offered including laughter ($n$ = 6), crying or sobbing ($n$ = 5), a yawn or pre-yawn ($n$ = 3), through breathing ($n$ = 3), and through focus ($n$ = 2). In the discussion the authors examined physiology of the open throat comparing participant responses to research. It was reported that the technique of using a cry or sob to find a lower laryngeal position can be linked to studies that demonstrate "contraction of the sternothyroid muscle" which in turn have "some effect on the laryngeal configuration…Pedagogical methods linking breath, or the intake of breath, was deemed by pedagogues in this sample to be vital in the production of open throat, and achieved using a variety of images or gestures in order to locate a sound quality and sense of space or freedom" (Mitchell et al., 2003, p. 178).

***Voice Evaluation***

Voice quality can be evaluated using subjective approaches and objective approaches. Historically, voice diagnostics were completed in a subjective manner until objective measures were adopted by practitioners. This trend to include objective voice measures began in the 1970s (Wendler et at., 1980). Traditionally, spoken voice has been evaluated by practitioners using a scoring system. Presently, objective-acoustic voice analysis is most often used for voice disorder identification. The score assigned to the patient's voice reflects the practitioner's subjective judgement. Objective measures of voice use analysis to quantify vocal production aspects (Barsties & Bodt, 2015). Acoustic analysis is valued because it is a noninvasive objective measure. Further, patient records can be analyzed independently of examinations (Wendler et al., 1980).

Subjective ratings of voice are affected by the size of the panel, listening error due to fatigue, focus or other mistakes, experience in evaluating voices, background as a professional in

the field, biases, and training. The evaluation scale can also impact reliability (Barsties & Bodt, 2015). Acoustic analysis of voice signals can identify frequency, time, cepstrum domain, and amplitude (Barsties & Bodt, 2015).

Kreiman et al. (1993) examined perceptual evaluations of voice quality. Listener ratings of voice quality were found to vary due to listener biases, listener background, vocal task performed, random error, and the interactions between the tasks and the listener. Kreiman et al. advocated the use of intra-rater and inter-rater reliability measures in future studies involving perceptual voice evaluation. They also encouraged the use of a fixed external reference recording to help reduce biases.

***Acoustic Analysis: Long-term average spectrum (LTAS)***

Long-term average spectrum (LTAS) has been used by researchers to examine choral tone quality (Daugherty et al., 2012; Grady & Gilliam, 2020; Manternach et al., 2017, 2019). “LTAS data provide a quantifiable index of sound quality across a specified period of time. These data can be useful for detecting persistent spectral events” (Daugherty et al., 2012, p. 367). LTAS provides information on sound pressure density (decibel level) and frequency (hertz [Hz]) averaged over a period of time—it provides information about tone quality in the form of spectral energy (Daugherty et al., 2012).

Daugherty used LTAS, singer perceptual measures, and expert perceptual measures to compare overall choral sound of an SATB choir performing while standing in different choral formations (Daugherty et al., 2012). Singers perceived their sound to be changed by both riser height and horizontal spacing. Singers believed the best choral sound, most comfortable singing, and best self to other ratio occurred in the spread spacing condition. Grady and Gilliam (2020) examined the effect of singer movement on choral tone using long-term average spectrum

(LTAS). Researchers were also interested in singer perceptions of the impact of movement on vocal tone. Recordings were rated by expert-listeners and singer-listeners. Those listeners were blind to the movement condition. Researchers reported an increase in spectral energy with the conditions involving more swaying. This increase in spectral energy as indicated by LTAS data can be interpreted as a difference in timbre.

## Visual and Olfactory Stimuli

### *Sniff Function and Scent Inhalation*

The facial expression of a singer can influence tone quality. Aura et al. (2017) studied the effect of flared nostrils and raised cheek bones, a characteristic singer's expression found in operatic singers, on resonator dimensions (see Figure 1). Researchers reported that inhalation through a singer's expression resulted in a raised velum, widening of the pharyngeal and epilaryngeal inlet, and a widening of the glottis for both classical singers ($n$ = 3) and non-singers ($n$ = 2). This link to resonator dimensions due to the singer's expression can be associated with desirable tone quality characteristics in Western classical singing.

**Figure 1**

*Singer Exhibiting Singers' Expression*

*Note.* Singer exhibiting singers' expression. Adapted from singer images presented in "The Nasal Musculature as a Control Panel for Singing

Aura et al. linked the singer's expression to "smelling-related reflexive muscles functions" (p. 510). Researchers speculated the use of the singer's expression may assist with tone quality by helping to widen the glottis before phonation begins. It might also assist with gentle vocal fold adduction which could potentially be useful in voice therapy and voice instruction to reduce hyperfunction of the voice.

—Why Classical Singers Use a Special Facial Expression?" by Aura et al., 2019.

Poletto et al. (2004) studied the effects of sniff on the intrinsic laryngeal muscles of humans by placing electrodes in intrinsic laryngeal muscles. It was reported that the sniff function involved rapid, maximum opening of the vocal folds, i.e., more space in the glottis, caused by the posterior cricoarytenoid and the cricothyroid. Sniffs can differ on duration, velocity, and volume, with a typical sniff having a duration of 1.6 s. When an odor is diluted, as compared to concentrated, the airflow velocity and volume of the sniff are larger. Rapid inspiration in the form of sniffing aids olfaction. Further, when an odor is perceived as pleasant, as opposed to unpleasant, that same sniff vigor (velocity and volume) is larger, (Mainland & Sobel, 2006). Inhalation of odorants can influence the parasympathetic and sympathetic nervous system.

Odorants have been documented as influencing body function and psychological behavior. "Studies document odorants influence in sympathetic and parasympathetic nervous systems, and neurophysiological brain activity. Moreover, odours compounds can act on the neuroendocrine system, neurotransmitters and neuromodulators, influencing psychological behaviour as well as body function" (Angelucci et al., 2014, p. 12096).

Stress caused by the nervous system can potentially impact the singing voice (Larrouy-Maestri & Morsomme 2014). Larrouy-Maestri & Morsomme (2014) had 31 music conservatory

students perform in both stressful and non-stressful conditions. Results suggested that stress can have both a positive and a negative effect on singing accuracy. In their study, 1st year students were impacted positively by stress, while the 2nd year students were impacted negatively by the stress.

### *Visual and Olfactory Effects of Roses on Humans*

Igarashi et al. (2014, p. 727) studied the effect of fresh rose flower inhalation on female university students ($N = 19$). Researchers reported "a significant increase in parasympathetic nervous activities." Parasympathetic nervous activity is linked to relaxation, and decreased heart and respiration rate (Karemaker, 2017). Participants in the study reported feelings of comfort from inhalation of fresh roses. In a related study involving many of the same researchers (Song et al., 2014), fifteen female college students viewed fresh roses for three minutes. Following the viewing, participants self-reported feelings of relaxation, comfort, and an improved emotional mood. There were also decreases in heart rate variability and oxy-hemoglobin concentrations (right prefrontal cortex). The researchers determined that within the confines of their study, viewing of the fresh roses induced psychological and physiological relaxation.

Hongratanaworakit (2009) studied the effect of rose oil (*Rosa damascene*) inhalation on humans. Participants ($N = 40$) exposed to rose oil rated themselves to be more relaxed and calmer than those that were in the control group. Further, when compared to the placebo group, "rose oil caused significant decreases of breathing rate, blood oxygen saturation and systolic blood pressure, which indicates a decrease of autonomic arousal" (Hongratanaworakit, 2009, p. 291).

Researchers have used Damask rose essential oil along with lavender as an intervention for pain and anxiety following C-section (Abbasijahromi et al., 2019). Three drops of essential

oil were applied to a cotton ball and held at a distance of 10 cm. for 30 minutes. Compared to the control groups, participants receiving treatment in the form of oil aroma inhalation reported decreased pain and anxiety levels.

**Need for Study**

Researchers have demonstrated that imagery and odorants can influence the physiological and psychological state of humans (Dayme, 2009; Hongratanaworakit, 2009; Song et al., 2014). Singers' "physiological state and concept of sound all have an effect on the activity of laryngeal muscles" (Dayme, 2009, p. 51). As the vocal tract changes, the sound is filtered through the altered resonator to amplify or suppresses different harmonics, thus changing the tone quality perceptually and objectively (spectrum analysis) (Bozeman, 2015; McCoy, 2020). While these topics have been researched separately, to the researcher's knowledge, there has been no research on the effect of scent inhalation on choral tone quality or language preference within the current context.

**Purpose of the Study**

Therefore, the purpose of this study was to explore the metaphorical motor-affective imagery of rose aroma inhalation, the experience of inhaling rose aroma, and the use of semi-direct anatomical imagery (i.e., open throat) with the aim of determining what acoustic and perceptual effects these conditions have on choral tone. A secondary aim was to examine singer preference and understanding of instructional prompts (literal vs. metaphorical) related to tone quality.

**Research Questions**

Specifically, the following research questions were addressed:

1. Will acoustic differences in choral tone quality be found among experimental conditions as measured by Long-Term Average Spectrum (LTAS)?
2. Will perceptual differences in tone quality be found among experimental conditions as measured by expert panel ratings?
3. Will perceptual differences in tone quality be found among experimental conditions as measured by singer self-perceptions ratings?
4. What themes are present in singer questionnaire responses pertaining to metaphorical and literal language use in the choral rehearsal?

**Definitions**

Acoustical terminology:

*Cepstrum/Quefrency:* used in analysis of speech and singing. “The cepstrum of a signal is defined as the square of the Fourier transform of the logarithm of the amplitude spectrum of the signal” (Noll & Schroeder, 1964, p. 1030).

*Decibel level* (dB): used to objectively measure sound pressure level (Basner et al., 2014). The subjective measure of sound pressure level is intensity, or the subjective loudness of the sound (McKinney, 1994).

*Just-noticeable difference* (*JND*) *or difference limen* (*DL*): The minimum amount of variation required for a perceptual change in the volume of the sound; for human perception the JND level is set at 1dB (Benesty, 2008).

*Long-term average spectrum* (*LTAS*): “LTAS data convey frequency (Hertz) and amplitude (sound pressure level) averaged over time (Grady & Gilliam, 2020).

*Perception of Loudness*: As defined by Hodges (2020, p. 125):

Loudness is the psychological variable most closely related to the physical variable of

amplitude, although other variables can also have an effect. Amplitude is expressed as sound pressure level (SPL), most often measured in decibels. In general, the greater the decibel level, the louder the perceived sound. The decibel scale is logarithmic, which means that 20 dB has an intensity level 10 times greater than 10 dB, 30 dB has an intensity level 100 times greater than 10 dB, and so on. However, this does not mean that we perceive a ten dB increase as ten times louder. The range of loudness we can perceive varies with the frequency, but as best it starts at 0 dB, the threshold of hearing, and ends with a sensation of pain somewhere around 120 dB.

Experimental condition abbreviations:

*Perform:* Prompt 1–Sing as if you are performing (control)

*Literal:* Prompt 2–For every inhalation, inhale slowly and deeply with an open throat (semi-direct/literal language condition)

*Imagine*: Prompt 3–For every inhalation, imagine you are inhaling the aroma of a fragrant rose (metaphorical language condition)

*Favorite*: Prompt 4–Choose your favorite prompt. It can be the imagery of the rose or thinking about an open throat, or a combination of both (singer preference condition)

*Oil*: Prompt 5–For every inhalation, inhale the aroma of the fragrant rose (experiential condition)

Figurative language terminology:

*Experiential Metaphor* (Begy, 2013): "An experiential metaphor is a structural metaphor wherein both the source and target domains are similar experiential gestalts…"

*Gestalt*: The whole makes more cognitive sense than the parts alone, such as the act of jumping. When jumping is broken down into its individual actions, it is harder to make sense of the action (Begy, 2013; Lakoff & Johnson, 1980).

*Imagery/Metaphor*: For the purpose of this this study, the terms metaphor and imagery were used interchangeably as one umbrella term for experiential, emotional, figurative language. See metaphorical language.

*Imagery Categories* (Fisher, 2017):

a) *Direct imagery*: Imagining oneself in the situation.
b) *Indirect imagery*: Imagining a situation from outside the body.
c) *Semi-direct imagery*: The combination of an external image and an internal image (i.e., anatomical imagery).
d) *Motor imagery*: Possessing movement qualities that involve oneself or others.

*Literal language*: see metaphorical language.

*Metaphor:* Lakoff and Johnson (1980; Johnson 1987) equate metaphor to "understanding and experiencing one kind of thing in terms of another" (p. 12). In a metaphor there is a source domain and a target domain. "Each domain has an image schema associated with it. When a metaphor is employed, the source domain supplies the reasoning to interpret the target domain (Lakoff & Johnson, 1980). See metaphorical language.

*Metaphorical language*: An umbrella term for figurative, emotional, and experiential language, as opposed to literal language (Burwell, 2006).

Singing terminology:

*Autonomic Nervous System:*

*a) Parasympathetic nervous system:* conserves energy by slowing down heart rate, stimulates digestion and increases saliva secretion.

b) *Sympathetic nervous system:* fight or flight response linked to increased heart rate, adrenalin secretion, and energy production through glycogen conversion (Hodges, 2020).

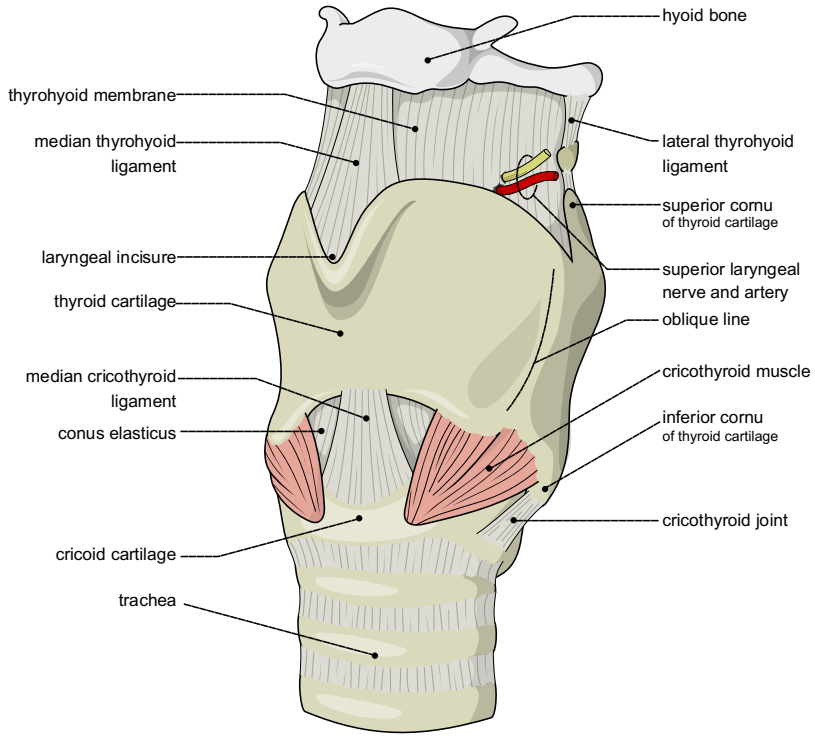
*Chiaroscuro*: Western classical tone perceived as having a balance of light (*chiaro*) and dark (*scuro*) qualities. A convergent resonator and an open throat help to achieve *chiaroscuro* tone (Bozeman, 2014). Also described as having well-balanced resonance (Miller, 1996).

*Hypersensitivity:* A hyper-response to a sensory stimulus in any sensory modality (Kuiper et al., 2018).

*Laryngeal Structure (*see Figure 2)

**Figure 2**

*Laryngeal Cartilages*




*Note.* Creative commons (Remesz, 2008).

a) *Cartilages:* The largest of the laryngeal cartilages is the *thyroid cartilage*. The *cricoid cartilage* sits below the thyroid cartilage. The leaf shaped cartilage is the *epiglottis*, which is directed over the vocal folds when swallowing occurs, directing that material into the esophagus (McCoy, 2020).

b) *Muscles and Other Laryngeal Structures:* (see Figure 3).

   i. *Cricothyroid (CT):* The CT muscle serves to elongate the vocal folds. The CT muscles are associated with higher pitched sounds primarily associated with head voice in treble voices, falsetto, and the lighter mechanism. It is comprised of two sections (McCoy, 2020).

   ii. *Epilaryngeal inlet:* The opening is situated immediately above the vocal folds. The *epilarynx* is the space that extends from the vocal folds to the top of the epiglottis (McCoy, 2020).

   iii. *Glottis:* The space between the vocal folds (see *laryngeal structure*). The glottis is open during inspiration and closed during vocal phonation. It serves as a valve to regulate airflow (McCoy, 2020).

   iv. *Posterior Cricoarytenoid:* This muscle serves to open the glottis by abducting the vocal folds.

   v. *Thyroarytenoid Muscle (TA):* The TA muscle comprises the body of the vocal folds, it is associated with lower pitches, primary chest voice or the heavier vocal mechanism.

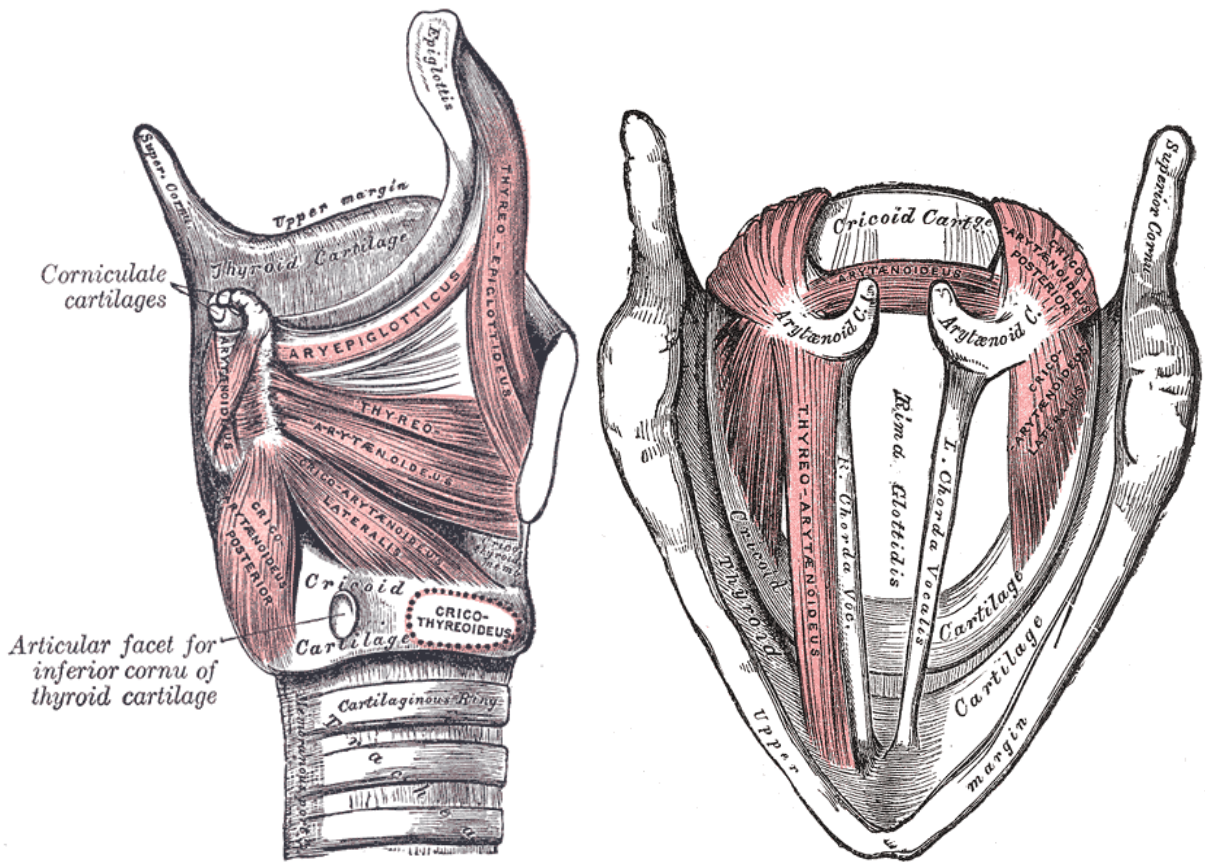
*Pharynx:*

a) *Pharyngeal inlet:* This opening connects the larynx and the pharynx.

b) *Pharyngeal constrictor muscles:* The pharyngeal muscles (inferior, middle, and superior, see Figures 4 & 5) "…wrap around the posterior of the pharynx, connecting to the thyroid cartilage, hyoid bone, stylohyoid ligament, mandible and skull. While they are intended by nature to assist with swallowing, narrowing the pharynx to help direct food into the esophagus, they are also important in the concept of the 'open throat' for singing and speaking; maximal opening is achieved only through the release of tension in the constrictors" (McCoy, 2020, p. 115).

**Figure 3**

*Laryngeal muscles*

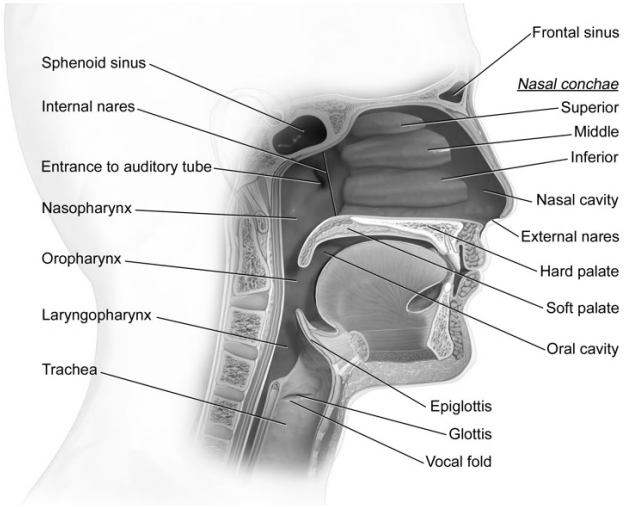



*Note.* Public domain (Gray, 1918).

c)

**Figure 4:**

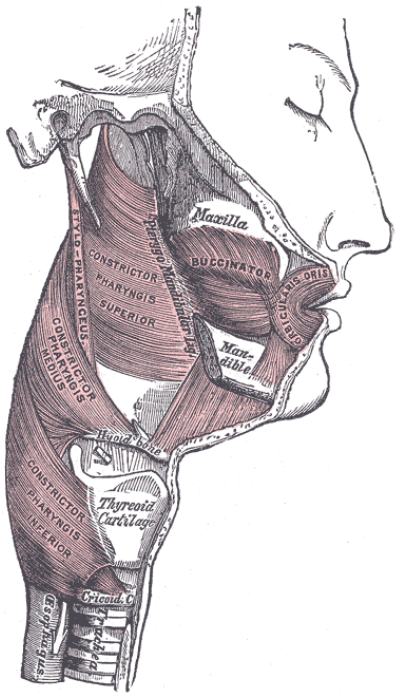
*Upper Respiratory System*




*Note.* Creative commons (Blausen, 2014).

**Figure 5**

*Pharyngeal constrictor muscles*




*Note.* Public domain (Gray, 1918).

*Singers Formant Cluster:* A clustering of formants three, four, and five in the 2.4–3.2 kHz range that is created by resonances at the epilaryngeal level (see *Epilaryngeal inlet).*

*Straw Phonation:* Straw phonation is a semi-occluded vocal tract exercise (SOVTE). The lips are semi-closed around the straw and then vocal exercises can be performed through that opening. SOVTE allow for tissue collision that is more efficient and economic (Titze, 2006). SOVTE "seem to help singers use less effort to create more sound and a more balanced tone" (Manternach et al., 2019, p. 48).

*Singing:* Singing can be interpreted as the acts of motivation (mind-body connection), respiration, phonation, resonation, and articulation (Rosine, 2021).

a) *Resonator:* "The resonator for increasing sonority in the voice is the vocal tract… this consists of the larynx, pharynx, and mouth, and on rare occasions for nasalized sounds, the nose. Because parts of the tract are muscular and highly mobile, it is capable of changes in length and width which alter the resonance of the voice as well as the quality of tone" (Dayme, 2009, p. 83).

*Velum:* The *velum*, or soft palate, can be raised or lowered to change singing resonance. It also functions to prevent food, water, or air from passing between the nose and mouth–it is a valve (McCoy, 2020).

Vocal Function:

*a) Hyperfunction:* demanding too much from the breathing or laryngeal mechanism sometimes resulting in a pressed or strident sound (McKinney, 1994).

*b) Hypofunction:* not enough activity of the laryngeal or breathing mechanism sometimes resulting in breathy sound (McKinney, 1994).

# CHAPTER THREE

# Method

## Summary

This study was a repeated measures within subject design with a control condition and four experimental conditions. This investigation included a lab-based task; singers in each choir ($n$ = 3) were asked to sing a musical excerpt under five conditions. Choral tone was measured objectively using the long-term average spectrum (LTAS) measure acquired through KayPentax Computerized Speech Lab (CSL) software (no pre-emphasis or smoothing, window size 512 points, bandwidth 86.13 Hz, Blackman window) and subjectively by an expert panel of choral teachers/conductors/voice teachers. The singer participant portion of the study took place in two music ensemble rehearsal spaces. Singer and expert panel perceptions of tone quality were obtained using questionnaires. Singer questionnaire comments were analyzed qualitatively using thematic analysis and coding to find reoccurring themes in the data. Participant responses were coded by two additional coders to assess interrater agreement. Singer participants took approximately 25–30 minutes to perform all singing and written tasks. The expert panel participants took approximately 15–20 minutes to complete all listening tasks and questionnaire prompts. Data were collected in the form of digital audio recordings and questionnaire responses. This study was approved by the Institutional Review Board (see Appendix A).

## Participants

### *Singer Participants*

Three mixed-voice choir ensembles at one large university in the Northwest United States served as the participants ($N$ = 93) for this study (see Appendix B). Singer mean age was 20.80 years ($SD$ = 3.15, range = 17–30) with 2.9 ($SD$ = 3.44, range = 0–20) ($M$) years voice lesson

experience and 7.91(*M*) years (*SD* = 4.30, range = 0–22) experience singing in choral ensembles. Between all choirs there was a total of 52 treble voices (soprano, *n* = 25; alto, *n* = 27) and 41 tenor/bass voices (tenor, *n* = 16; bass, *n* = 25).

There were 67 singers who also identified as instrumentalists with 6.7 (*SD* = 6.10, range = 1–18) mean years of experience on their primary instrument. Of those instrumentalists, 45 said they were an instrumentalist before singing in a choir or taking voice. When divided into categories, instrumentalists were as follows: brass (*n* = 2), woodwinds (*n* = 6), bowed strings (*n* = 5), strummed strings (*n* = 14), and piano/organ/percussion (*n* = 40). Singers (*n* = 92, 1 missing data point) were asked to assess their vocal health on the day of the experiment using a 7-point Likert-type scale (1 unhealthy–7 healthy, *M* = 4.95, *SD* = 1.20).

**Table 1**

*Total Sensory Hypersensitivity Scale (SHS) Reponses: Singers (N = 92)*

| | I often react to odors that others do not initially notice. | | I seem to notice smells that other people do not. | | I rarely notice smells. | |
|---|---|---|---|---|---|---|
| | *n* | % | *n* | % | *n* | % |
| Strongly Disagree | 11 | 11.80% | 11 | 11.80% | 25 | 26.90% |
| Disagree | 16 | 17.20% | 15 | 16.10% | 43 | 46.20% |
| Neutral | 27 | 29.00% | 26 | 28.00% | 7 | 7.50% |
| Agree | 33 | 35.50% | 31 | 33.30% | 14 | 15.10% |
| Strongly Agree | 5 | 5.40% | 9 | 9.70% | 3 | 3.20% |

Singers completed olfactory (sense of smell) questions extracted from the Dixon et al. (2016) Sensory Hypersensitivity Scale (SHS) self-report tool. The sensory hypersensitivity scale (SHS) was developed by researchers (Dixon et al., 2016) to detect hypersensitivity in modality-specific areas, such as olfaction. The SHS self-report questionnaire was reported to have strong

internal reliably (Cronbach's alpha = 0.81), it is a valid measure for hypersensitivity. Singers were asked to respond to prompts using a 5-point Likert-type scale (1 strongly disagree–5 strongly agree). Reponses to the SHS self-report tool are in Table 1.

**Choir One**

Choir One was comprised of 35 singers (9 sopranos, 10 altos, 7 tenors, 9 basses) with varying degrees of experience both singing in choral ensembles (*M* = 10.20, *SD* = 3.95, range 4–22 years) and taking voice lessons (*M* = 4.54, *SD* = 4.04, range 0–20 years). Student ages were 18–33 (*M* = 21.70, *SD* = 3.80) years.

**Table 2**

*Sensory Hypersensitivity Scale (SHS) Reponses: Choir One (n = 35)*

| | I often react to odors that others do not initially notice. | | I seem to notice smells that other people do not. | | I rarely notice smells. | |
|---|---|---|---|---|---|---|
| | *n* | % | *n* | % | *n* | % |
| Strongly Disagree | 5 | 14.30% | 4 | 11.40% | 12 | 34.30% |
| Disagree | 6 | 17.10% | 7 | 20.00% | 17 | 48.60% |
| Neutral | 12 | 34.30% | 8 | 22.90% | 2 | 5.70% |
| Agree | 10 | 28.60% | 14 | 40.00% | 3 | 8.60% |
| Strongly Agree | 2 | 5.70% | 2 | 5.70% | 1 | 2.90% |

Singers completed olfactory questions extracted from the Dixon et al. (2016) Sensory Hypersensitivity Scale (SHS) self-report tool. Singers were asked to respond to prompts using a 5-point Likert-like scale (1 strongly disagree–5 strongly agree). Reponses to the SHS self-report tool are in Table 2.

Of the singers, 26 (74.30%) identified as an instrumentalist with 2–18 (*M* = 7.24, *SD* = 6.47) years of experience on their primary instrument. Of those instrumentalists, 16 said they were an instrumentalist before singing in a choir or taking voice. Instrumentalist categories

represented in the ensemble were woodwinds ($n$ = 1), bowed strings ($n$ = 3), strummed strings ($n$ = 5), and piano/organ/percussion ($n$ = 17). Choir members ($n$ = 35) were asked to assess their vocal health on the day of the experiment using a 7-point Likert-like scale (1 unhealthy–7 healthy). Participant responses ranged from 3–7 ($M$ = 5.31, $SD$ = 0.87).

**Choir Two**

Choir Two was comprised of 33 singers (9 soprano, 8 alto, 5 tenor, 11 bass) with varying degrees of experience both singing in choral ensembles ($M$ = 4.97, $SD$ = 3.52, range 0–13 years) and taking voice lessons ($M$ = 1.58, $SD$ = 2.09, range 0–7 years). Student ages were 17–31 ($M$ = 20.55, $SD$ = 3.06) years.

Of the singers, 23 (67.60%) identified as an instrumentalist with 1–18 ($M$ = 6.88, $SD$ = 6.70) years of experience on their primary instrument. Of those instrumentalists, 20 said they were an instrumentalist before singing in a choir or taking voice lessons. Instrumentalist categories represented in the ensemble were brass, ($n$ = 1), woodwinds ($n$ = 3), bowed strings ($n$ = 1), strummed strings ($n$ = 7), and piano/organ/percussion ($n$ = 12).

**Table 3**

*Sensory Hypersensitivity Scale (SHS) Reponses: Choir Two (n = 33)*

| | I often react to odors that others do not initially notice. | | I seem to notice smells that other people do not. | | I rarely notice smells. | |
|---|---|---|---|---|---|---|
| | *n* | % | *n* | % | *n* | % |
| Strongly Disagree | 5 | 14.70% | 5 | 14.70% | 10 | 29.40% |
| Disagree | 4 | 11.80% | 5 | 14.70% | 11 | 32.40% |
| Neutral | 8 | 23.50% | 8 | 23.50% | 4 | 11.80% |
| Agree | 14 | 41.20% | 9 | 26.50% | 6 | 17.60% |
| Strongly Agree | 2 | 5.90% | 6 | 17.60% | 2 | 5.90% |

Choir members ($n$ = 33) were asked to assess their vocal health on the day of the

experiment using a 7-point Likert-like scale (1 unhealthy–7 healthy). Participant responses ranged from 3–7 ($M$ = 4.73, $SD$ = 1.44).

Singers completed olfactory questions extracted from the Dixon et al. (2016) Sensory Hypersensitivity Scale (SHS) self-report tool. Singers were asked to respond to prompts using a 5-point Likert-like scale (1 strongly disagree–5 strongly agree). Reponses to the SHS self-report tool are in Table 3.

**Choir Three**

Choir Three was comprised of 24 singers (6 sopranos, 9 altos, 4 tenors, 5 basses) with varying degrees of experience both singing in choral ensembles ($M$ = 8.60, $SD$ = 3.49, range 2–14 years) and taking voice lessons ($M$ = 2.30, $SD$ = 3.06, range 0–9 years). Student ages were 18–24 ($M$ = 19.88, $SD$ = 1.68) years.

Of the singers, 18 (75.00%) identified as an instrumentalist with 1–13 ($M$ = 5.70, $SD$ = 4.58) years of experience on their primary instrument. Of those instrumentalists, 9 said they were an instrumentalist before singing in a choir or taking voice lessons. Instrumentalist categories represented in the ensemble were brass ($n$ = 1), woodwinds ($n$ = 2), bowed strings ($n$ = 1), strummed strings ($n$ = 2), and piano/organ/percussion ($n$ = 11).

Choir members ($n$ = 24) were asked to assess their vocal health on the day of the experiment using a 7-point Likert-like scale (1 unhealthy–7 healthy). Participant responses ranged from 3–7 ($M$ = 4.71, $SD$ = 1.16).

Singers completed olfactory questions extracted from the Dixon et al. (2016) Sensory Hypersensitivity Scale (SHS) self-report tool. Singers were asked to respond to prompts using a 5-point Likert-like scale (1 strongly disagree–5 strongly agree). Reponses to the SHS self-report tool are in Table 4.

**Table 4**

*Sensory Hypersensitivity Scale (SHS) Reponses: Choir Three (n = 24)*

| | I often react to odors that others do not initially notice. | | I seem to notice smells that other people do not. | | I rarely notice smells. | |
|---|---|---|---|---|---|---|
| | *n* | % | *n* | % | *n* | % |
| Strongly Disagree | 1 | 4.20% | 2 | 8.30% | 3 | 12.50% |
| Disagree | 6 | 25.00% | 3 | 12.50% | 15 | 62.50% |
| Neutral | 7 | 29.20% | 10 | 41.70% | 1 | 4.20% |
| Agree | 9 | 37.50% | 8 | 33.30% | 5 | 20.80% |
| Strongly Agree | 1 | 4.20% | 1 | 4.20% | 0 | 0.00% |

### *Expert Panel Participants*

The expert panel started with 71 participants and was reduced to 62 after removing participants with less than five years of choral teaching/directing experience. Expert panel participants ($N = 62$) ranged in age from 25–82 ($M = 50.44$, $SD = 14.30$). Expert panel participants reported 0–48 years voice teaching experience ($M = 23.44$, $SD = 13.71$) and 5–61 years choral teaching/directing ($M = 25.40$, $SD = 13.20$). The expert panel consisted of 30 male identifying participants (48.4% 32 female (51.6%)  and 0% self-identified as non-binary or other (see Appendix C). There were 8 expert panel members with a bachelor's degree (12.9%), 36 with a master's degree (58.1%), and 18 with a doctoral degree (29%).

Expert panel participants were asked to choose which categories of choir they had experience conducting and/or teaching over the course of their career (Grady & Brunkan, 2022). Those six categories and participant responses were children's choir ($n = 43$), middle level ($n = 45$), high school ($n = 49$), church ($n = 47$), community ($n = 38$), and collegiate ($n = 35$). Multiple participants reported experience in more than one category (range 1–6, $M = 4.13$, $SD = 1.41$). Expert panel participant experience by number of categories was 3 participants with experience

in only 1 category (4.8%), 4 participants with experience in 2 categories (6.5%), 14 participants with experience in 3 categories (22.6%), 15 participants with experience in 4 categories (21%), 13 participants with experience in five categories (21%), and 13 participants with experience in all 6 categories (21%).

G*Power statistical software was used to conduct an a priori power analysis in order to determine the required sample size of expert panel participants (Faul et al., 2007). The alpha level was set at 0.05, the effect size was medium ($f = 0.25$), and the power was set at 0.80 (Cohen, 1988; Silveira & Silvey, 2020). The minimum required expert panel participant size was determined to be 27.

Expert panel participants were recruited through email and social media using an online recruitment protocol (see Appendix D). The recruitment message was emailed to American Choral Directors Association (ACDA) members whose emails were available on official ACDA webpages ($n = 24$ state websites). The announcement was posted on the following Facebook groups: *I'm a Choir Director, ACDA Northwest Region, Oregon ACDA, I Teach Middle School Chorus, Middle School Choir Directors,* and *Researchers in Music Education.* Oregon, Utah, and Wyoming certified choral adjudicators were emailed in addition to teachers and church directors affiliated with the researcher. The snowball sampling method was used to further recruit participants.

### *Qualitative Coding Assistants*

Two independent raters with choral singing experience (7.5 *M* years) were recruited to verify the researcher's coding of qualitative comments. Interrater agreement was calculated by dividing the number of agreements by the total number of agreements and disagreements (Miles & Huberman, 1994). The strength of the agreement was set at 80%, almost perfect agreement

as defined by Landis and Koch (1977).

**Stimulus video**

A stimulus video (20:52 duration) was created to ensure consistent delivery of aural instructions (i.e., verbal prompts, starting pitch, metronome click) and visual stimulus for the choir (i.e., on screen text, conductor gesture, tempo, alignment) (Grady & Gilliam, 2020; Manternach & Daugherty, 2017). The video was created to help control possible confounding variables that might have arisen from changes in the live delivery of instructions or conducting such as changes in tempo, conducting gesture, nonverbal feedback, and pacing/tone of verbal prompts (Daugherty et al., 2019). Order of experimental conditions (perform, literal, imagine, favorite, oil) for the video was obtained randomly using a random number generator (Haahr, 2023).

The conductor was recorded performing *Jubilate Deo* at 75 bpm (Praetorius, n.d.). The conducting performance clip was then used for every sung repetition of the song. All instruction in the video was shown as text and read aloud by a narrator. The instructions explained to singers how to proceed through each experimental condition and prompted singers when it was time to complete the singer questionnaire. A timer was displayed to show singers how much time they had to complete each portion of the written questionnaire.

The stimulus video began by notifying singers of the need to notice their own vocal tone and overall tone of the choir as they sang *Jubilate Deo* as they were prompted to rate their individual tone and the choir's tone following each performance. When the choir was asked to sing for each condition, they were shown the same video clip that consisted of a starting pitch (C4 performed on a piano) and a conductor performing a conducting pattern at 75 bpm. A four-beat conducting prep with accompanying metronome click was given to allow variation in singer

inhalation time as opposed to dictating a timed inhalation. The video included two opportunities to rehearse with the video conductor (which could be repeated upon request from the choir), the first of which had synthesized clarinet audio doubling the vocal line. The script for the stimulus video can be found in Appendix E.

A pilot study was conducted with eight singers in order to test and refine the stimulus video, questionnaire, and procedures. It was determined that the entire process should take singers approximately 25–30 minutes to complete all required tasks. The questionnaire was revised due to spelling errors and the procedure was amended to be more efficient based on feedback from pilot participants.

**Musical excerpt**

Researchers (Manternach et al., 2017) studying the effects of straw phonation on acoustic measures of a mixed chorus used *Jubilate Deo* by Michael Praetorius as one of the repertoire selections for analysis. Straw phonation is a semi-occluded vocal tract exercise (SOVTE). The lips are semi-closed around the straw and then vocal exercises can be performed through that opening. SOVTE allow for tissue collision that is more efficient and economic (Titze, 2006). SOVTE "seem to help singers use less effort to create more sound and a more balanced tone" (Manternach et al., 2019, p. 48).

*Jubilate Deo* was used in the present study following the same protocols set forth by Manternach et al. (2017). *Jubilate Deo* was performed at 75 beats per minute first sung in unison, then as a round in four parts. The round started with sopranos followed by tenors, altos, and then basses. Each voice part entered four beats after the prior group's entrance and sang the excerpt three additional times after the unison singing, holding the final /ɑ/ of "alleluia" until all parts had finished their phrase and the conductor released the final note. The performance

duration was 1 minute and 17 seconds. The entire sequence included the unison introduction, four-part canon repeated three times, and the sustained final note (see Appendix F).

**Experimental Conditions**

Experimental condition prompts were: a) sing as if you are performing (perform); b) for every inhalation, inhale slowly and deeply with an open throat (literal); c) for every inhalation, imagine you are inhaling the aroma of a fragrant rose (imagine); d) choose your favorite prompt, it can be the imagery of the rose or thinking about an open throat, or a combination of both (favorite); and e) for every inhalation, inhale the aroma of the fragrant rose (oil). Singers were asked to sing as if they were performing for all experimental conditions. The first repetition (perform) served as a control for singers. For all other conditions, singers were asked to remember to sing as if they are performing, and to also incorporate the new experimental prompt. In order to produce the rose aroma for the final experimental condition, rose essential oil was used. Singers were notified of each experimental condition via the stimulus video prior to each singing task.

***Rose essential oil***

The researcher used an eyedropper to stain cotton balls with one drop of 10% rose essential oil (*Rosa damascene*) procured from the Revive Essential Oils. While a 4% dilution has been used by researchers for rose oil inhalation, researchers recommended that future research try a different oil concentration (Fazlollahpour-Rokni, 2019). I have experimented with different oil concentrations, I used 100% rose essential oil in my related pilot study, “The Effects of Rose Aroma Inhalation and Imagined Rose Aroma Inhalation on Singer Tone Quality” upon the recommendation of an acupuncturist/massage therapist. Five researchers tested multiple oil concentrations and agreed that 100% rose essential oil aroma most imitated fresh rose, albeit

at a stronger potency.

Upon conclusion of the previous related study, it was discovered that 100% rose essential oil could potentially be overpowering when administered simultaneously to singers. For the present study I administered the oil to the cotton balls 12 hours prior to use by singers. This delay was designed to allow time for the odor to somewhat dissipate in an effort to keep the rose aroma confined to the cotton ball while in use by the singers and avoid the oversaturation of the aroma in the research space. The stained cotton balls were individually sealed within Ziplock bags to further mask the scent, then placed in a box for distribution. All participants had the option to wear latex free gloves when holding the cotton ball stained with the drop of oil.

***Research Rooms***

Research rooms (Room A, Room B) consisted of two university ensemble rehearsal spaces which have been used for choral rehearsals. The dimensions of Room A were approximately 11.66-m (38.25-ft) by 13.72-m (45.25-ft) with an average ceiling height of 7.92-m (26-ft). There were sound clouds hanging at various heights from the unfinished ceiling that channel sound forward. Further, the back wall is designed like an acoustical shell, it also directed sound forward. The room while mainly rectangular had slight trapezoidal dimensions, though the side walls are not parallel. The floor consisted of raked levels with a large carpet covering the linoleum on the main floor and 127 plastic moveable chairs. Most chairs are plastic, but some are covered in cloth with padding. There was a forced air HVAC system that contributed to ambient sound of the room.

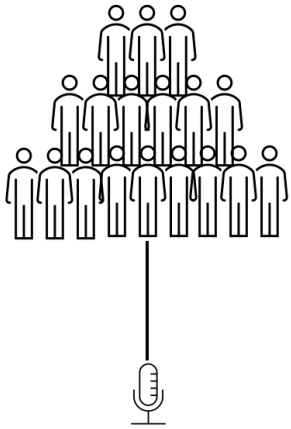
The dimensions of Room B were approximately 14.40-m (47.25-ft) by 12.27-m (40.25-ft). There was a domed acoustic tile treatment to the ceiling. The lowest part of the dome was approximately 4.88-m (16-ft), and the highest part was approximately 7.01-m (23-ft). The room

was rectangular in shape with not quite parallel walls. Three of the four walls were covered in low pile carpet. The floor consisted of raked levels and 94 permanent upholstered theatre chairs and 16 hard plastic chair/desks. The raked levels are primarily wood with some metal elements. The main floor is vinyl over the top of cement. Other materials present in the room include wood trusses, concrete, gypsum wall board, and glass. There was a forced air HVAC system that contributed to ambient sound of the room.

***Equipment***

**Figure 6**

*Microphone Placement*



*Note.* 5ft. (1.52-m) from the front center of the choir at a height of 48 in. (1.22-m)

Choir audio was recorded using a Zoom H4N Pro Handy audio recorder with cardioid characteristics and a frequency range of 20–20,000 Hz at a sampling rate of 44.1 kHz (16 bits) (Grady & Gilliam, 2020; Titze & Winholtz, 1993). Audio was saved to the Zoom audio recorder as .wav files. To maintain consistency, the audio recorder was preset at a consistent distance for all choirs (5 ft/1.52-m from the first row at a height of 48 in./1.22-m), see Figure 6.

Researchers have used a similar height of 44 in. (1.12m) to represent seated listener ear height (Daugherty, Grady, & Coffeen, 2019). The microphone recording level was set at recording level 37 and remained unchanged for all groups (see Figure 2). The stimulus video was played from a 2020 MacBook Pro with audio being played through the room's ceiling-mounted speakers. The volume remained consistent for each choral ensemble.

***Procedure***

The singer participant portion of the research study took place during each choir's designated afternoon rehearsal time. The two research rooms were preset with all equipment and materials needed for the study. Singers entered the research space, picked up a packet of materials, and signed in to receive a participant ID number. Participants then used this participant ID number to remain anonymous to all but the researcher.

Singers were instructed to sit in their usual choir formation within the room and complete the informed consent materials and demographic portion of the singer questionnaire (see Appendix G). Singers were informed that they could drop out of the study at any time without penalty. The demographic portion of the questionnaire consisted of questions inquiring about singer age, choral voice part, singing experience, instrumental experience, vocal health rating, and olfactory questions extracted from the Dixon et al. (2016) Sensory Hypersensitivity Scale (SHS) self-report tool (see Appendix H). The full SHS assesses modality specific sensitivities such as taste, hearing, and touch in addition to general sensitivity. Because olfaction was the only relevant measure to this study, only that portion of the SHS scale was extract. No edits were made to the language used in the SHS.

Singers completed the first portion of the singer questionnaire then followed prompts in the stimulus video. Singers began by rehearsing *Jubilate Deo* with the stimulus video, once with

the melody playing through the classroom speakers, and a second time with only the video of the conductor. The stimulus video offered the opportunity to rehearse *Jubilate Deo* additional times. Choir One did not request additional practice with the conductor. Choir Two and Choir Three asked to practice with the video conductor a second time.

Following each singing task, singers were prompted via the questionnaire to rate their individual tone and the overall choral tone following each sung performance. To remain consistent across ratings between groups, singers and the expert panel were given the same definition of good tone quality (for this questionnaire good tone quality is defined as consistent, clear, free, rich, ringing, and resonant).

Singers also had the option to explain how language prompts from the video effected their tone quality (see Appendix I). Following completion of the video, singers filled out the third section of the questionnaire which were then collected by the researcher. The entire process took 25–30 minutes.

## Dependent Measures

### *Perceptual Measures*

#### Singer Questionnaire

The researcher-designed questionnaire consisted of 45 items based on the following variables (1) perceived individual tone; (2) perceived choral tone; (3) language preference; and (4) perceived differences between imagining the aroma of a rose and actually inhaling the aroma of a rose. The singer questionnaire was modeled after questionnaires used in similar perceptual studies (Brunkan, 2012; Grady & Brunkan, 2022; Grady & Gilliam, 2020; Manternach & Daugherty, 2017). The singer questionnaire was refined after the original pilot study and through consultation with a music educator researcher at the university to include opportunities for

singers to comment after each experimental condition. Further, formatting was modified so all scales were oriented similarly (low–high, left–right, positive–negative).

The first portion of the singer questionnaire collected demographic data (age, vocal part sung in choir, choral singer experience, experience taking voice lessons, instrumental background). The second portion collected choral and individual tone quality ratings and comments following each singing task (perform, literal, imagine, favorite, oil). The third section of the singer questionnaire prompted singers to answer multiple choice questions pertaining to tone quality, language preference, and prior experience with prompts used in the video. Singers had the option to provide free-response comments on their experience.

**Expert Panel Questionnaire**

Expert panel perceptions of tone quality were measured via a web-based questionnaire (Google Form). Experts were instructed to listen to all audio while wearing personal headphones. Researchers conducting similar studies have asked listener participants to use personal headphones while rating choral tone (Grady & Gilliam, 2020). The questionnaire consisted of informed consent materials, demographic questions, an opportunity for experts to test their audio, and the audio recordings used for LTAS analysis (see Appendix J and K). There were fifteen audio recordings–five experimental conditions for each of the three choirs. Each recording was the complete performance of *Jubilate Deo* under the experimental condition.

Each expert was asked to listen to the choral example then rate the overall tone quality (5-point Likert-type scale, 1 (poor tone quality) to 5 (good tone quality) according to the given definition ("good tone quality is defined as consistent, clear, free, rich, ringing, and resonant") (see Appendix L). The order of the audio files ($n$ = 15) was randomized using a random sequence generator (Haahr, 2023). That randomized order was used for the expert panel questionnaire. The

expert panel all experienced the same randomized order of experimental conditions and choir order. There was no change in that order between expert panel participants.

***Objective Measures***

Tone of each choral ensemble was measured objectively using spectrum analysis (long-term average spectrum – LTAS). Analysis of the audio recordings was performed using KayPentax Computerized Speech Lab (CSL) software (Kay PENTAX, PENTAX Medical Company, NJ). The audio analysis was completed following protocols set forth by Grady & Gilliam (2020). The LTAS function was used to process audio excerpts with a spectrogram bandwidth of 86.13 Hz. The window size was set at 512 points. There was no pre-emphasis or smoothing. A Blackman window was utilized (Grady & Gilliam, 2020).

Through audio analysis in CSL it was discovered that some of the higher frequencies were not present in the data report. The lack of higher frequencies in the analysis was determined to be due to the audio recorder levels which were set lower than optimal. To boost the audio of the files so the full spectrum of frequencies would appear, the choral .wav files were imported into Logic Pro (Version 10.7.7) running on a 2020 MacBook Pro. The gain tool was applied to all choral audio files. The setting remained consistent for all audio files (gain boost of 24). This process was discussed with researchers conducting similar studies with choirs using LTAS and was deemed to be acceptable.

The boosted audio files were imported to CSL and LTAS was calculated for each performance of *Jubilate Deo* with each choir having a total of five recordings (five experimental conditions), for a grand total of 15 recordings (see Appendix M):

- Recording 1 prompt: *Sing as if you are performing* (control);

- Recording 2 prompt: *For every inhalation, inhale slowly and deeply with an open throat* (semi-direct/literal language condition);
- Recording 3 prompt: *For every inhalation, imagine you are inhaling the aroma of a fragrant rose* (metaphorical language condition);
- Recording 4 prompt: *Choose your favorite prompt. It can be the imagery of the rose or thinking about an open throat, or a combination of both* (singer preference condition);
- Recording 5 prompt: *For every inhalation, inhale the aroma of the fragrant rose* (experiential condition).

# CHAPTER FOUR

## Results

### Research Question One: Long-Term Average Spectrum (LTAS)

The research questions were designed to determine what differences may be present among experimental conditions as measured by acoustic and perceptual measures. I also wanted to explore any themes that may be present in singer questionnaire responses pertaining to metaphorical and literal language use in the choral rehearsal. Research results pertaining to these topics will be presented in the order of the research questions.

#### *LTAS 0- to 10-kHz*

##### Choir One

Research question one pertained to acoustic differences in choral tone quality as measured by Long-Term Average Spectrum (LTAS). A one-way repeated-measures analysis of variance (ANOVA) was performed to examine the effect of experimental conditions (perform, literal, imagine, favorite, and oil) on spectral energy levels (0- to 10-kHz) of Choir One. G*Power statistical software was used to conduct an a priori power analysis in order to determine the required sample size of singer participants (Faul et al., 2007). The alpha level was set at 0.05, the effect size was medium ($f = 0.25$), and the power was set at 0.80 (Cohen, 1988; Silveira & Silvey, 2020). The minimum required size was determined to be 21.

Sphericity assumptions were not met (Mauchly's $W = 0.27$, $\chi^2$ 132.68, $p < .001$). The estimated sphericity departure was $\varepsilon = 0.67$. The Greenhouse-Geisser correction was applied, and degrees of freedom were adjusted. There was a significant within-subjects effect of experimental conditions on LTAS for Choir One, $F(1, 2.68) = 1783.11$, $p < .001$ (see Table 5).

**Table 5**

*Paired Samples Effect Sizes: LTAS (0- to 10-kHz) Choir One (n = 113*)*

| | | | Standardizer[a] | Point Estimate | 95% Confidence Interval | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| Pair 1 | Perform - Literal | Cohen's d | 0.49135 | 1.962 | 1.65 | 2.271 |
| | | Hedges' correction | 0.49456 | 1.949 | 1.639 | 2.256 |
| Pair 2 | Perform - Imagine | Cohen's d | 0.79685 | 2.32 | 1.97 | 2.668 |
| | | Hedges' correction | 0.80205 | 2.305 | 1.957 | 2.65 |
| Pair 3 | Perform - Favorite | Cohen's d | 0.5159 | 5.411 | 4.688 | 6.132 |
| | | Hedges' correction | 0.5193 | 5.376 | 4.658 | 6.092 |
| Pair 4 | Perform - Oil | Cohen's d | 0.69852 | 6.623 | 5.694 | 7.549 |
| | | Hedges' correction | 0.70371 | 6.574 | 5.652 | 7.493 |
| Pair 5 | Literal - Imagine | Cohen's d | 0.5267 | 1.68 | 1.396 | 1.96 |
| | | Hedges' correction | 0.53013 | 1.669 | 1.387 | 1.947 |
| Pair 6 | Literal - Favorite | Cohen's d | 0.40288 | 4.538 | 3.923 | 5.15 |
| | | Hedges' correction | 0.40553 | 4.508 | 3.897 | 5.116 |
| Pair 7 | Literal - Oil | Cohen's d | 0.5712 | 6.358 | 5.464 | 7.248 |
| | | Hedges' correction | 0.57544 | 6.311 | 5.424 | 7.195 |
| Pair 8 | Imagine - Favorite | Cohen's d | 0.44277 | 2.118 | 1.788 | 2.445 |
| | | Hedges' correction | 0.44568 | 2.104 | 1.776 | 2.429 |
| Pair 9 | Imagine - Oil | Cohen's d | 0.69222 | 3.933 | 3.359 | 4.504 |
| | | Hedges' correction | 0.69737 | 3.904 | 3.335 | 4.471 |
| Pair 10 | Favorite - Oil | Cohen's d | 0.64593 | 2.841 | 2.405 | 3.274 |
| | | Hedges' correction | 0.65073 | 2.82 | 2.387 | 3.25 |

a. The denominator used in estimating the effect sizes.

Cohen's d uses the sample standard deviation of the mean difference.

Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

*Note.* There were missing higher frequency data points. The *n* values ranged from 103–117 depending on pairing (Perform & Literal, *n* = 117; Perform & Imagine; *n* = 117, Perform & Favorite, *n* = 116; Perform & Oil, *n* = 103).

There were also significant multivariate test results (Wilks' $\Lambda = 0.01$, $F(4, 99) = 2683.19$, $p < .001$). Table 6 displays full spectrum (0- to 10-kHz) mean sound pressure levels (SPL) for Choir One under each experimental condition. Figure 7 displays the estimated marginal means of SPL level for Choir One.

**Table 6**

*Full Spectrum (0- to 10-kHz) Mean Sound Pressure Level (SPL) for Each Experimental Condition: Choir One (n = 35)*

| Experimental Condition | *M* | Range | *SD* |
|---|---|---|---|
| Perform | 12.34 | -1.85–49.42 | 13.32 |
| Literal | 11.38 | -2.87–48.27 | 13.38 |
| Imagine | 10.49 | -3.10–48.14 | 13.42 |
| Favorite | 9.67 | -3.95–46.80 | 13.34 |
| Oil | 9.44 | -4.31-45.58 | 13.72 |

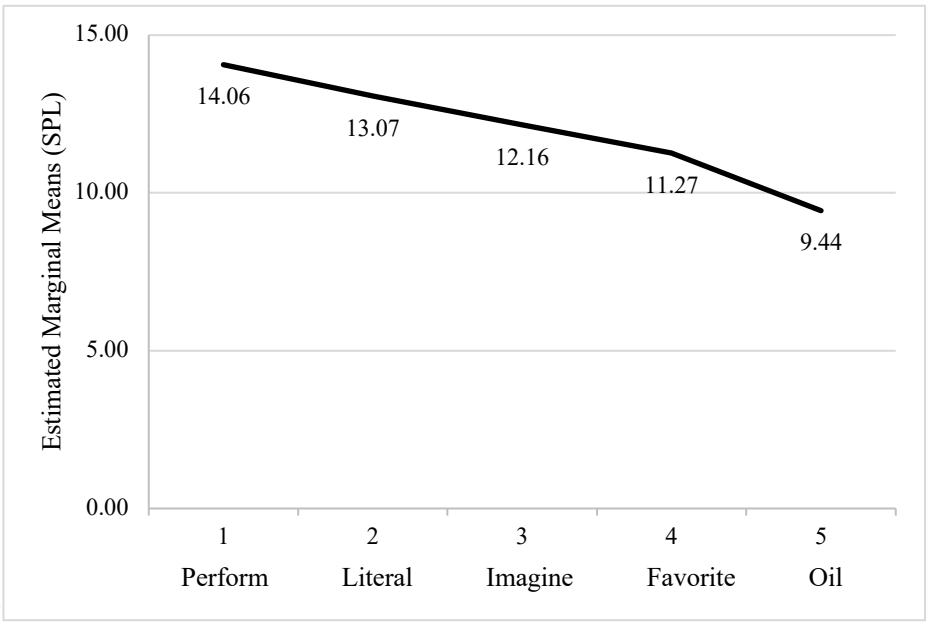
*Note*. For the Favorite and the Oil experimental conditions there were missing data points in the 8.87- to 9.99-kHz region under the oil condition, and one missing data point at 9.99kHz in the favorite condition. The resulting values were Favorite $n = 116$, Oil $n = 103$.

Post hoc pair-wise comparisons with a Bonferroni adjusted alpha level ($p = 0.05/10 = 0.01$) were used to determine where differences occurred between group pairs (Brunkan, 2012; Daugherty et al. 2012). The mean difference between all experimental condition pairings in Choir One were found to be significant at the 0.05 level. There was a difference in terms of LTAS dB between all conditions indicating a change in the sound. Table 7 displays full spectrum (0- to 10-kHz) pairwise comparisons of experimental condition for Choir One.

Figure 8 displays the full spectrum (0- to 10-kHz) LTAS contour data of Choir One singing under experimental conditions. Note that for all LTAS line graphs, the numeric values of

**Figure 7**

*Full Spectrum (*0- to 10-kHz*) Estimated Marginal Means Data of Choir One Singing Under Experimental Condition*




*s*

the y-axis have been intentionally removed per Grady and Gilliam (2020) protocols. Grady and Gilliam recommend interpreting graphs of this type by comparing the sound pressure levels between the conditions to notice changes or similarities in the contour between experimental conditions.

**Table 7**

*Full Spectrum (0- to 10-kHz) Paired Samples for Each Experimental Condition: Choir One*

| | | 0- to 10-kHz Frequency Region, dB | | | | |
|---|---|---|---|---|---|---|
| | | | | | 95% Confidence Interval for Difference[b] | |
| (I) factor1 | (J) factor1 | Mean Difference (I-J) | Std. Error | Sig.[b] | Lower Bound | Upper Bound |
| 1 Perform | 2 Literal | 0.99* | 0.05 | <.001 | 0.85 | 1.14 |
| | 3 Imagine | 1.91* | 0.08 | <.001 | 1.67 | 2.14 |
| | 4 Favorite | 2.80* | 0.05 | <.001 | 2.64 | 2.94 |
| | 5 Oil | 4.63* | 0.07 | <.001 | 4.43 | 4.82 |

**Table 7 (continued).**

| | | 0- to 10-kHz Frequency Region, dB | | | | |
|---|---|---|---|---|---|---|
| | | | | | 95% Confidence Interval for Difference[b] | |
| (I) factor1 | (J) factor1 | Mean Difference (I-J) | Std. Error | Sig.[b] | Lower Bound | Upper Bound |
| 2 Literal | 1 Perform | -0.99* | 0.05 | <.001 | -1.14 | -0.85 |
| | 3 Imagine | 0.91* | 0.05 | <.001 | 0.75 | 1.06 |
| | 4 Favorite | 1.80* | 0.04 | <.001 | 1.68 | 1.91 |
| | 5 Oil | 3.63* | 0.06 | <.001 | 3.47 | 3.80 |
| 3 Imagine | 1 Perform | -1.90* | 0.08 | <.001 | -2.14 | -1.67 |
| | 2 Literal | -0.91* | 0.05 | <.001 | -1.06 | -0.75 |
| | 4 Favorite | 0.89* | 0.04 | <.001 | 0.76 | 1.01 |
| | 5 Oil | 2.72* | 0.07 | <.001 | 2.53 | 2.92 |
| 4 Favorite | 1 Perform | -2.79* | 0.05 | <.001 | -2.95 | -2.64 |
| | 2 Literal | -1.80* | 0.04 | <.001 | -1.91 | -1.69 |
| | 3 Imagine | -0.89* | 0.04 | <.001 | -1.01 | -0.76 |
| | 5 Oil | 1.84* | 0.06 | <.001 | 1.65 | 2.02 |
| 5 Oil | 1 Perform | -4.63* | 0.07 | <.001 | -4.82 | -4.43 |
| | 2 Literal | -3.63* | 0.06 | <.001 | -3.80 | -3.47 |
| | 3 Imagine | -2.72* | 0.07 | <.001 | -2.92 | -2.52 |
| | 4 Favorite | -1.84* | 0.06 | <.001 | -2.02 | -1.65 |

Based on estimated marginal means
*. The mean difference is significant at the 0.05 level.
b. Adjustment for multiple comparisons: Bonferroni.

### Choir Two

A repeated measures ANOVA was performed to examine the effect of experimental conditions (perform, literal, imagine, favorite, and oil) on spectral energy levels (0- to 10-kHz) in Choir Two. Sphericity assumptions were not met (Mauchly's $W = 0.20$, $\chi^2$ 181.98, $p < .001$). The estimated sphericity departure was $\varepsilon = 0.54$. The Greenhouse-Geisser correction was applied, and degrees of freedom were adjusted. There was a significant within-subjects effect of experimental conditions on LTAS for Choir Two, $F(1, 2.17) = 511.50$, $p < .001$ (see Table 8).

**Figure 8**

*Full Spectrum (0- to 10-kHz) LTAS Contour Data of Choir One Singing Under Experimental Conditions*

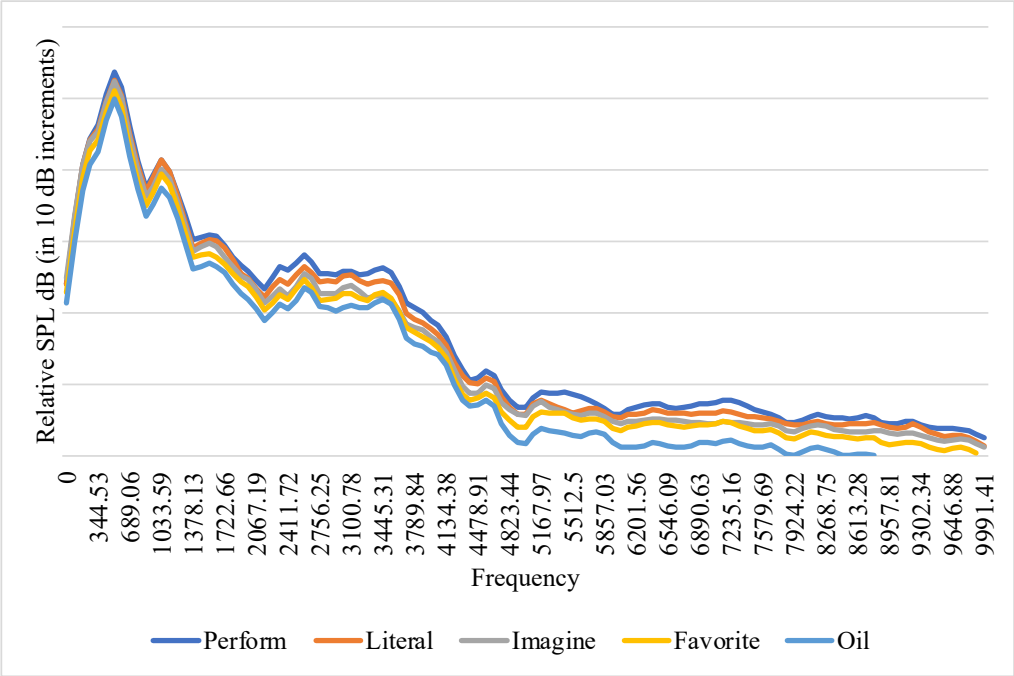



**Table 8**

*Paired Samples Effect Sizes: LTAS (0- to 10-kHz) Choir Two (n = 117)*

| | | | Standardizer[a] | Point Estimate | 95% Confidence Interval | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| Pair 1 | Perform - Literal | Cohen's d | 0.52847 | -2.728 | -3.121 | -2.332 |
| | | Hedges' correction | 0.53192 | -2.71 | -3.1 | -2.316 |
| Pair 2 | Perform - Imagine | Cohen's d | 0.65402 | -2.978 | -3.399 | -2.553 |
| | | Hedges' correction | 0.65829 | -2.958 | -3.377 | -2.536 |
| Pair 3 | Perform - Favorite | Cohen's d | 0.55648 | -3.13 | -3.569 | -2.687 |
| | | Hedges' correction | 0.56011 | -3.109 | -3.546 | -2.67 |
| Pair 4 | Perform - Oil | Cohen's d | 0.76309 | 0.314 | 0.128 | 0.499 |
| | | Hedges' correction | 0.76807 | 0.312 | 0.127 | 0.496 |
| | | Cohen's d | 0.46966 | -1.077 | -1.304 | -0.848 |

**Table 8 (continued).**

| | | | Standardizer[a] | Point Estimate | 95% Confidence Interval | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| Pair 5 | Literal - Imagine | Hedges' correction | 0.47272 | -1.07 | -1.295 | -0.842 |
| | | Cohen's d | 0.41836 | -0.717 | -0.919 | -0.513 |
| Pair 6 | Literal - Favorite | Hedges' correction | 0.42109 | -0.713 | -0.913 | -0.509 |
| | | Cohen's d | 0.98564 | 1.706 | 1.42 | 1.988 |
| Pair 7 | Literal - Oil | Hedges' correction | 0.99207 | 1.694 | 1.41 | 1.975 |
| | | Cohen's d | 0.43328 | 0.475 | 0.283 | 0.665 |
| Pair 8 | Imagine - Favorite | Hedges' correction | 0.43611 | 0.472 | 0.281 | 0.661 |
| | | Cohen's d | 0.92361 | 2.368 | 2.012 | 2.72 |
| Pair 9 | Imagine - Oil | Hedges' correction | 0.92963 | 2.352 | 1.999 | 2.703 |
| | | Cohen's d | 0.87729 | 2.258 | 1.915 | 2.599 |
| Pair 10 | Favorite - Oil | Hedges' correction | 0.88302 | 2.244 | 1.902 | 2.582 |

a. The denominator used in estimating the effect sizes.
Cohen's d uses the sample standard deviation of the mean difference.
Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

There were also significant multivariate test results (Wilks' $\Lambda = 0.08$, $F(4,113) = 324.71$, $p < .001$). Table 9 displays full spectrum (0- to 10-kHz) mean sound pressure levels (SPL) for Choir Two under each experimental condition. Figure 9 displays the estimated marginal means of SPL level for Choir Two.

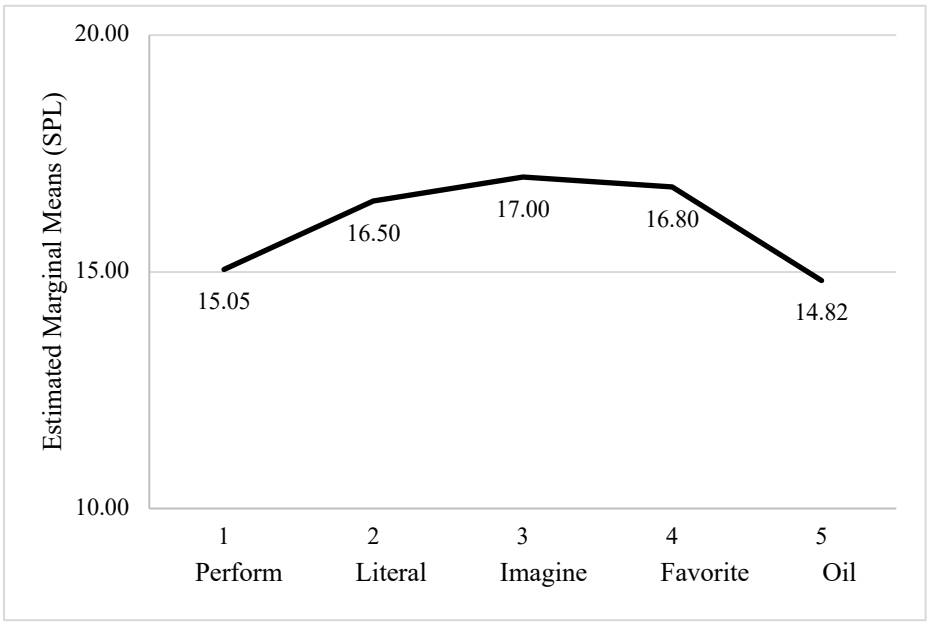
**Table 9**

*Full Spectrum (0- to 10-kHz) Mean Sound Pressure Level (SPL) for Each Experimental Condition: Choir Two (*N *= 117)*

| Experimental Condition | *M* | Range | *SD* |
|---|---|---|---|
| Perform | 15.05 | 2.76–51.28 | 12.69 |
| Literal | 16.47 | 4.51–52.03 | 12.42 |
| Imagine | 17 | 4.69–52.85 | 12.57 |
| Favorite | 16.8 | 4.71–52.41 | 12.54 |
| Oil | 14.82 | 2.45–52.13 | 13.21 |

**Figure 9**

*Full Spectrum (*0- to 10-Khz*) Estimated Marginal Means Data of Choir Two Singing Under Experimental Conditions*




Post hoc pair-wise comparisons with a Bonferroni adjusted alpha level ($p$ = 0.05/10 = 0.01) were used to determine where differences occurred between group pairs (Brunkan, 2012; Daugherty et al. 2012). The mean difference between all experimental condition pairings in Choir Two were found to be significant at the 0.05 level. Table 10 displays full spectrum (0- to 10-kHz) pairwise comparisons of experimental condition for Choir Two. Figure 10 displays the full spectrum (0- to 10-kHz) LTAS contour data of Choir Two singing under experimental conditions.

**Choir Three**

A repeated measures ANOVA was performed to examine the effect of experimental conditions (perform, literal, imagine, favorite, and oil) on spectral energy levels (0- to 10-kHz) in Choir Three. Sphericity assumptions were not met (Mauchly's $W$ = 0.49, $\chi^2$ 81.75, $p$ <.001).

**Table 10**

*Full Spectrum (0- to 10-kHz) Paired Samples for Each Experimental Condition: Choir Two*

| | | 0- to 10-kHz Frequency Region, dB | | | | |
|---|---|---|---|---|---|---|
| | | | | | 95% Confidence Interval for Difference[b] | |
| (I) factor1 | (J) factor1 | Mean Difference (I-J) | Std. Error | Sig.[b] | Lower Bound | Upper Bound |
| 1 Perform | 2 Literal | -1.44* | 0.05 | <.001 | -1.58 | -1.30 |
| | 3 Imagine | -1.95* | 0.06 | <.001 | -2.12 | -1.77 |
| | 4 Favorite | -1.74* | 0.05 | <.001 | -1.89 | -1.59 |
| | 5 Oil | .24* | 0.07 | 0.009 | 0.04 | 0.44 |
| 2 Literal | 1 Perform | 1.44* | 0.05 | <.001 | 1.30 | 1.58 |
| | 3 Imagine | -0.5* | 0.04 | <.001 | -0.63 | -0.38 |
| | 4 Favorite | -0.3* | 0.04 | <.001 | -0.41 | -0.19 |
| | 5 Oil | 1.68* | 0.09 | <.001 | 1.42 | 1.94 |
| 3 Imagine | 1 Perform | 1.95* | 0.06 | <.001 | 1.77 | 2.12 |
| | 2 Literal | 0.51* | 0.04 | <.001 | 0.38 | 0.63 |
| | 4 Favorite | 0.21* | 0.04 | <.001 | 0.09 | 0.32 |
| | 5 Oil | 2.19* | 0.09 | <.001 | 1.94 | 2.43 |
| 4 Favorite | 1 Perform | 1.74* | 0.05 | <.001 | 1.59 | 1.89 |
| | 2 Literal | 0.30* | 0.04 | <.001 | 0.19 | 0.41 |
| | 3 Imagine | -0.21* | 0.04 | <.001 | -0.32 | -0.09 |
| | 5 Oil | 1.98* | 0.08 | <.001 | 1.75 | 2.21 |
| 5 Oil | 1 Perform | -0.24* | 0.07 | 0.01 | -0.44 | -0.04 |
| | 2 Literal | -1.68* | 0.09 | <.001 | -1.94 | -1.42 |
| | 3 Imagine | -2.19* | 0.09 | <.001 | -2.43 | -1.94 |
| | 4 Favorite | -1.98* | 0.08 | <.001 | -2.21 | -1.75 |

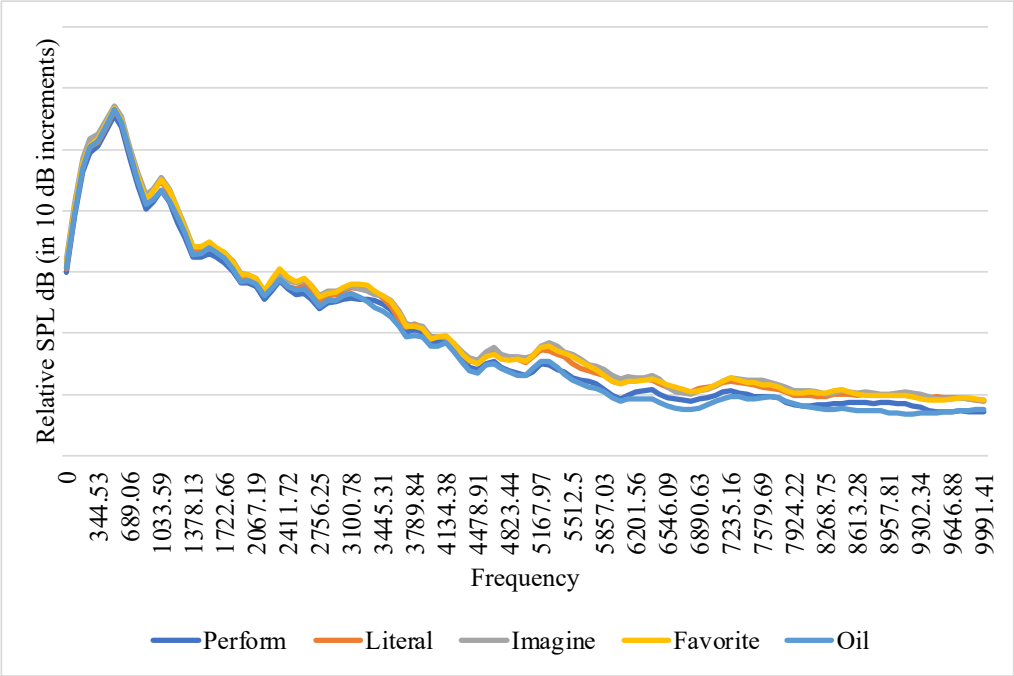
Based on estimated marginal means

*. The mean difference is significant at the 0.05 level.

b. Adjustment for multiple comparisons: Bonferroni.

**Figure 10**

*Full Spectrum (0- to 10-kHz) LTAS Contour Data of Choir Two Singing Under Experimental Conditions*




The estimated sphericity departure was ε = 0.74. The Greenhouse-Geisser correction was applied, and degrees of freedom were adjusted. There was a significant within-subjects effect of experimental conditions on LTAS for Choir Three, $F(1, 2.96) = 207.44$, $p < .001$ (see Table 11).

**Table 11**

*Paired Samples Effect Sizes: LTAS (0- to 10-kHz) Choir Three (n = 117)*

| | | | Standardizer[a] | Point Estimate | 95% Confidence Interval | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| Pair 1 | Perform - Literal | Cohen's d | 0.8664 | 0.611 | 0.412 | 0.807 |
| | | Hedges' correction | 0.87206 | 0.607 | 0.41 | 0.802 |
| Pair 2 | Perform - Imagine | Cohen's d | 0.62731 | 2.83 | 2.422 | 3.235 |
| | | Hedges' correction | 0.6314 | 2.811 | 2.406 | 3.214 |
| | | Cohen's d | 0.6706 | 2.081 | 1.756 | 2.402 |

**Table 11 (continued).**

| | | | Standardizer[a] | Point Estimate | 95% Confidence Interval | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| Pair 3 | Perform - Favorite | Hedges' correction | 0.67497 | 2.067 | 1.745 | 2.386 |
| Pair 4 | Perform - Oil | Cohen's d | 0.97281 | 1.625 | 1.347 | 1.9 |
| | | Hedges' correction | 0.97916 | 1.615 | 1.339 | 1.888 |
| Pair 5 | Literal - Imagine | Cohen's d | 0.74161 | 1.68 | 1.396 | 1.96 |
| | | Hedges' correction | 0.74645 | 1.669 | 1.387 | 1.947 |
| Pair 6 | Literal - Favorite | Cohen's d | 0.7693 | 1.126 | 0.892 | 1.356 |
| | | Hedges' correction | 0.77432 | 1.118 | 0.886 | 1.347 |
| Pair 7 | Literal - Oil | Cohen's d | 1.10833 | 0.949 | 0.729 | 1.166 |
| | | Hedges' correction | 1.11556 | 0.943 | 0.724 | 1.159 |
| Pair 8 | Imagine - Favorite | Cohen's d | 0.54095 | -0.702 | -0.904 | -0.499 |
| | | Hedges' correction | 0.54448 | -0.698 | -0.898 | -0.495 |
| Pair 9 | Imagine - Oil | Cohen's d | 0.77032 | -0.252 | -0.435 | -0.067 |
| | | Hedges' correction | 0.77534 | -0.25 | -0.432 | -0.067 |
| Pair 10 | Favorite - Oil | Cohen's d | 0.83148 | 0.224 | 0.04 | 0.407 |
| | | Hedges' correction | 0.83691 | 0.222 | 0.039 | 0.404 |

a. The denominator used in estimating the effect sizes.
Cohen's d uses the sample standard deviation of the mean difference.
Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

There were also significant multivariate test results (Wilks' $\Lambda = 0.09$, $F(4,113) = 279.35$, $p < .001$). Table 12 displays full spectrum (0- to 10-kHz) mean sound pressure levels (SPL) for Choir Three under each experimental condition. Figure 11 displays the estimated marginal means of SPL level for Choir Three.

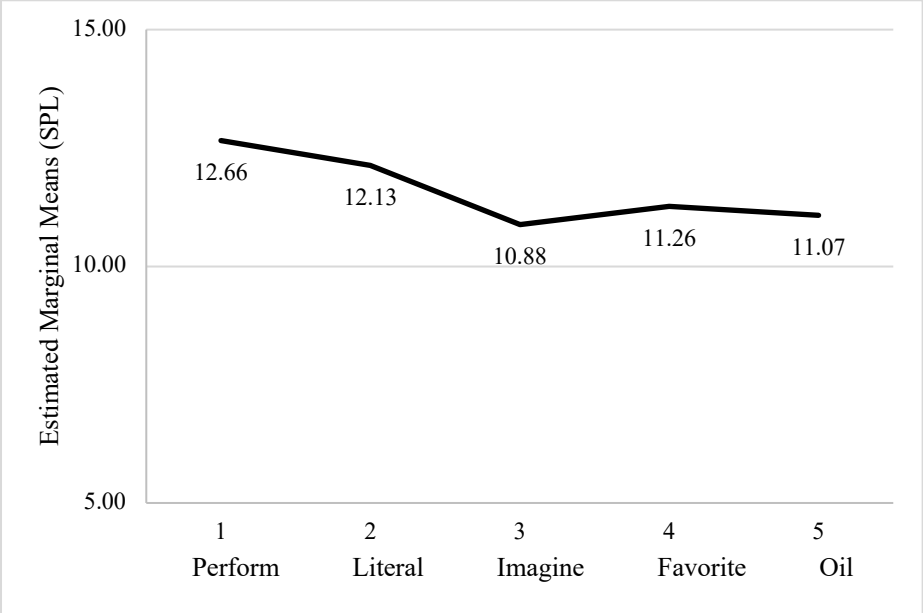
**Table 12**

*Full Spectrum (0- to 10-kHz) Mean Sound Pressure Level (SPL) for Each Experimental Condition: Choir Three (n = 117)*

| Experimental Condition | *M* | Range | *SD* |
|---|---|---|---|
| Perform | 12.66 | 0.87–51.14 | 13.33 |
| Literal | 12.13 | 1.42–50.00 | 12.85 |
| Imagine | 10.88 | -0.28–48.83 | 13.12 |
| Favorite | 11.26 | -0.45–49.11 | 12.96 |
| Oil | 11.07 | -0.31–48.71 | 12.93 |

**Figure 11**

*Full Spectrum (*0- to 10-Khz*) Estimated Marginal Means Data of Choir Three Singing Under Experimental Conditions*




Post hoc pair-wise comparisons with a Bonferroni adjusted alpha level ($p = 0.05/10 = 0.01$) were used to determine where differences occurred between group pairs (Brunkan, 2012; Daugherty et al. 2012). The mean difference between all experimental condition pairings in Choir Three were found to be significant at the 0.05 level except for the following pairs: Imagine ($M = 10.88$, $SD = 13.12$) and Oil ($M = 11.08$, $SD = 12.93$), $p = 0.075$; Favorite ($M = 11.26$, $SD =$

12.96) and Oil ($M$ = 11.08, $SD$ = 12.93), $p$ = 0.17. Table 13 displays full spectrum (0- to 10-kHz) pairwise comparisons of experimental condition for Choir Three. Figure 12 displays the full spectrum (0- to 10-kHz) LTAS contour data of Choir Three singing under experimental conditions.

**Table 13**

*Full Spectrum (0- to 10-kHz) Paired Samples for Each Experimental Condition: Choir Three*

| | | 0- to 10-kHz Frequency Region, dB | | | | |
|---|---|---|---|---|---|---|
| | | | | | 95% Confidence Interval for Difference[b] | |
| (I) factor1 | (J) factor1 | Mean Difference (I-J) | Std. Error | Sig.[b] | Lower Bound | Upper Bound |
| 1 Perform | 2 Literal | 0.53* | 0.08 | <.001 | 0.30 | 0.76 |
| | 3 Imagine | 1.78* | 0.06 | <.001 | 1.61 | 1.94 |
| | 4 Favorite | 1.40* | 0.06 | <.001 | 1.22 | 1.57 |
| | 5 Oil | 1.58* | 0.09 | <.001 | 1.32 | 1.84 |
| 2 Literal | 1 Perform | -0.53* | 0.08 | <.001 | -0.76 | -0.30 |
| | 3 Imagine | 1.25* | 0.07 | <.001 | 1.05 | 1.44 |
| | 4 Favorite | 0.87* | 0.07 | <.001 | 0.66 | 1.07 |
| | 5 Oil | 1.05* | 0.10 | <.001 | 0.76 | 1.35 |
| 3 Imagine | 1 Perform | -1.78* | 0.06 | <.001 | -1.94 | -1.61 |
| | 2 Literal | -1.25* | 0.07 | <.001 | -1.44 | -1.05 |
| | 4 Favorite | -0.38* | 0.05 | <.001 | -0.52 | -0.24 |
| | 5 Oil | -0.19 | 0.07 | 0.075 | -0.40 | 0.01 |
| 4 Favorite | 1 Perform | -1.40* | 0.06 | <.001 | -1.57 | -1.22 |
| | 2 Literal | -0.87* | 0.07 | <.001 | -1.07 | -0.67 |
| | 3 Imagine | 0.38* | 0.05 | <.001 | 0.24 | 0.52 |
| | 5 Oil | 0.19 | 0.08 | 0.17 | -0.03 | 0.41 |
| 5 Oil | 1 Perform | -1.58* | 0.09 | <.001 | -1.84 | -1.32 |
| | 2 Literal | -1.05* | 0.10 | <.001 | -1.35 | -0.76 |
| | 3 Imagine | 0.19 | 0.07 | 0.08 | -0.01 | 0.40 |
| | 4 Favorite | -0.19 | 0.08 | 0.17 | -0.41 | 0.03 |

Based on estimated marginal means

*. The mean difference is significant at the 0.05 level.

b. Adjustment for multiple comparisons: Bonferroni.

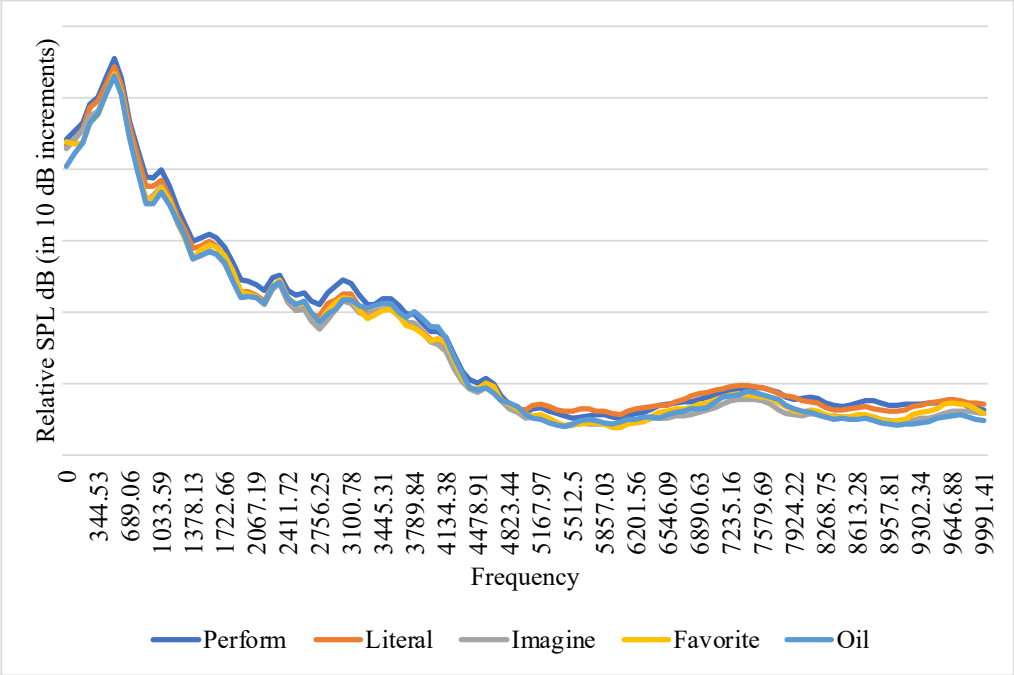
### *LTAS 2.0- to 4.0-kHz*

#### Choir One

A repeated measures ANOVA was performed to examine the effect of experimental conditions (perform, literal, imagine, favorite, and oil) on spectral energy levels (2.0- to 4.0-kHz) of Choir One. Sphericity assumptions were not met (Mauchly's $W = 0.27$, $\chi^2$ 27.12, $p < 0.001$). The estimated sphericity departure was $\varepsilon = 0.60$.

**Figure 12**

*Full Spectrum (0- to 10-kHz) LTAS Contour Data of Choir Three Singing Under Experimental Conditions*




The Greenhouse-Geisser correction was applied, and degrees of freedom were adjusted. There was a significant within-subjects effect of experimental conditions on LTAS for Choir One, $F(1, 2.64) = 725.01$, $p < .001$ (see Table 14).

**Table 14**

*Paired Samples Effect Sizes: LTAS (2- to 4-kHz) Choir One (n = 23)*

| | | | Standardizer[a] | Point Estimate | 95% Confidence Interval | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| Pair 1 | Perform - Literal | Cohen's d | 0.38224 | 3.455 | 2.356 | 4.541 |
| | | Hedges' correction | 0.39591 | 3.335 | 2.274 | 4.384 |
| Pair 2 | Perform - Imagine | Cohen's d | 0.64317 | 4.324 | 2.986 | 5.651 |
| | | Hedges' correction | 0.66619 | 4.174 | 2.883 | 5.455 |
| Pair 3 | Perform - Favorite | Cohen's d | 0.3616 | 9.506 | 6.684 | 12.319 |
| | | Hedges' correction | 0.37454 | 9.178 | 6.453 | 11.893 |
| Pair 4 | Perform - Oil | Cohen's d | 0.35039 | 13.507 | 9.52 | 17.484 |
| | | Hedges' correction | 0.36293 | 13.04 | 9.191 | 16.88 |
| Pair 5 | Literal - Imagine | Cohen's d | 0.48775 | 2.994 | 2.019 | 3.957 |
| | | Hedges' correction | 0.5052 | 2.891 | 1.949 | 3.82 |
| Pair 6 | Literal - Favorite | Cohen's d | 0.36194 | 5.849 | 4.081 | 7.607 |
| | | Hedges' correction | 0.3749 | 5.647 | 3.94 | 7.345 |
| Pair 7 | Literal - Oil | Cohen's d | 0.48565 | 7.026 | 4.921 | 9.122 |
| | | Hedges' correction | 0.50303 | 6.783 | 4.751 | 8.807 |
| Pair 8 | Imagine - Favorite | Cohen's d | 0.44981 | 1.46 | 0.859 | 2.044 |
| | | Hedges' correction | 0.46591 | 1.409 | 0.83 | 1.973 |
| Pair 9 | Imagine - Oil | Cohen's d | 0.63781 | 3.06 | 2.067 | 4.04 |
| | | Hedges' correction | 0.66063 | 2.954 | 1.996 | 3.9 |
| Pair 10 | Favorite - Oil | Cohen's d | 0.35083 | 3.692 | 2.528 | 4.844 |
| | | Hedges' correction | 0.36338 | 3.564 | 2.441 | 4.676 |

a. The denominator used in estimating the effect sizes.

Cohen's d uses the sample standard deviation of the mean difference.

Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

There were also significant multivariate test results (Wilks' $\Lambda = 0.01$, $F(4, 19) = 988.57$, $p < .001$). Table 15 displays 2.0- to 4.0-kHz region mean sound pressure levels (SPL) for Choir

One under each experimental condition. Figure 13 displays the estimated marginal means of SPL level for Choir One.

Post hoc pair-wise comparisons with a Bonferroni adjusted alpha level ($p = 0.05/10 = 0.01$) were used to determine where differences occurred between group pairs (Brunkan, 2012; Daugherty et al. 2012).

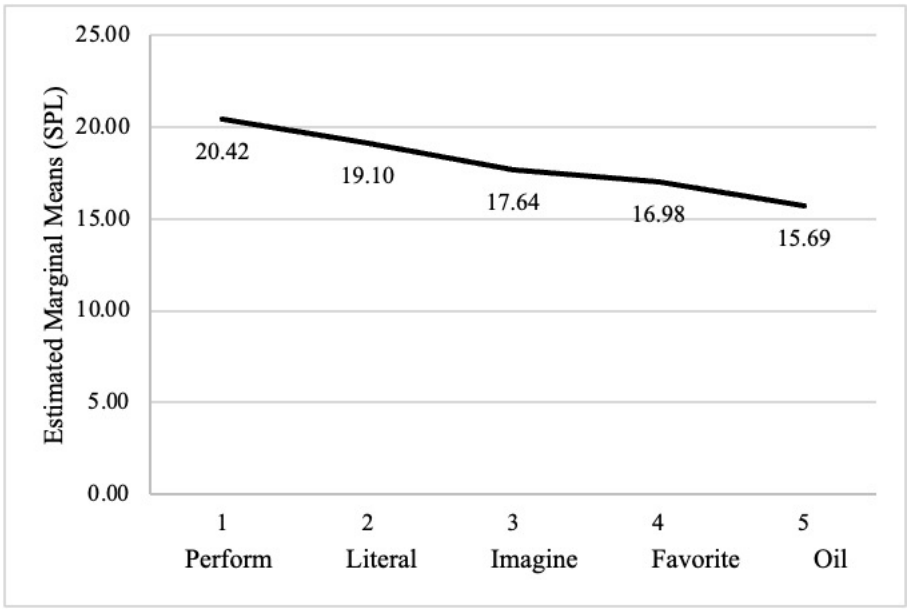
**Table 15**

*2.0- to 4.0-kHz Frequency Region. Mean Sound Pressure Level (SPL) for Each Experimental Condition: Choir One (*N = *23)*

| Experimental Condition | *M* | Range | *SD* |
|---|---|---|---|
| Perform | 20.42 | 14.68–23.74 | 2.35 |
| Literal | 19.1 | 13.46–22.21 | 2.36 |
| Imagine | 17.64 | 12.26–21.18 | 2.31 |
| Favorite | 16.98 | 11.63–20.28 | 2.25 |
| Oil | 15.69 | 10.21–19.17 | 2.37 |

**Figure 13**

*2.0- to 4.0-kHz Region Estimated Marginal Means Data of Choir One Singing Under Experimental Conditions*



The mean difference between all experimental condition pairings in Choir One were found to be significant at the 0.05 level. Table 16 displays 2.0- to 4.0-kHz frequency region pairwise comparisons of experimental condition for Choir One.

Figure 14 displays the 2.0- to 4.0-kHz frequency region LTAS contour of Choir One singing under experimental conditions.

**Figure 14**

*2.0- to 4.0-kHz Region LTAS Contour of Choir One Singing Under Experimental Conditions*

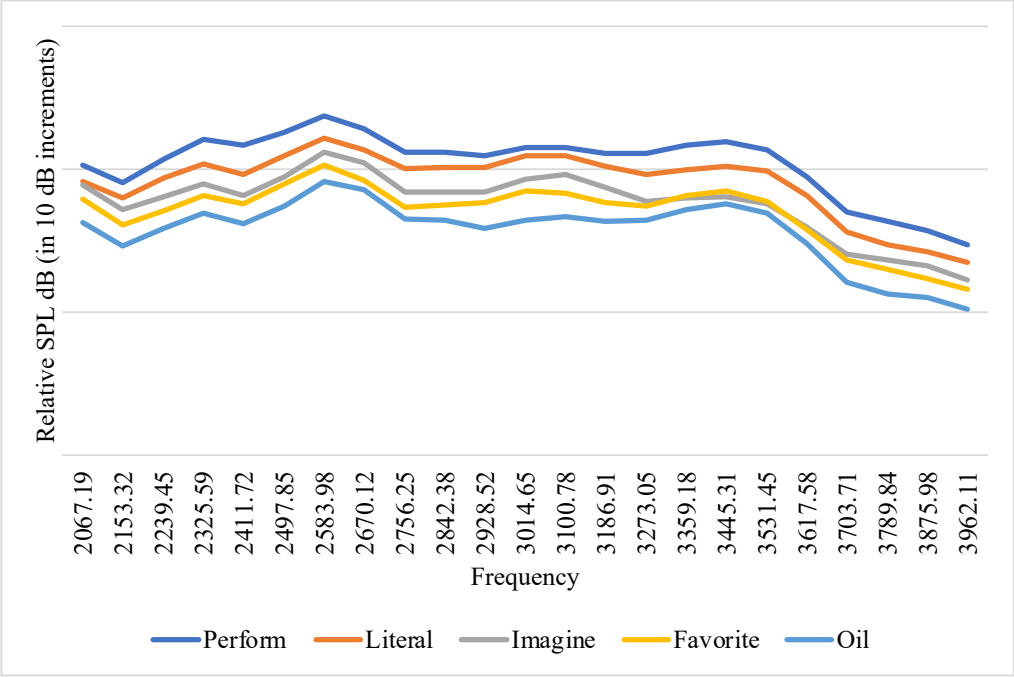


**Table 16**

*2.1- to 3.9-kHz Frequency Region Paired Samples for Each Experimental Condition: Choir One*

| | | 2.0- to 4.0-kHz Frequency Region, dB | | | | |
|---|---|---|---|---|---|---|
| | | | | | 95% Confidence Interval for Difference[b] | |
| (I) factor1 | (J) factor1 | Mean Difference (I-J) | Std. Error | Sig.[b] | Lower Bound | Upper Bound |
| 1 Perform | 2 Literal | 1.32* | 0.08 | <.001 | 1.07 | 1.57 |
| | 3 Imagine | 2.78* | 0.13 | <.001 | 2.36 | 3.20 |
| | 4 Favorite | 3.44* | 0.08 | <.001 | 3.20 | 3.67 |
| | 5 Oil | 4.73* | 0.07 | <.001 | 4.51 | 4.96 |
| 2 Literal | 1 Perform | -1.32* | 0.08 | <.001 | -1.57 | -1.07 |
| | 3 Imagine | 1.46* | 0.10 | <.001 | 1.14 | 1.78 |
| | 4 Favorite | 2.27* | 0.08 | <.001 | 1.88 | 2.35 |
| | 5 Oil | 3.41* | 0.10 | <.001 | 3.10 | 3.73 |
| 3 Imagine | 1 Perform | -2.78* | 0.13 | <.001 | -3.20 | -2.37 |
| | 2 Literal | -1.46* | 0.10 | <.001 | -1.78 | -1.14 |
| | 4 Favorite | 0.66* | 0.09 | <.001 | 0.36 | 0.95 |
| | 5 Oil | 1.96* | 0.13 | <.001 | 1.54 | 2.37 |
| 4 Favorite | 1 Perform | -3.44* | 0.08 | <.001 | -3.67 | -3.20 |
| | 2 Literal | -2.12* | 0.08 | <.001 | -2.36 | -1.88 |
| | 3 Imagine | -0.66* | 0.09 | <.001 | -0.95 | -0.36 |
| | 5 Oil | 1.30* | 0.07 | <.001 | 1.07 | 1.52 |
| 5 Oil | 1 Perform | -4.73* | 0.07 | <.001 | -4.96 | -4.51 |
| | 2 Literal | -3.41* | 0.10 | <.001 | -3.73 | -3.10 |
| | 3 Imagine | -1.95* | 0.13 | <.001 | -2.37 | -1.54 |
| | 4 Favorite | -1.30* | 0.07 | <.001 | -1.52 | -1.07 |

Based on estimated marginal means
*. The mean difference is significant at the 0.05 level.
b. Adjustment for multiple comparisons: Bonferroni.

### Choir Two

A repeated measures ANOVA was performed to examine the effect of experimental conditions (perform, literal, imagine, favorite, and oil) on spectral energy levels (0- to 10-kHz) in Choir Two. Sphericity assumptions were not met (Mauchly's $W = 0.43$, $\chi^2$ 17.33, $p = 0.04$). The

estimated sphericity departure was ε = 0.69. The Greenhouse-Geisser correction was applied, and degrees of freedom were adjusted. There was a significant within-subjects effect of experimental conditions on LTAS for Choir Two, $F(1, 2.71) = 96.86$, $p < .001$ (see Table 17).

There were also significant multivariate test results (Wilks' $\Lambda = 0.08$, $F(4,19) = 111.12$, $p < .001$).

**Table 17**

*Paired Samples Effect Sizes: LTAS (2- to 4-kHz) Choir Two (n = 23)*

| | | | Standardizer[a] | Point Estimate | 95% Confidence Interval | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| Pair 1 | Perform - Literal | Cohen's d | 0.38979 | -2.563 | -3.412 | -1.7 |
| | | Hedges' correction | 0.40374 | -2.475 | -3.294 | -1.641 |
| Pair 2 | Perform - Imagine | Cohen's d | 0.46725 | -3.138 | -4.138 | -2.124 |
| | | Hedges' correction | 0.48397 | -3.029 | -3.995 | -2.051 |
| Pair 3 | Perform - Favorite | Cohen's d | 0.60617 | -2.678 | -3.557 | -1.786 |
| | | Hedges' correction | 0.62786 | -2.586 | -3.434 | -1.724 |
| Pair 4 | Perform - Oil | Cohen's d | 0.70594 | 0.105 | -0.306 | 0.513 |
| | | Hedges' correction | 0.7312 | 0.101 | -0.296 | 0.496 |
| Pair 5 | Literal - Imagine | Cohen's d | 0.49026 | -0.952 | -1.44 | -0.45 |
| | | Hedges' correction | 0.50781 | -0.92 | -1.391 | -0.434 |
| Pair 6 | Literal - Favorite | Cohen's d | 0.53881 | -1.159 | -1.683 | -0.619 |
| | | Hedges' correction | 0.55809 | -1.119 | -1.625 | -0.598 |
| Pair 7 | Literal - Oil | Cohen's d | 0.70882 | 1.514 | 0.902 | 2.11 |
| | | Hedges' correction | 0.73418 | 1.462 | 0.871 | 2.037 |
| Pair 8 | Imagine - Favorite | Cohen's d | 0.44338 | -0.355 | -0.773 | 0.071 |
| | | Hedges' correction | 0.45924 | -0.343 | -0.746 | 0.068 |
| Pair 9 | Imagine - Oil | Cohen's d | 0.56003 | 2.75 | 1.839 | 3.647 |
| | | Hedges' correction | 0.58007 | 2.655 | 1.775 | 3.521 |
| | | Cohen's d | 0.51586 | 3.29 | 2.236 | 4.332 |

**Table 17 (continued).**

| | | | Standardizer[a] | Point Estimate | 95% Confidence Interval | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| | | Cohen's d | 0.38979 | -2.563 | -3.412 | -1.7 |
| Pair 10 | Favorite - Oil | Hedges' correction | 0.53432 | 3.177 | 2.159 | 4.183 |

a. The denominator used in estimating the effect sizes.

Cohen's d uses the sample standard deviation of the mean difference.

Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

Table 18 displays 2.0- to 4.0-kHz region mean sound pressure levels (SPL) for Choir One under each experimental condition. Figure 15 displays the estimated marginal means of SPL level for Choir Two.

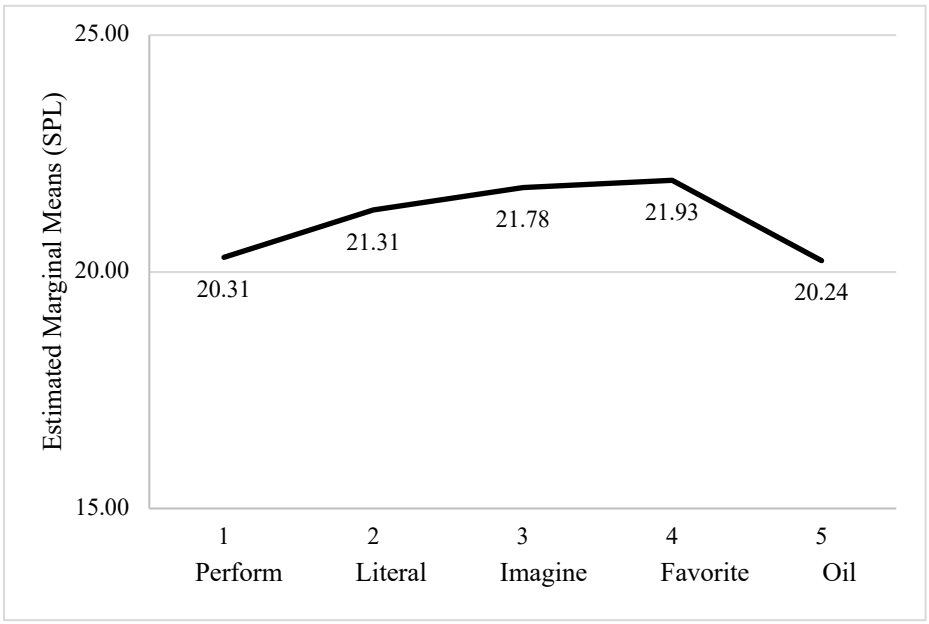
**Table 18**

*2.0- to 4.0-kHz Frequency Region. Mean Sound Pressure Level (SPL) for Each Experimental Condition: Choir Two (*N = *23)*

| Experimental Condition | *M* | Range | *SD* |
|---|---|---|---|
| Perform | 20.31 | 14.21–24.31 | 2.63 |
| Literal | 21.31 | 15.17–24.63 | 2.7 |
| Imagine | 21.78 | 15.18–25.21 | 2.78 |
| Favorite | 21.93 | 14.78–26.18 | 3.1 |
| Oil | 20.24 | 13.5–24.38 | 3.12 |

**Figure 15**

*2.0-* to 4.0-kHz *Region Estimated Marginal Means Data of Choir Two Singing Under Experimental Conditions*




Post hoc pair-wise comparisons with a Bonferroni adjusted alpha level ($p = 0.05/10 = 0.01$) were used to determine where differences occurred between group pairs (Brunkan, 2012; Daugherty et al. 2012). The mean difference between all experimental condition pairings in Choir Two were found to be significant at the 0.05 level except in the follow pairings: Perform ($M = 20.31$, $SD = 2.63$) and Oil ($M = 20.24$, $SD = 3.12$), ($p = 1.00$); Imagine ($M = 21.78$, $SD = 2.78$) and Favorite ($M = 21.93$, $SD = 3.10$), ($p = 1.00$). Table 19 displays 2.0- to 4.0-kHz region pairwise comparisons of experimental condition for Choir Two.

**Table 19**

*2.1- to 3.9-kHz Frequency Region Paired Samples for Each Experimental Condition: Choir Two*

| | | 2.0- to 4.0-kHz Frequency Region, dB | | | | |
|---|---|---|---|---|---|---|
| | | | | | 95% Confidence Interval for Difference[b] | |
| (I) factor1 | (J) factor1 | Mean Difference (I-J) | Std. Error | Sig.[b] | Lower Bound | Upper Bound |
| 1 Perform | 2 Literal | 1.00* | 0.08 | <.001 | -1.25 | -0.75 |
| | 3 Imagine | -1.47* | 0.10 | <.001 | -1.77 | -1.16 |
| | 4 Favorite | -1.62* | 0.13 | <.001 | -2.02 | -1.23 |
| | 5 Oil | 0.07 | 0.14 | 1.00 | -0.39 | 0.53 |
| 2 Literal | 1 Perform | 1.00* | 0.08 | <.001 | 0.75 | 1.25 |
| | 3 Imagine | -0.47* | 0.10 | 0.002 | -0.79 | -0.15 |
| | 4 Favorite | -0.62* | 0.11 | <.001 | -0.98 | -0.27 |
| | 5 Oil | 1.07* | 0.15 | <.001 | 0.61 | 1.53 |
| 3 Imagine | 1 Perform | 1.47* | 0.10 | <.001 | 1.16 | 1.77 |
| | 2 Literal | 0.47* | 0.10 | 0.002 | 0.15 | 0.79 |
| | 4 Favorite | -0.16 | 0.10 | 1.00 | -0.45 | 0.13 |
| | 5 Oil | 1.54* | 0.12 | <.001 | 1.18 | 1.90 |
| 4 Favorite | 1 Perform | 1.62* | 0.13 | <.001 | 1.23 | 2.02 |
| | 2 Literal | 0.62* | 0.11 | <.001 | 0.27 | 0.98 |
| | 3 Imagine | 0.16 | 0.10 | 1.00 | -0.13 | 0.45 |
| | 5 Oil | 1.70* | 0.11 | <.001 | 1.36 | 2.03 |
| 5 Oil | 1 Perform | -0.07 | 0.15 | 1.00 | -0.53 | 0.39 |
| | 2 Literal | -1.07* | 0.15 | <.001 | -1.53 | -0.61 |
| | 3 Imagine | -1.54* | 0.12 | <.001 | -1.90 | -1.18 |
| | 4 Favorite | -1.70* | 0.11 | <.001 | -2.03 | -1.36 |

Based on estimated marginal means
*. The mean difference is significant at the 0.05 level.
b. Adjustment for multiple comparisons: Bonferroni.

## Choir Three

A repeated measures ANOVA was performed to examine the effect of experimental conditions (perform, literal, imagine, favorite, and oil) on spectral energy levels (0- to 10-kHz) in Choir Three. Sphericity assumptions were not met (Mauchly's $W = 0.05$, $\chi^2$ 60.82, $p < .001$). The estimated sphericity departure was $\varepsilon = 0.42$. The Greenhouse-Geisser correction was applied,

and degrees of freedom were adjusted. There was a significant within-subjects effect of experimental conditions on LTAS for Choir Three, $F(1, 1.67) = 52.07$, $p < .001$ (see Table 20).

**Table 20**

*Paired Samples Effect Sizes: LTAS (2- to 4-kHz) Choir Three (n = 23)*

| | | | Standardizer[a] | Point Estimate | 95% Confidence Interval | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| Pair 1 | Perform - Literal | Cohen's d | 0.33378 | 4.507 | 3.118 | 5.885 |
| | | Hedges' correction | 0.34572 | 4.351 | 3.01 | 5.682 |
| Pair 2 | Perform - Imagine | Cohen's d | 0.80308 | 2.484 | 1.641 | 3.312 |
| | | Hedges' correction | 0.83182 | 2.398 | 1.584 | 3.198 |
| Pair 3 | Perform - Favorite | Cohen's d | 0.46668 | 3.625 | 2.48 | 4.758 |
| | | Hedges' correction | 0.48338 | 3.5 | 2.394 | 4.594 |
| Pair 4 | Perform - Oil | Cohen's d | 1.10282 | 1.104 | 0.574 | 1.618 |
| | | Hedges' correction | 1.14228 | 1.066 | 0.555 | 1.562 |
| Pair 5 | Literal - Imagine | Cohen's d | 0.64342 | 0.762 | 0.29 | 1.222 |
| | | Hedges' correction | 0.66644 | 0.736 | 0.28 | 1.179 |
| Pair 6 | Literal - Favorite | Cohen's d | 0.48162 | 0.389 | -0.039 | 0.809 |
| | | Hedges' correction | 0.49885 | 0.376 | -0.038 | 0.781 |
| Pair 7 | Literal - Oil | Cohen's d | 0.94921 | -0.302 | -0.717 | 0.119 |
| | | Hedges' correction | 0.98318 | -0.292 | -0.692 | 0.115 |
| Pair 8 | Imagine - Favorite | Cohen's d | 0.55323 | -0.548 | -0.982 | -0.103 |
| | | Hedges' correction | 0.57303 | -0.529 | -0.948 | -0.1 |
| Pair 9 | Imagine - Oil | Cohen's d | 0.59199 | -1.313 | -1.867 | -0.743 |
| | | Hedges' correction | 0.61317 | -1.268 | -1.803 | -0.718 |
| Pair 10 | Favorite - Oil | Cohen's d | 0.92054 | -0.515 | -0.946 | -0.074 |
| | | Hedges' correction | 0.95348 | -0.497 | -0.913 | -0.072 |

a. The denominator used in estimating the effect sizes.

Cohen's d uses the sample standard deviation of the mean difference.

Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

There were also significant multivariate test results (Wilks' $\Lambda = 0.02$, $F(4,19) = 197.35$, $p < .001$). Table 15 displays 2.0- to 4.0-kHz region mean sound pressure levels (SPL) for Choir One under each experimental condition. Figure 16 displays the estimated marginal means of SPL level for Choir Three.

Post hoc pair-wise comparisons with a Bonferroni adjusted alpha level ($p = 0.05/10 = 0.01$) were used to determine where differences occurred between group pairs. The mean difference between all experimental condition pairings in Choir Three were found to be significant at the 0.05 level except in the follow pairings: Literal ($M = 16.22$, $SD = 1.91$) and Favorite ($M = 16.03$, $SD = 2.04$), ($p = 0.75$); Literal ($M = 16.22$, $SD = 1.91$) and Oil ($M = 16.50$, $SD = 1.43$), ($p = 1.00$); Imagine ($M = 15.72$, $SD = 1.87$) and Favorite ($M = 16.03$, $SD = 2.04$), ($p = 0.15$); Oil ($M = 16.50$, $SD = 1.43$) and Favorite ($M = 16.03$, $SD = 2.04$), ($p = 0.22$). Table 21 displays 2.0- to 4.0-kHz region pairwise comparisons of experimental condition for Choir Three.

**Figure 16**

*2.0- to 4.0-kHz Region LTAS Contour of Choir Two Singing Under Experimental Conditions*

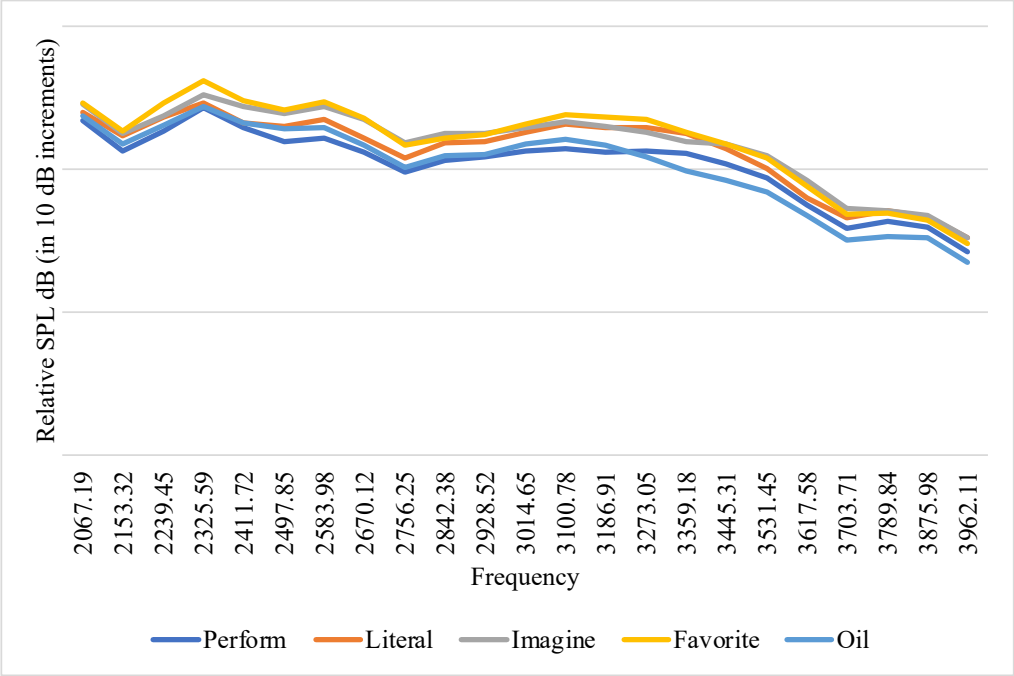


**Table 21**

*2.0- to 4.0-kHz Frequency Region. Mean Sound Pressure Level (SPL) for Each Experimental Condition: Choir Three (*N = *23)*

| Experimental Condition | *M* | Range | *SD* |
|---|---|---|---|
| Perform | 17.72 | 12.94–20.85 | 1.99 |
| Literal | 16.22 | 11.77–10.73 | 1.91 |
| Imagine | 15.72 | 11.56–19.63 | 1.87 |
| Favorite | 16.03 | 11.70–20.19 | 2.04 |
| Oil | 16.50 | 13.70–19.88 | 1.43 |

**Figure 17**

*2.0-* to 4.0-kHz *Region Estimated Marginal Means Data of Choir Three Singing Under Experimental Conditions*

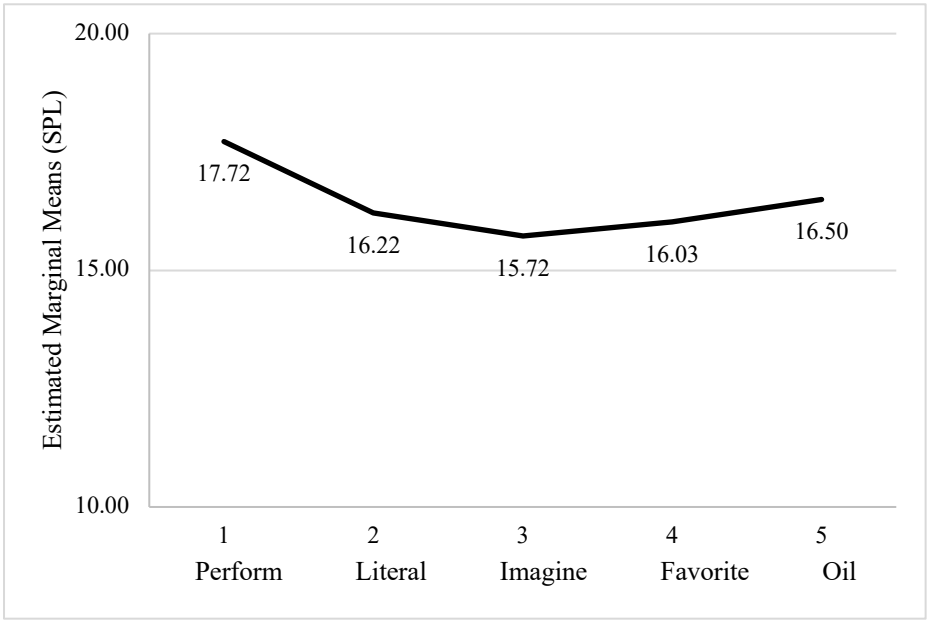



Figure 18 displays the 2.0- to 4.0-kHz Region LTAS contour of Choir Three singing under experimental conditions.

**Table 22**

*2.1- to 3.9-kHz Frequency Region Paired Samples for Each Experimental Condition: Choir Three*

| | | 2.0- to 4.0-kHz Frequency Region, dB | | | | |
|---|---|---|---|---|---|---|
| | | | | | 95% Confidence Interval for Difference[b] | |
| (I) factor1 | (J) factor1 | Mean Difference (I-J) | Std. Error | Sig.[b] | Lower Bound | Upper Bound |
| 1 Perform | 2 Literal | 1.50* | 0.07 | <.001 | 1.29 | 1.72 |
| | 3 Imagine | 2.00* | 0.17 | <.001 | 1.47 | 2.52 |
| | 4 Favorite | 1.69* | 0.10 | <.001 | 1.39 | 2.00 |
| | 5 Oil | 1.22* | 0.23 | <.001 | 0.50 | 1.94 |
| 2 Literal | 1 Perform | -1.50* | 0.07 | <.001 | -1.72 | -1.29 |
| | 3 Imagine | 0.49* | 0.13 | 0.01 | 0.07 | 0.91 |
| | 4 Favorite | 0.19 | 0.10 | 0.75 | -0.13 | 0.50 |
| | 5 Oil | -0.29 | 0.20 | 1.00 | -0.9 | 0.33 |
| 3 Imagine | 1 Perform | -2.00* | 0.17 | <.001 | -2.52 | -1.47 |
| | 2 Literal | -0.49* | 0.13 | 0.01 | -0.91 | -0.07 |
| | 4 Favorite | -0.30 | 0.12 | 0.15 | -0.66 | 0.06 |
| | 5 Oil | -0.78* | 0.12 | <.001 | -1.16 | -0.39 |
| 4 Favorite | 1 Perform | -1.69* | 0.10 | <.001 | -2.00 | -1.39 |
| | 2 Literal | -0.19 | 0.10 | 0.75 | -0.50 | 0.13 |
| | 3 Imagine | 0.30 | 0.12 | 0.15 | -0.06 | 0.66 |
| | 5 Oil | -0.47 | 0.20 | 0.22 | -1.07 | 0.12 |
| 5 Oil | 1 Perform | -1.22* | 0.23 | <.001 | -1.94 | -0.50 |
| | 2 Literal | 0.29 | 0.20 | 1.00 | -0.33 | 0.9 |
| | 3 Imagine | 0.78* | 0.12 | <.001 | 0.39 | 1.16 |
| | 4 Favorite | 0.47 | 0.19 | 0.22 | -0.12 | 1.07 |

Based on estimated marginal means
*. The mean difference is significant at the 0.05 level.
b. Adjustment for multiple comparisons: Bonferroni.

### *Acoustic Difference in Tone Quality*

Large-scale comparisons between each of the choirs *(n* = 3) were not conducted due to the environmental differences in the two research rooms. LTAS measurements for all choral ensembles yielded perceptible changes in choral tone associated with experimental conditions.

There were statistically significant acoustic differences in choral tone for all experimental pairings when examining the full spectrum 0- to 10-kHz range for all choirs, with the exception of Choir Three pairings oil & literal and oil and favorite. In the 2.0- to 4.0-kHz range all pairings had statistically significant acoustic differences except the Choir Two pairing Perform and Oil, and Choir Three pairings Favorite and Literal, Favorite and Imagine, and Favorite and Oil, and Literal and Oil. Many pairings were found to have sound pressure level differences over the just-noticeable difference (JND) of 1 dB (see Table 23).

**Table 23**

*Paired Sample Sound Pressure Level Differences: All Individual Choir Pairings*

| Condition Pairings | 0- to 10-kHz Frequency Region, dB | | | 2.0- to 4.0-kHz Frequency Region, dB | | |
|---|---|---|---|---|---|---|
| | Choir One | Choir Two | Choir Three | Choir One | Choir Two | Choir Three |
| Perform & Literal | 0.99* | -1.44* | 0.53* | 1.32* | 1.00* | 1.50* |
| Perform & Imagine | 1.91* | -1.95* | 1.78* | 2.78* | -1.47* | 2.00* |
| Perform & Favorite | 2.80* | -1.74* | 1.40* | 3.44* | -1.62* | 1.69* |
| Perform & Oil | 4.63* | 0.24* | 1.58* | 4.73* | 0.07 | 1.22* |
| Literal & Imagine | -0.91* | -0.5* | 1.25* | 1.46* | 0.47* | 0.49* |
| Literal & Favorite | 1.80* | -0.3* | 0.87* | 2.27* | -0.62* | 0.19 |
| Literal & Oil | 2.72* | 1.68* | 1.05* | 3.41* | 1.07* | -0.29 |
| Imagine & Favorite | 0.89* | 0.21* | -0.38* | -0.66* | -0.16 | -0.3 |
| Imagine & Oil | 2.72* | 2.19* | -0.19 | 1.96* | 1.54* | -0.78* |
| Favorite & Oil | 1.84* | -1.98* | -0.19 | -1.30* | 1.70* | 0.47 |

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Bonferroni.

The JND is ≥ 1dB

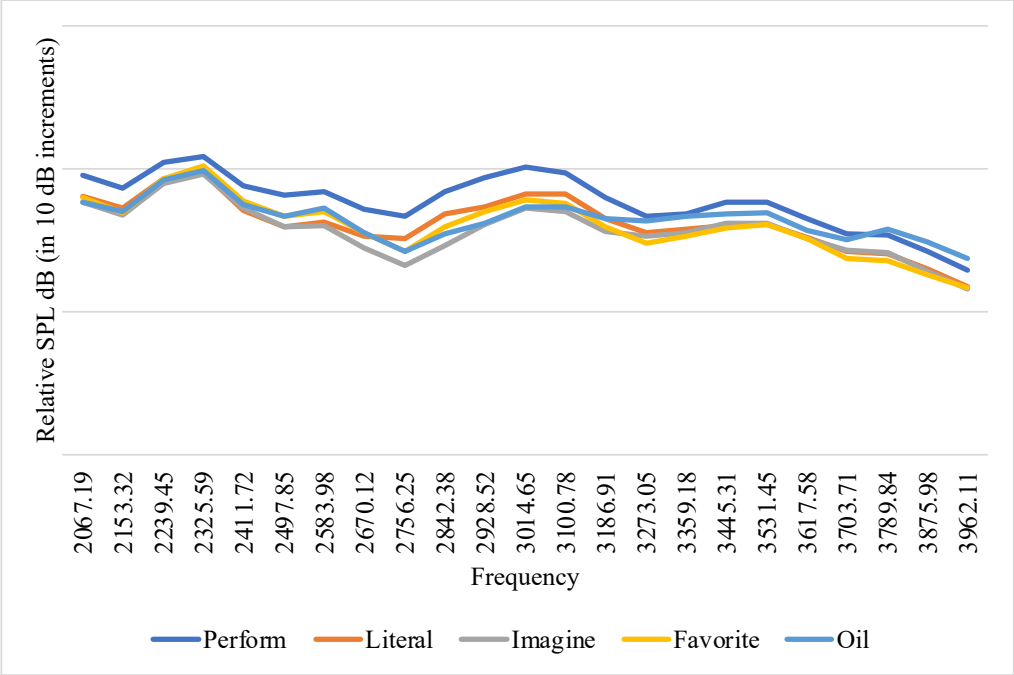
**Research Question Two: Expert Panel Perceptual Analysis**

***Expert Panel Perceptions***

Research question two addressed perceptual differences in tone quality as measured by expert panel ratings. Expert panel participants rated tone quality using a five-point Likert-type scale (1 poor tone quality, 5 good tone quality). Good tone quality was defined as consistent, clear, free, rich, ringing, and resonant. The definition was created by the researcher combining perceptual characteristics used by vocal pedagogues to describe tone quality (McKinney, 1994; Miller, 1996; Olson, 2010).

**Figure 18**

*2.0- to 4.0-kHz Region LTAS Contour of Choir Three Singing Under Experimental Conditions*




**Choir One**

A one-way repeated-measures analysis of variance (ANOVA) was performed to examine the effect of experimental conditions (perform, literal, imagine, favorite, and oil) on expert panel perceptions of choral tone (Likert-type scale, 1–5) of Choir One. Sphericity assumptions were met (Mauchly's $W = 0.91$, $\chi^2$ 5.50, $p = 0.79$). The estimated sphericity was $\varepsilon = 1.00$. There was a

significant within-subjects effect of experimental conditions on expert panel perceptions of choral tone for Choir One, $F(1, 4) = 9.88$, $p < .001$ (see Table 24).

**Table 24**

*Paired Samples Effect Sizes: Expert Panel Choir One (n = 62)*

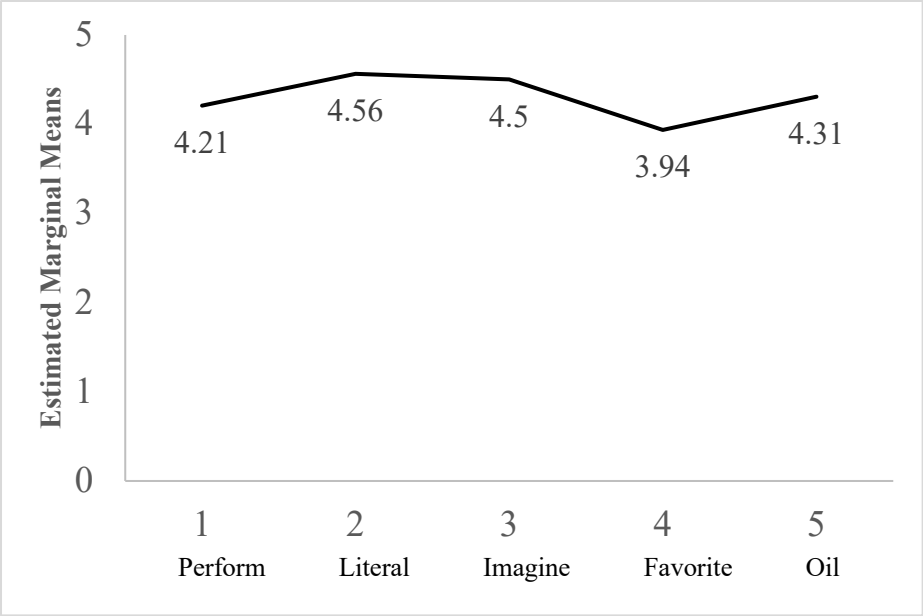
| | | | Standardizer[a] | Point Estimate | 95% Confidence Interval | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| Pair 1 | Perform - Literal | Cohen's d | 0.851 | -0.417 | -0.675 | -0.156 |
| | | Hedges' correction | 0.862 | -0.412 | -0.667 | -0.154 |
| Pair 2 | Perform - Imagine | Cohen's d | 0.857 | -0.339 | -0.594 | -0.082 |
| | | Hedges' correction | 0.867 | -0.335 | -0.586 | -0.081 |
| Pair 3 | Perform - Favorite | Cohen's d | 0.978 | 0.28 | 0.025 | 0.533 |
| | | Hedges' correction | 0.99 | 0.277 | 0.025 | 0.527 |
| Pair 4 | Perform - Oil | Cohen's d | 0.844 | -0.115 | -0.364 | 0.136 |
| | | Hedges' correction | 0.854 | -0.113 | -0.359 | 0.134 |
| Pair 5 | Literal - Imagine | Cohen's d | 0.847 | 0.076 | -0.173 | 0.325 |
| | | Hedges' correction | 0.857 | 0.075 | -0.171 | 0.321 |
| Pair 6 | Literal - Favorite | Cohen's d | 0.979 | 0.643 | 0.367 | 0.914 |
| | | Hedges' correction | 0.991 | 0.635 | 0.362 | 0.903 |
| Pair 7 | Literal - Oil | Cohen's d | 0.808 | 0.319 | 0.063 | 0.573 |
| | | Hedges' correction | 0.819 | 0.315 | 0.062 | 0.566 |
| Pair 8 | Imagine - Favorite | Cohen's d | 0.969 | 0.583 | 0.311 | 0.85 |
| | | Hedges' correction | 0.981 | 0.576 | 0.307 | 0.84 |
| Pair 9 | Imagine - Oil | Cohen's d | 0.786 | 0.246 | -0.007 | 0.498 |
| | | Hedges' correction | 0.796 | 0.243 | -0.007 | 0.492 |
| Pair 10 | Favorite - Oil | Cohen's d | 0.927 | -0.4 | -0.657 | -0.14 |
| | | Hedges' correction | 0.939 | -0.395 | -0.649 | -0.138 |

a. The denominator used in estimating the effect sizes.
Cohen's d uses the sample standard deviation of the mean difference.
Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

There were also significant multivariate test results (Wilks' $\Lambda = 0.65$, $F(4, 61) = 7.93$, $p < .001$). Table 25 displays expert panel perceptions of tone quality across experimental conditions for Choir One. Figure 19 displays the estimated marginal means of expert panel perceptions of choral tone for Choir One.

**Figure 19**

*Estimated Marginal Means: Expert Panel Perceptions of Choir One Choral Tone Singing Under Experimental Conditions*




Post hoc pair-wise comparisons with a Bonferroni adjusted alpha level ($p = 0.05/10 = 0.01$) were used to determine where differences occurred between group pairs. The mean difference between experimental condition groups in Choir One were found to be significant at the 0.05 level in the following pairings: Literal and Favorite ($p < .001$); Imagine and Favorite ($p < .001$); Favorite and Oil ($p = 0.03$). Table 26 displays pairwise comparisons of expert panel perceptions of choral tone by experimental condition for Choir One.

**Table 25**

*Mean Tone Ratings for Each Experimental Condition by Expert Panel: Choir One (N = 66)*

| Experimental Condition | *M* | *SD* | 95% Confidence Interval *LL–UL* |
|---|---|---|---|
| Perform | 4.21 | 0.66 | 4.064–4.37 |
| Literal | 4.56 | 0.56 | 4.42–4.71 |
| Imagine | 4.50 | 0.70 | 4.32–4.68 |
| Favorite | 3.94 | 0.83 | 3.73–4.15 |
| Oil | 4.31 | 0.70 | 4.13–4.48 |

**Table 26**

*Expert Panel Perceptions Pairwise Comparisons: Choir One*

| | | | | | 95% Confidence Interval for Difference[b] | |
|---|---|---|---|---|---|---|
| (I) factor1 | (J) factor1 | Mean Difference (I-J) | Std. Error | Sig.[b] | Lower Bound | Upper Bound |
| 1 Perform | 2 Literal | -0.36* | 0.11 | 0.02 | -0.67 | -0.04 |
| | 3 Imagine | -0.29 | 0.11 | 0.10 | -0.61 | 0.03 |
| | 4 Favorite | 0.27 | 0.12 | 0.31 | -0.09 | 0.64 |
| | 5 Oil | -0.10 | 0.11 | 1.00 | -0.41 | 0.22 |
| 2 Literal | 1 Perform | 0.36* | 0.11 | 0.02 | 0.04 | 0.67 |
| | 3 Imagine | 0.07 | 0.11 | 1.00 | -0.25 | 0.38 |
| | 4 Favorite | 0.63* | 0.12 | <.001 | 0.27 | 0.99 |
| | 5 Oil | 0.26 | 0.10 | 0.15 | -0.04 | 0.56 |
| 3 Imagine | 1 Perform | 0.29 | 0.11 | 0.10 | -0.03 | 0.61 |
| | 2 Literal | -0.07 | 0.11 | 1.00 | -0.38 | 0.25 |
| | 4 Favorite | 0.57* | 0.12 | <.001 | 0.21 | 0.92 |
| | 5 Oil | 0.20 | 0.10 | 0.57 | -0.10 | 0.48 |
| 4 Favorite | 1 Perform | -0.27 | 0.12 | 0.31 | -0.64 | 0.09 |
| | 2 Literal | -0.63* | 0.12 | <.001 | -0.99 | -0.27 |
| | 3 Imagine | -0.57* | 0.12 | <.001 | -0.92 | -0.21 |
| | 5 Oil | -0.37* | 0.12 | 0.03 | -0.71 | -0.03 |

**Table 26 (continued).**

| (I) factor1 | (J) factor1 | Mean Difference (I-J) | Std. Error | Sig.[b] | 95% Confidence Interval for Difference[b] Lower Bound | Upper Bound |
|---|---|---|---|---|---|---|
| 5 Oil | 1 Perform | 0.10 | 0.11 | 1.00 | -0.22 | 0.41 |
| | 2 Literal | -0.26 | 0.13 | 0.15 | -0.56 | 0.04 |
| | 3 Imagine | -0.19 | 0.10 | 0.57 | -0.48 | 0.10 |
| | 4 Favorite | 0.37* | 0.12 | 0.03 | 0.03 | 0.71 |

Based on estimated marginal means
*. The mean difference is significant at the .05 level.
b. Adjustment for multiple comparisons: Bonferroni.

**Choir Two**

A one-way repeated-measures analysis of variance (ANOVA) was performed to examine the effect of experimental conditions (perform, literal, imagine, favorite, and oil) on expert panel perceptions of choral tone (Likert-type scale, 1–5) of Choir Two. Sphericity assumptions were not met (Mauchly's $W = 0.73$, $\chi^2$ 18.76, $p = 0.03$). The estimated sphericity departure was $\varepsilon = 0.86$. The Greenhouse-Geisser correction was applied, and degrees of freedom were adjusted. There was a significant within-subjects effect of experimental conditions on expert panel perceptions of choral tone for Choir Two, $F(1, 3.45) = 4.84$, $p < 0.01$ (see Table 27). There were also significant multivariate test results (Wilks' $\Lambda = 0.70$, $F(4, 58) = 6.10$, $p < 0.01$).

**Table 27**

*Paired Samples Effect Sizes: Expert Panel Choir Two (n = 62)*

| | | | Standardizer[a] | Point Estimate | 95% Confidence Interval Lower | Upper |
|---|---|---|---|---|---|---|
| Pair 1 | Perform - Literal | Cohen's d | 0.682 | 0.236 | -0.017 | 0.488 |
| | | Hedges' correction | 0.691 | 0.234 | -0.017 | 0.482 |

**Table 27 (continued).**

| | | | Standardizer[a] | Point Estimate | 95% Confidence Interval | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| Pair 2 | Perform - Imagine | Hedges' correction | 0.914 | 0.071 | -0.176 | 0.316 |
| Pair 3 | Perform - Favorite | Cohen's d | 0.757 | 0.533 | 0.265 | 0.797 |
| | | Hedges' correction | 0.766 | 0.526 | 0.262 | 0.787 |
| Pair 4 | Perform - Oil | Cohen's d | 0.658 | 0.245 | -0.008 | 0.497 |
| | | Hedges' correction | 0.666 | 0.242 | -0.008 | 0.491 |
| Pair 5 | Literal - Imagine | Cohen's d | 0.783 | -0.124 | -0.373 | 0.127 |
| | | Hedges' correction | 0.793 | -0.122 | -0.368 | 0.125 |
| Pair 6 | Literal - Favorite | Cohen's d | 0.717 | 0.337 | 0.08 | 0.592 |
| | | Hedges' correction | 0.726 | 0.333 | 0.079 | 0.585 |
| Pair 7 | Literal - Oil | Cohen's d | 0.83 | 0 | -0.249 | 0.249 |
| | | Hedges' correction | 0.84 | 0 | -0.246 | 0.246 |
| Pair 8 | Imagine - Favorite | Cohen's d | 0.723 | 0.468 | 0.204 | 0.729 |
| | | Hedges' correction | 0.732 | 0.463 | 0.202 | 0.72 |
| Pair 9 | Imagine - Oil | Cohen's d | 0.9 | 0.108 | -0.143 | 0.357 |
| | | Hedges' correction | 0.911 | 0.106 | -0.141 | 0.352 |
| Pair 10 | Favorite - Oil | Cohen's d | 0.761 | -0.318 | -0.572 | -0.061 |
| | | Hedges' correction | 0.771 | -0.314 | -0.565 | -0.061 |

a. The denominator used in estimating the effect sizes.
Cohen's d uses the sample standard deviation of the mean difference.
Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

Table 28 displays expert panel perceptions of tone quality across experimental conditions for Choir Two. Figure 20 displays the estimated marginal means of expert panel perceptions of choral tone for Choir Two.

Post hoc pair-wise comparisons with a Bonferroni adjusted alpha level ($p = 0.05/10 = 0.01$) were used to determine where differences occurred between group pairs. The mean difference between

all experimental condition pairings in Choir Two were found to be non-significant at the 0.05 level with the exceptions of: Perform and Favorite ($p < 0.00$).

**Table 28**

*Mean Tone Ratings for Each Experimental Condition by Expert Panel: Choir Two (N = 66)*

| Experimental Condition | *M* | *SD* | 95% Confidence Interval *LL–UL* |
|---|---|---|---|
| Perform | 2.11 | 0.77 | 1.92–2.31 |
| Literal | 1.96 | 0.73 | 1.77–2.14 |
| Imagine | 2.05 | 0.66 | 1.75–2.15 |
| Favorite | 1.71 | 0.71 | 1.53–1.90 |
| Oil | 1.95 | 0.78 | 1.75–2.15 |

**Figure 20**

*Estimated Marginal Means: Expert Panel Perceptions of Choir Two Choral Tone Singing Under Experimental Conditions*

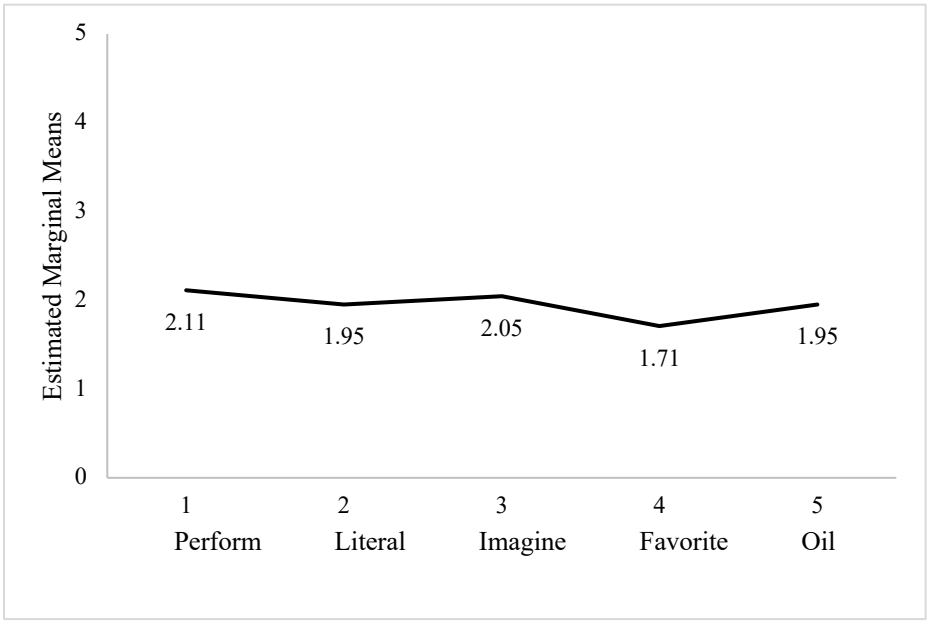



Table 29 displays pairwise comparisons of expert panel perceptions of choral tone by experimental condition for Choir Two.

**Table 29**

*Expert Panel Perceptions Pairwise Comparisons: Choir Two*

| | | | | | 95% Confidence Interval for Difference[b] | |
|---|---|---|---|---|---|---|
| (I) factor1 | (J) factor1 | Mean Difference (I-J) | Std. Error | Sig.[b] | Lower Bound | Upper Bound |
| 1 Perform | 2 Literal | 0.16 | 0.09 | 0.07 | -0.01 | 0.34 |
| | 3 Imagine | 0.07 | 0.16 | 0.58 | -0.17 | 0.30 |
| | 4 Favorite | 0.40* | 0.10 | <.001 | 0.21 | 0.60 |
| | 5 Oil | 0.16 | 0.08 | 0.06 | -0.01 | 0.33 |
| 2 Literal | 1 Perform | -0.16 | 0.09 | 0.07 | -0.34 | 0.01 |
| | 3 Imagine | -0.10 | 0.10 | 0.33 | -0.20 | 0.10 |
| | 4 Favorite | 0.24 | 0.09 | 0.24 | 0.06 | 0.42 |
| | 5 Oil | 0.00 | 0.11 | 1.00 | -0.21 | 0.21 |
| 3 Imagine | 1 Perform | -0.07 | 0.16 | 0.58 | -0.30 | 0.17 |
| | 2 Literal | 0.10 | 0.10 | 0.33 | -0.10 | 0.20 |
| | 4 Favorite | 0.34* | 0.09 | <.001 | 0.16 | 0.52 |
| | 5 Oil | 0.10 | 0.11 | 0.40 | -0.13 | 0.33 |
| 4 Favorite | 1 Perform | -0.40* | 0.10 | <.001 | -0.60 | -0.21 |
| | 2 Literal | -0.24 | 0.09 | 0.24 | -0.42 | -0.06 |
| | 3 Imagine | -0.34* | 0.10 | <.001 | -0.52 | -0.16 |
| | 5 Oil | -0.24 | 0.10 | 0.02 | -0.43 | -0.05 |
| 5 Oil | 1 Perform | -0.16 | 0.08 | 0.06 | -0.33 | 0.01 |
| | 2 Literal | 0.00 | 0.11 | 1.00 | -0.21 | 0.21 |
| | 3 Imagine | -0.10 | 0.11 | 0.40 | -0.33 | 0.13 |
| | 4 Favorite | 0.24 | 0.10 | 0.02 | 0.05 | 0.43 |

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Bonferroni.

**Choir Three**

A one-way repeated-measures analysis of variance (ANOVA) was performed to examine the effect of experimental conditions (perform, literal, imagine, favorite, and oil) on expert panel perceptions of choral tone (Likert-type scale, 1–5) of Choir Three. Sphericity assumptions were

not met (Mauchly's $W = 0.66$, $\chi^2$ 24.73, $p = .003$*).* The estimated sphericity departure was $\varepsilon = 0.89$. The Greenhouse-Geisser correction was applied, and degrees of freedom were adjusted. There was a significant within-subjects effect of experimental conditions on expert panel perceptions of choral tone for Choir Three, $F(1, 3.35) = 52.25$, $p < .001$. (see Table 30). There were also significant multivariate test results (Wilks' $\Lambda = 0.38$, $F(4, 58) = 23.21$, $p < .001$).

Table 31 displays expert panel perceptions of tone quality across experimental conditions for Choir Three. Figure 21 displays the estimated marginal means of expert panel perceptions of choral tone for Choir Three.

**Table 30**

*Paired Samples Effect Sizes: Expert Panel Choir Three (n* = 62

| | | | Standardizer[a] | Point Estimate | 95% Confidence Interval | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| Pair 1 | Perform - Literal | Cohen's d | 0.682 | 0.236 | -0.017 | 0.488 |
| | | Hedges' correction | 0.691 | 0.234 | -0.017 | 0.482 |
| Pair 2 | Perform - Imagine | Cohen's d | 0.903 | 0.071 | -0.178 | 0.32 |
| | | Hedges' correction | 0.914 | 0.071 | -0.176 | 0.316 |
| Pair 3 | Perform - Favorite | Cohen's d | 0.757 | 0.533 | 0.265 | 0.797 |
| | | Hedges' correction | 0.766 | 0.526 | 0.262 | 0.787 |
| Pair 4 | Perform - Oil | Cohen's d | 0.658 | 0.245 | -0.008 | 0.497 |
| | | Hedges' correction | 0.666 | 0.242 | -0.008 | 0.491 |
| Pair 5 | Literal - Imagine | Cohen's d | 0.783 | -0.124 | -0.373 | 0.127 |
| | | Hedges' correction | 0.793 | -0.122 | -0.368 | 0.125 |
| Pair 6 | Literal - Favorite | Cohen's d | 0.717 | 0.337 | 0.08 | 0.592 |
| | | Hedges' correction | 0.726 | 0.333 | 0.079 | 0.585 |
| Pair 7 | Literal - Oil | Cohen's d | 0.83 | 0 | -0.249 | 0.249 |
| | | Hedges' correction | 0.84 | 0 | -0.246 | 0.246 |
| Pair 8 | Imagine - Favorite | Cohen's d | 0.723 | 0.468 | 0.204 | 0.729 |
| | | Hedges' correction | 0.732 | 0.463 | 0.202 | 0.72 |
| | | Cohen's d | 0.9 | 0.108 | -0.143 | 0.357 |

**Table 30 (continued).**

| | | | Standardizer[a] | Point Estimate | 95% Confidence Interval | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| Pair 9 | Imagine - Oil | Hedges' correction | 0.911 | 0.106 | -0.141 | 0.352 |
| | | Cohen's d | 0.761 | -0.318 | -0.572 | -0.061 |
| Pair 10 | Favorite - Oil | Hedges' correction | 0.771 | -0.314 | -0.565 | -0.061 |

a. The denominator used in estimating the effect sizes.
Cohen's d uses the sample standard deviation of the mean difference.
Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

**Table 31**

*Mean Tone Ratings for Each Experimental Condition by Expert Panel: Choir Three (*N = *66)*

| Experimental Condition | *M* | *SD* | 95% Confidence Interval *LL–UL* |
|---|---|---|---|
| Perform | 3.24 | 0.80 | 3.04–3.45 |
| Literal | 2.11 | 0.81 | 1.91–2.32 |
| Imagine | 2.60 | 0.66 | 2.43–2.77 |
| Favorite | 3.02 | 0.82 | 2.81–3.22 |
| Oil | 3.10 | 0.78 | 2.90–3.30 |

Post hoc pair-wise comparisons with a Bonferroni adjusted alpha level ($p = 0.05/10 = 0.01$) were used to determine where differences occurred between group pairs. The mean difference between all experimental condition pairings in Choir Three were found to be significant at the 0.05 level with the exceptions of: Perform and Favorite ($p = 0.10$); Perform and Oil ($p = 0.28$); Favorite and Oil ($p = 1.00$). Table 32 displays pairwise comparisons of expert panel perceptions of choral tone by experimental condition for Choir Three.

**Table 32**

*Expert Panel Perceptions Pairwise Comparisons: Choir Three*

| (I) factor1 | (J) factor1 | Mean Difference (I-J) | Std. Error | Sig.[b] | 95% Confidence Interval for Difference[b] Lower Bound | Upper Bound |
|---|---|---|---|---|---|---|
| 1 Perform | 2 Literal | 1.13* | 0.13 | <.001 | 0.77 | 1.49 |
| | 3 Imagine | 0.65* | 0.10 | <.001 | 0.35 | 0.94 |
| | 4 Favorite | 0.23 | 0.09 | 0.18 | -0.05 | 0.50 |
| | 5 Oil | 0.15 | 0.11 | 1.00 | -0.16 | 0.45 |
| 2 Literal | 1 Perform | -1.13* | 0.13 | <.001 | -1.49 | -0.77 |
| | 3 Imagine | -0.48* | 0.09 | <.001 | -0.73 | -0.24 |
| | 4 Favorite | -0.90* | 0.11 | <.001 | -1.22 | -0.59 |
| | 5 Oil | -0.98* | 0.13 | <.001 | -1.35 | -0.62 |
| 3 Imagine | 1 Perform | -0.65* | 0.10 | <.001 | -0.94 | -0.35 |
| | 2 Literal | 0.48* | 0.09 | <.001 | 0.24 | 0.73 |
| | 4 Favorite | -0.42* | 0.10 | <.001 | -0.70 | -0.14 |
| | 5 Oil | -0.50* | 0.11 | <.001 | -0.83 | -0.17 |
| 4 Favorite | 1 Perform | -0.23 | 0.09 | 0.184 | -0.50 | 0.05 |
| | 2 Literal | 0.90* | 0.11 | <.001 | 0.59 | 1.22 |
| | 3 Imagine | 0.42* | 0.10 | <.001 | 0.14 | 0.70 |
| | 5 Oil | -0.08 | 0.12 | 1.00 | -0.43 | 0.27 |
| 5 Oil | 1 Perform | -0.15 | 0.11 | 1.00 | -0.45 | 0.16 |
| | 2 Literal | 0.98* | 0.13 | <.001 | 0.62 | 1.35 |
| | 3 Imagine | 0.50* | 0.11 | <.001 | 0.17 | 0.83 |
| | 4 Favorite | 0.08 | 0.12 | 1.00 | -0.27 | 0.43 |

Based on estimated marginal means
*. The mean difference is significant at the .05 level.
b. Adjustment for multiple comparisons: Bonferroni.

### *Expert Panel perceptual differences in tone quality*

Expert panel perceptions of choral tone were significantly different. Expert-panel perceptual ratings were not found to be statistically significant across all three choirs. There were two cases of statistical significance shared between two choirs, Imagine and Favorite, and Literal and Favorite (see Table 33). In the six other cases, the mean difference between experimental

conditions was statistically significant within the context of one choir, not shared across two choirs. There was a significant within-subject effect and significant multivariate test results for all choirs.

**Figure 21**

*Estimated Marginal Means: Expert Panel Perceptions of Choir Three Choral Tone Singing Under Experimental Conditions*

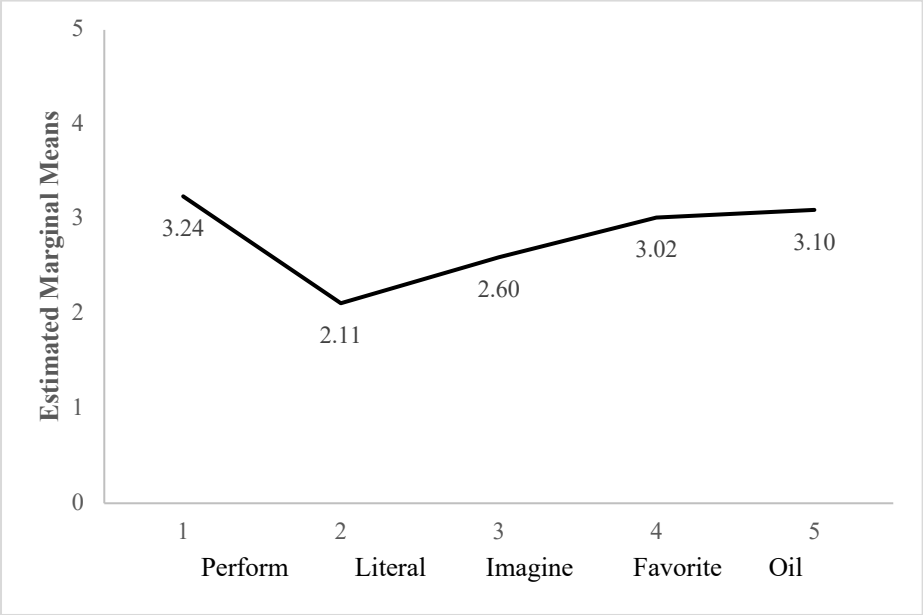



**Table 33**

*Expert Panel Perceptions: Mean Choral Tone Rating Differences*

| Condition Pairings | Choir One | Choir Two | Choir Three |
|---|---|---|---|
| Perform & Literal | -0.36* | 0.16 | 1.13* |
| Perform & Imagine | -0.29 | 0.07 | 0.65* |
| Perform & Favorite | 0.27 | 0.40* | 0.23 |
| Perform & Oil | -0.10 | 0.16 | 0.15 |
| Literal & Imagine | 0.07 | -0.10 | -0.48* |
| Literal & Favorite | 0.63* | 0.24 | -0.90* |
| Literal & Oil | 0.26 | 0.00 | -0.98* |
| Imagine & Favorite | -0.57* | -0.34* | 0.42* |
| Imagine & Oil | -0.37* | -0.24 | -0.08 |
| Favorite & Oil | 0.37* | 0.24 | 0.08 |

*Note.* Based on estimated marginal means. *. The mean difference is significant at the .05 level. b. Adjustment for multiple comparisons: Bonferroni.

**Research Question Three: Singer Self-Perceptions Analysis**

Research question three pertained to singer self-ratings of overall choral tone and individual tone. Singer participants rated tone quality using a five-point Likert-type scale (1 poor tone quality, 5 good tone quality). Good tone quality was defined as consistent, clear, free, rich, ringing, and resonant. The definition was a researcher-created definition combining perceptual characteristics used by vocal pedagogues to describe tone quality (McKinney, 1994; Miller, 1996; Olson, 2010).

***Choir One***

**Self-Perceptions of Choral Tone**

A one-way repeated-measures analysis of variance (ANOVA) was performed to examine the effect of experimental conditions (perform, literal, imagine, favorite, and oil) on singer self-perceptions of overall choral tone (Likert-type scale, 1–5) of Choir One. Sphericity assumptions were not met (Mauchly's $W = 0.53$, $\chi^2$ 20.52, $p = 0.02$*).* The estimated sphericity departure was $\varepsilon = 0.77$. The Greenhouse-Geisser correction was applied, and degrees of freedom were adjusted. There was a significant within-subjects effect of experimental conditions on singer self-perceptions of choral tone for Choir One, $F(1, 3.10) = 7.02$, $p < .001$ (see Table 34).

There were also significant multivariate test results (Wilks' $\Lambda = 0.40$, $F(4, 31) = 11.51$, $p < .001$).

**Table 34**

*Paired Samples Effect Sizes: Choral Tone Choir One (n = 35)*

| | | | Standardizer[a] | Point Estimate | 95% Confidence Interval | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| Pair 1 | Perform - Literal | Cohen's d | 0.604 | -0.662 | -1.025 | -0.292 |
| | | Hedges' correction | 0.618 | -0.648 | -1.002 | -0.285 |
| Pair 2 | Perform - Imagine | Cohen's d | 0.78 | -0.33 | -0.668 | 0.013 |
| | | Hedges' correction | 0.798 | -0.322 | -0.653 | 0.013 |
| Pair 3 | Perform - Favorite | Cohen's d | 0.651 | -0.922 | -1.314 | -0.52 |
| | | Hedges' correction | 0.666 | -0.901 | -1.285 | -0.509 |
| Pair 4 | Perform - Oil | Cohen's d | 0.658 | -0.781 | -1.156 | -0.397 |
| | | Hedges' correction | 0.673 | -0.764 | -1.13 | -0.388 |
| Pair 5 | Literal - Imagine | Cohen's d | 0.733 | 0.195 | -0.141 | 0.528 |
| | | Hedges' correction | 0.75 | 0.19 | -0.138 | 0.516 |
| Pair 6 | Literal - Favorite | Cohen's d | 0.833 | -0.24 | -0.574 | 0.098 |
| | | Hedges' correction | 0.852 | -0.235 | -0.562 | 0.096 |
| Pair 7 | Literal - Oil | Cohen's d | 0.867 | -0.132 | -0.464 | 0.202 |
| | | Hedges' correction | 0.886 | -0.129 | -0.453 | 0.197 |
| Pair 8 | Imagine - Favorite | Cohen's d | 0.725 | -0.473 | -0.819 | -0.12 |
| | | Hedges' correction | 0.742 | -0.462 | -0.801 | -0.117 |
| Pair 9 | Imagine - Oil | Cohen's d | 0.919 | -0.28 | -0.616 | 0.06 |
| | | Hedges' correction | 0.939 | -0.274 | -0.602 | 0.059 |
| Pair 10 | Favorite - Oil | Cohen's d | 0.612 | 0.14 | -0.194 | 0.472 |
| | | Hedges' correction | 0.626 | 0.137 | -0.19 | 0.461 |

a. The denominator used in estimating the effect sizes.
Cohen's d uses the sample standard deviation of the mean difference.
Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

Table 35 displays singer self-perceptions of tone quality across experimental conditions for Choir One. Figure 22 displays the estimated marginal means of singer self-perceptions of overall choral tone for Choir One.

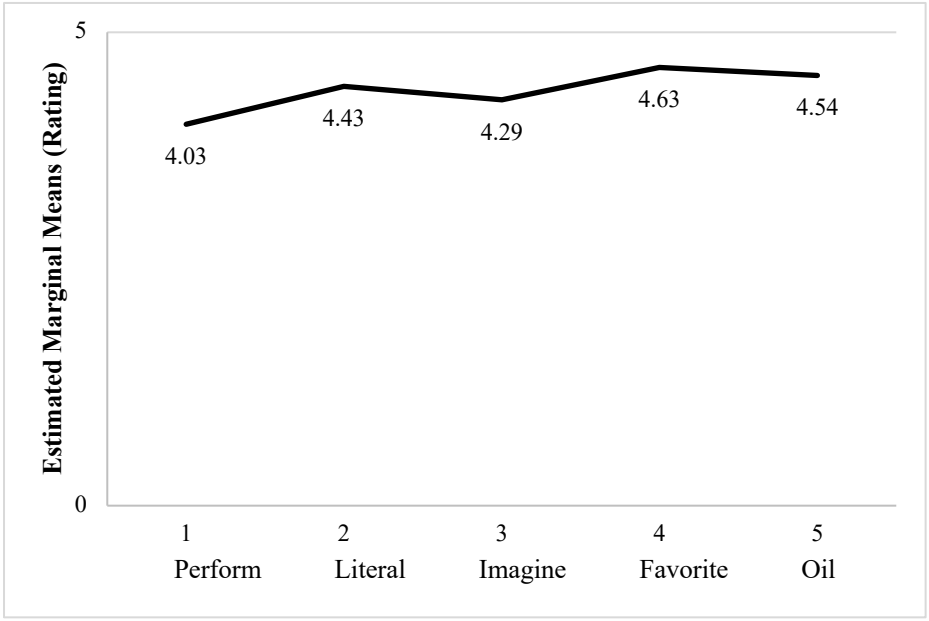
**Table 35**

*Mean Self-Ratings of Choral Tone for Each Experimental Condition: Choir One (*N = *35)*

| Experimental Condition | *M* | *SD* | 95% Confidence Interval *LL–UL* |
|---|---|---|---|
| Perform | 4.03 | 0.45 | 3.87–4.18 |
| Literal | 4.43 | 0.56 | 4.24–4.62 |
| Imagine | 4.29 | 0.75 | 4.03–4.54 |
| Favorite | 4.63 | 0.55 | 4.44–4.82 |
| Oil | 4.54 | 0.56 | 4.35–4.74 |

**Figure 22**

*Choir One Singer Self-Perceptions of Overall Choral Tone Singing Under Experimental Conditions*




Post hoc pair-wise comparisons with a Bonferroni adjusted alpha level ($p$ = 0.05/10 = 0.01) were used to determine where differences occurred between group pairs. The mean difference between experimental condition pairings in Choir One were found to be significant at the 0.05 level in the following pairings: Literal and Favorite ($p$ <.001); Imagine and Favorite ($p$

<.001); Favorite and Oil ($p$ = 003). Table 36 displays pairwise comparisons of singer self-perceptions of choral tone by experimental condition for Choir One.

**Table 36**

*Pairwise Comparisons of Singer Self-Perceptions of Choral Tone: Choir One*

| | | | | | 95% Confidence Interval for Difference[b] | |
|---|---|---|---|---|---|---|
| (I) factor1 | (J) factor1 | Mean Difference (I-J) | Std. Error | Sig.[b] | Lower Bound | Upper Bound |
| 1 Perform | 2 Literal | -0.40* | 0.10 | 0.00 | -0.71 | -0.09 |
| | 3 Imagine | -0.26 | 0.13 | 0.59 | -0.65 | 0.14 |
| | 4 Favorite | -0.60* | 0.11 | <.001 | -0.93 | -0.27 |
| | 5 Oil | -0.51* | 0.11 | <.001 | -0.85 | -0.18 |
| 2 Literal | 1 Perform | 0.40* | 0.10 | 0.00 | 0.09 | 0.71 |
| | 3 Imagine | 0.14 | 0.12 | 1.00 | -0.23 | 0.52 |
| | 4 Favorite | -0.20 | 0.14 | 1.00 | -0.62 | 0.22 |
| | 5 Oil | -0.11 | 0.15 | 1.00 | -0.56 | 0.33 |
| 3 Imagine | 1 Perform | 0.26 | 0.13 | 0.59 | -0.14 | 0.65 |
| | 2 Literal | -0.14 | 0.12 | 1.00 | -0.52 | 0.23 |
| | 4 Favorite | -0.34 | 0.12 | 0.08 | -0.71 | 0.03 |
| | 5 Oil | -0.26 | 0.16 | 1.00 | -0.72 | 0.21 |
| 4 Favorite | 1 Perform | 0.60* | 0.11 | <.001 | 0.27 | 0.93 |
| | 2 Literal | 0.20 | 0.14 | 1.00 | -0.22 | 0.62 |
| | 3 Imagine | 0.34 | 0.12 | 0.08 | -0.03 | 0.71 |
| | 5 Oil | 0.09 | 0.10 | 1.00 | -0.23 | 0.40 |
| 5 Oil | 1 Perform | 0.51* | 0.11 | <.001 | 0.18 | 0.85 |
| | 2 Literal | 0.11 | 0.15 | 1.00 | -0.33 | 0.55 |
| | 3 Imagine | 0.26 | 0.16 | 1.00 | -0.21 | 0.72 |
| | 4 Favorite | -0.09 | 0.10 | 1.00 | -0.40 | 0.23 |

Based on estimated marginal means
*. The mean difference is significant at the 0.05 level.
b. Adjustment for multiple comparisons: Bonferroni.

### Self-Perceptions of Individual Tone

A one-way repeated-measures analysis of variance (ANOVA) was performed to examine the effect of experimental conditions (perform, literal, imagine, favorite, and oil) on singer self-

perceptions of overall individual tone (Likert-type scale, 1–5) of Choir One. Sphericity assumptions were met (Mauchly's $W = 0.60$, $\chi^2$ 16.54, $p = 0.06$*).* There was a significant within-subjects effect of experimental conditions on singer self-perceptions of individual tone quality, $F(1, 4) = 4.15$, $p < 0.001$ (see Table 37). There were also significant multivariate test results (Wilks' $\Lambda = 0.50$, $F(4, 31) = 8.00$, $p < .001$).

**Table 37**

*Paired Samples Effect Sizes: Individual Tone Choir One (n* = 35)

| | | | Standardizer[a] | Point Estimate | 95% Confidence Interval | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| Pair 1 | Perform - Literal | Cohen's d | 0.758 | -0.415 | -0.757 | -0.066 |
| | | Hedges' correction | 0.775 | -0.405 | -0.74 | -0.065 |
| Pair 2 | Perform - Imagine | Cohen's d | 0.91 | -0.251 | -0.586 | 0.087 |
| | | Hedges' correction | 0.931 | -0.246 | -0.573 | 0.085 |
| Pair 3 | Perform - Favorite | Cohen's d | 0.698 | -0.819 | -1.198 | -0.43 |
| | | Hedges' correction | 0.714 | -0.8 | -1.171 | -0.421 |
| Pair 4 | Perform - Oil | Cohen's d | 0.701 | -0.653 | -1.014 | -0.283 |
| | | Hedges' correction | 0.716 | -0.638 | -0.992 | -0.277 |
| Pair 5 | Literal - Imagine | Cohen's d | 1.147 | 0.075 | -0.258 | 0.406 |
| | | Hedges' correction | 1.173 | 0.073 | -0.252 | 0.397 |
| Pair 6 | Literal - Favorite | Cohen's d | 0.852 | -0.302 | -0.639 | 0.039 |
| | | Hedges' correction | 0.871 | -0.295 | -0.624 | 0.038 |
| Pair 7 | Literal - Oil | Cohen's d | 1.033 | -0.138 | -0.47 | 0.196 |
| | | Hedges' correction | 1.057 | -0.135 | -0.46 | 0.191 |
| Pair 8 | Imagine - Favorite | Cohen's d | 0.968 | -0.354 | -0.693 | -0.01 |
| | | Hedges' correction | 0.99 | -0.346 | -0.678 | -0.01 |
| Pair 9 | Imagine - Oil | Cohen's d | 0.942 | -0.243 | -0.577 | 0.095 |
| | | Hedges' correction | 0.963 | -0.237 | -0.564 | 0.093 |
| | | Cohen's d | 0.9 | 0.127 | -0.207 | 0.459 |

**Table 37 (continued).**

| | | | Standardizer[a] | Point Estimate | 95% Confidence Interval | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| Pair 10 | Favorite - Oil | Hedges' correction | 0.921 | 0.124 | -0.202 | 0.449 |

a. The denominator used in estimating the effect sizes.
Cohen's d uses the sample standard deviation of the mean difference.
Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

Table 38 displays singer self-perceptions of individual tone quality across experimental conditions for Choir One. Figure 23 displays the estimated marginal means of singer self-perceptions of individual tone quality for Choir One.

**Table 38**

*Mean Self-Ratings of Individual Tone for Each Experimental Condition: Choir One (*N = *35)*

| Experimental Condition | *M* | *SD* | 95% Confidence Interval *LL–UL* |
|---|---|---|---|
| Perform | 3.77 | 0.49 | 3.60–3.94 |
| Literal | 4.09 | 0.70 | 3.85–4.33 |
| Imagine | 4.00 | 0.88 | 3.70–4.30 |
| Favorite | 4.34 | 0.68 | 4.11–4.58 |
| Oil | 4.23 | 0.73 | 3.98–4.48 |

Post hoc pair-wise comparisons with a Bonferroni adjusted alpha level ($p = 0.05/10 = 0.01$) were used to determine where differences occurred between group pairs (Brunkan, 2012; Daugherty et al. 2012). The mean difference between all experimental condition pairings in Choir One was found to be significant at the 0.05 level in the following pairings: Perform and Favorite ($p < .001$); Perform and Oil ($p = 0.01$). Table 39 displays pairwise comparisons of singer self-perceptions of individual tone quality by experimental condition for Choir One.

**Figure 23**

*Choir One Singer Self-Perceptions of Individual Tone Quality Under Experimental Conditions*

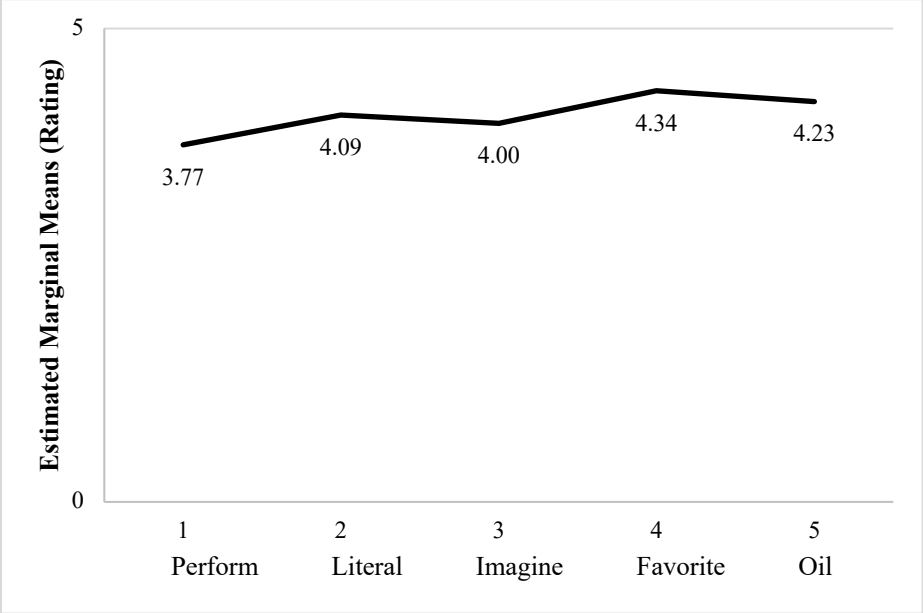



**Table 39**

*Pairwise Comparisons of Singer Self-Perceptions of Individual Tone: Choir One*

| (I) factor1 | (J) factor1 | Mean Difference (I-J) | Std. Error | Sig.b | 95% Confidence Interval for Difference[b] | |
|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound |
| 1 Perform | 2 Literal | -0.31 | 0.13 | 0.20 | -0.70 | 0.07 |
| | 3 Imagine | -0.23 | 0.15 | 1.00 | -0.69 | 0.23 |
| | 4 Favorite | -0.57* | 0.12 | <.001 | -0.93 | -0.22 |
| | 5 Oil | -0.46* | 0.12 | 0.01 | -0.81 | -0.10 |
| 2 Literal | 1 Perform | 0.31 | 0.13 | 0.20 | -0.07 | 0.70 |
| | 3 Imagine | 0.09 | 0.20 | 1.00 | -0.50 | 0.67 |
| | 4 Favorite | -0.26 | 0.14 | 0.83 | -0.69 | 0.18 |
| | 5 Oil | -0.14 | 0.18 | 1.00 | -0.67 | 0.38 |
| 3 Imagine | 1 Perform | 0.23 | 0.15 | 1.00 | -0.23 | 0.69 |
| | 2 Literal | -0.09 | 0.19 | 1.00 | -0.67 | 0.50 |
| | 4 Favorite | -0.34 | 0.16 | 0.44 | -0.83 | 0.15 |
| | 5 Oil | -0.23 | 0.16 | 1.00 | -0.71 | 0.25 |

**Table 39 (continued).**

| | | | | | | |
|---|---|---|---|---|---|---|
| 4 Favorite | 1 Perform | 0.57* | 0.12 | <.001 | 0.22 | 0.93 |
| | 2 Literal | 0.26 | 0.14 | 0.83 | -0.18 | 0.69 |
| | 3 Imagine | 0.34 | 0.16 | 0.44 | -0.15 | 0.83 |
| | 5 Oil | 0.11 | 0.15 | 1.00 | -0.34 | 0.57 |
| 5 Oil | 1 Perform | 0.46* | 0.12 | 0.01 | 0.10 | 0.81 |
| | 2 Literal | 0.14 | 0.18 | 1.00 | -0.38 | 0.67 |
| | 3 Imagine | 0.23 | 0.16 | 1.00 | -0.25 | 0.71 |
| | 4 Favorite | -0.11 | 0.15 | 1.00 | -0.57 | 0.34 |

Based on estimated marginal means
*. The mean difference is significant at the 0.05 level.
b. Adjustment for multiple comparisons: Bonferroni.

### *Choir Two*

#### Self-Perceptions of Choral Tone

A one-way repeated-measures analysis of variance (ANOVA) was performed to examine the effect of experimental conditions (perform, literal, imagine, favorite, and oil) on singer self-perceptions of overall choral tone (Likert-type scale, 1–5) of Choir Two. Sphericity assumptions were met (Mauchly's $W = 0.61$, $\chi^2$ 14.83, $p = 0.10$*).* There was a significant within-subjects effect of experimental conditions on singer self-perceptions of choral tone for Choir Two, $F(1, 4) = 11.52$, $p < .001$ (see Table 40).

**Table 40**

*Paired Samples Effect Sizes: Choral Tone Choir Two (n* = 34*)*

| | | | Standardizer[a] | Point Estimate | 95% Confidence Interval | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| Pair 1 | Perform - Literal | Cohen's d | 0.812 | -0.435 | -0.784 | -0.08 |
| | | Hedges' correction | 0.831 | -0.425 | -0.766 | -0.078 |
| Pair 2 | Perform - Imagine | Cohen's d | 0.86 | -0.513 | -0.868 | -0.152 |
| | | Hedges' correction | 0.88 | -0.501 | -0.848 | -0.148 |
| | | Cohen's d | 0.853 | -0.724 | -1.098 | -0.341 |

**Table 40 (continued).**

| | | | Standardizer[a] | Point Estimate | 95% Confidence Interval | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| Pair 3 | Perform - Favorite | Hedges' correction | 0.873 | -0.707 | -1.073 | -0.333 |
| Pair 4 | Perform - Oil | Cohen's d | 0.755 | -1.124 | -1.556 | -0.681 |
| | | Hedges' correction | 0.773 | -1.097 | -1.519 | -0.665 |
| Pair 5 | Literal - Imagine | Cohen's d | 0.793 | -0.111 | -0.448 | 0.227 |
| | | Hedges' correction | 0.811 | -0.109 | -0.437 | 0.222 |
| Pair 6 | Literal - Favorite | Cohen's d | 0.79 | -0.335 | -0.678 | 0.013 |
| | | Hedges' correction | 0.809 | -0.327 | -0.663 | 0.013 |
| Pair 7 | Literal - Oil | Cohen's d | 0.754 | -0.603 | -0.971 | -0.227 |
| | | Hedges' correction | 0.772 | -0.589 | -0.948 | -0.222 |
| Pair 8 | Imagine - Favorite | Cohen's d | 0.521 | -0.339 | -0.682 | 0.009 |
| | | Hedges' correction | 0.533 | -0.331 | -0.667 | 0.009 |
| Pair 9 | Imagine - Oil | Cohen's d | 0.704 | -0.559 | -0.923 | -0.188 |
| | | Hedges' correction | 0.721 | -0.546 | -0.901 | -0.184 |
| Pair 10 | Favorite - Oil | Cohen's d | 0.614 | -0.395 | -0.747 | -0.037 |
| | | Hedges' correction | 0.629 | -0.386 | -0.729 | -0.037 |

a. The denominator used in estimating the effect sizes.
Cohen's d uses the sample standard deviation of the mean difference.
Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

*Note.* Missing data resulted in *n* values of 33 and 34.

There were also significant multivariate test results (Wilks' $\Lambda = 0.42$, $F(4, 29) = 9.89$, $p < .001$).

Table 41 displays singer self-perceptions of overall choral tone quality across experimental conditions for Choir Two. Figure 24 displays the estimated marginal means of singer self-perceptions of overall choral tone for Choir Two.

**Table 41**

*Mean Self-Ratings of Choral Tone for Each Experimental Condition: Choir Two (n = 33)*

| Experimental Condition | *M* | *SD* | 95% Confidence Interval *LL–UL* |
|---|---|---|---|
| Perform | 3.45 | 0.80 | 3.18–3.74 |
| Literal | 3.85 | 0.76 | 3.58–4.12 |
| Imagine | 3.91 | 0.77 | 3.64–4.18 |
| Favorite | 4.06 | 0.70 | 3.81–4.31 |
| Oil | 4.30 | 0.64 | 4.08–4.53 |

Post hoc pair-wise comparisons with a Bonferroni adjusted alpha level ($p = 0.05/10 = 0.01$) were used to determine where differences occurred between group pairs (Brunkan, 2012; Daugherty et al. 2012). The mean difference between all experimental condition pairings in Choir Two were found to be significant at the 0.05 level in the following pairings: Literal and Favorite ($p < .001$); Imagine and Favorite ($p < .001$); Favorite and Oil ($p = 003$). Table 42 displays pairwise comparisons of singer self-perceptions of choral tone by experimental condition for Choir Two.

**Figure 24**

*Choir Two Singer Self-Perceptions of Overall Choral Tone Singing Under Experimental Conditions*

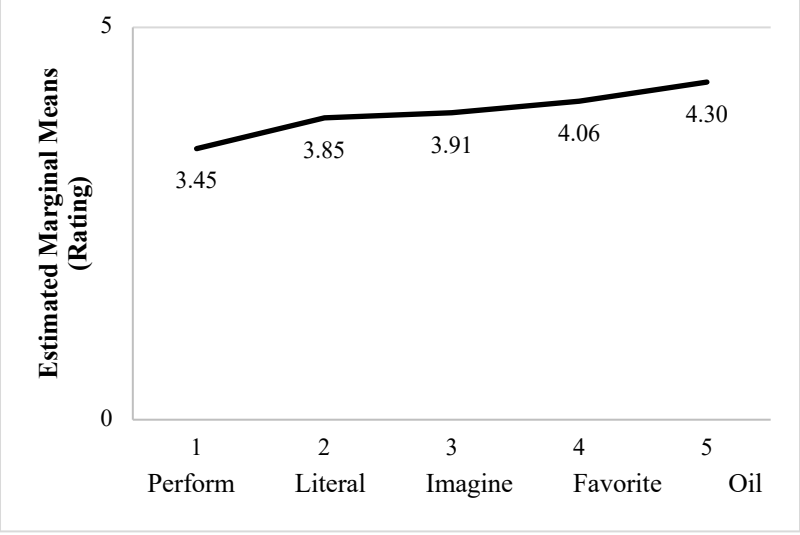


**Table 42**

*Pairwise Comparisons of Singer Self-Perceptions of Choral Tone: Choir Two*

| (I) factor1 | (J) factor1 | Mean Difference (I-J) | Std. Error | Sig.[b] | 95% Confidence Interval for Difference[b] | |
|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound |
| 1 Perform | 2 Literal | -0.39 | 0.14 | 0.07 | -0.81 | 0.02 |
| | 3 Imagine | -0.46 | 0.15 | 0.05 | -0.91 | 0.00 |
| | 4 Favorite | -0.61* | 0.15 | 0.00 | -1.06 | -0.15 |
| | 5 Oil | -0.85* | 0.13 | <.001 | -1.25 | -0.45 |
| 2 Literal | 1 Perform | 0.39 | 0.14 | 0.07 | -0.02 | 0.81 |
| | 3 Imagine | -0.06 | 0.14 | 1.00 | -0.47 | 0.35 |
| | 4 Favorite | -0.21 | 0.13 | 1.00 | -0.60 | 0.18 |
| | 5 Oil | -0.46* | 0.13 | 0.02 | -0.85 | -0.06 |
| 3 Imagine | 1 Perform | 0.46 | 0.15 | 0.051 | -0.00 | 0.91 |
| | 2 Literal | 0.06 | 0.14 | 1.00 | -0.35 | 0.47 |
| | 4 Favorite | -0.15 | 0.09 | 0.96 | -0.42 | 0.12 |
| | 5 Oil | -0.39* | 0.12 | 0.03 | -0.76 | -0.02 |
| 4 Favorite | 1 Perform | 0.61* | 0.15 | 0.00 | 0.15 | 1.06 |
| | 2 Literal | 0.21 | 0.13 | 1.00 | -0.18 | 0.60 |
| | 3 Imagine | 0.15 | 0.09 | 0.96 | -0.12 | 0.42 |
| | 5 Oil | -0.24 | 0.11 | 0.30 | -0.57 | 0.08 |
| 5 Oil | 1 Perform | 0.85* | 0.13 | <.001 | 0.45 | 1.25 |
| | 2 Literal | 0.46* | 0.13 | 0.02 | 0.06 | 0.85 |
| | 3 Imagine | 0.04* | 0.12 | 0.03 | 0.02 | 0.76 |
| | 4 Favorite | 0.24 | 0.11 | 0.30 | -0.08 | 0.57 |

Based on estimated marginal means
*. The mean difference is significant at the 0.05 level.
b. Adjustment for multiple comparisons: Bonferroni.

**Self-Perceptions of Individual Tone**

A one-way repeated-measures analysis of variance (ANOVA) was performed to examine the effect of experimental conditions (perform, literal, imagine, favorite, and oil) on singer self-perceptions of overall individual tone (Likert-type scale, 1–5) of Choir Two. Sphericity assumptions were met (Mauchly's $W = 0.80$, $\chi^2$ 6.77, $p = 0.66$). There was a significant within-

subjects effect of experimental conditions on singer self-perceptions of individual tone quality, $F(1, 4) = 411.35$, $p < 0.001$ (see Table 43).

**Table 43**

*Paired Samples Effect Sizes: Individual Tone Choir Two (n = 34*)*

| | | | Standardizer[a] | Point Estimate | 95% Confidence Interval | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| Pair 1 | Perform - Literal | Cohen's d | 0.696 | -0.305 | -0.652 | 0.047 |
| | | Hedges' correction | 0.713 | -0.297 | -0.636 | 0.046 |
| Pair 2 | Perform - Imagine | Cohen's d | 0.821 | -0.179 | -0.517 | 0.161 |
| | | Hedges' correction | 0.841 | -0.175 | -0.505 | 0.157 |
| Pair 3 | Perform - Favorite | Cohen's d | 0.613 | -0.912 | -1.309 | -0.506 |
| | | Hedges' correction | 0.627 | -0.891 | -1.279 | -0.494 |
| Pair 4 | Perform - Oil | Cohen's d | 0.637 | -1.095 | -1.523 | -0.656 |
| | | Hedges' correction | 0.652 | -1.069 | -1.487 | -0.641 |
| Pair 5 | Literal - Imagine | Cohen's d | 0.765 | 0.119 | -0.224 | 0.46 |
| | | Hedges' correction | 0.784 | 0.116 | -0.219 | 0.449 |
| Pair 6 | Literal - Favorite | Cohen's d | 0.637 | -0.476 | -0.833 | -0.112 |
| | | Hedges' correction | 0.652 | -0.465 | -0.813 | -0.11 |
| Pair 7 | Literal - Oil | Cohen's d | 0.712 | -0.681 | -1.056 | -0.297 |
| | | Hedges' correction | 0.73 | -0.664 | -1.031 | -0.29 |
| Pair 8 | Imagine - Favorite | Cohen's d | 0.743 | -0.554 | -0.912 | -0.189 |
| | | Hedges' correction | 0.761 | -0.541 | -0.891 | -0.184 |
| Pair 9 | Imagine - Oil | Cohen's d | 0.708 | -0.813 | -1.203 | -0.413 |
| | | Hedges' correction | 0.726 | -0.793 | -1.174 | -0.404 |
| Pair 10 | Favorite - Oil | Cohen's d | 0.635 | -0.286 | -0.632 | 0.064 |
| | | Hedges' correction | 0.651 | -0.279 | -0.617 | 0.063 |

a. The denominator used in estimating the effect sizes.
Cohen's d uses the sample standard deviation of the mean difference.
Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

*Note.* Missing data resulted in *n* values of 33 and 34.

There were also significant multivariate test results (Wilks' $\Lambda = 0.33$, $F(4, 29) = 14.83$, $p < .001$).

Table 44 displays singer self-perceptions of individual tone quality across experimental conditions for Choir Two. Figure 25 displays the estimated marginal means of singer self-perceptions of individual tone quality for Choir Two.

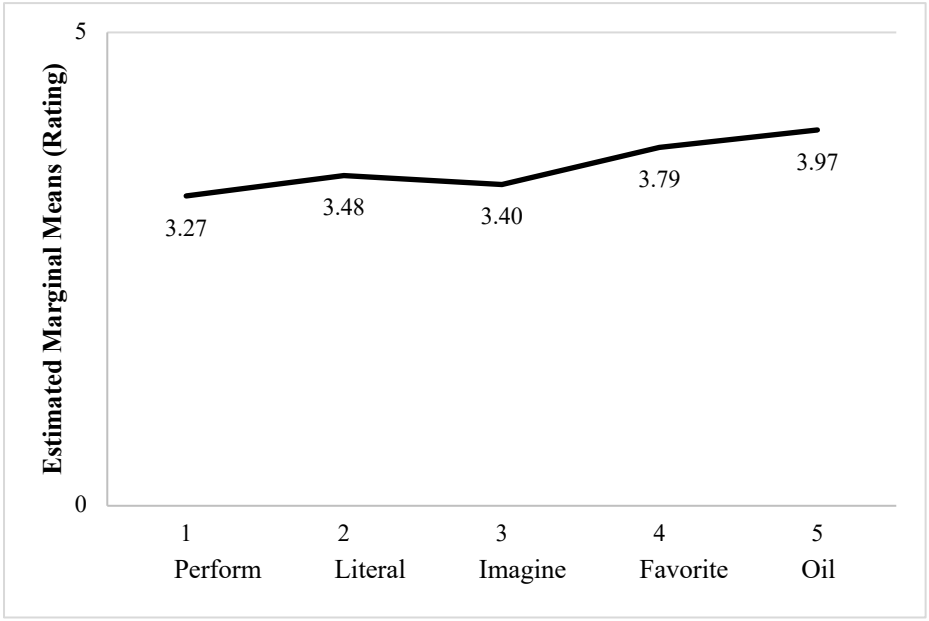
**Table 44**

*Mean Self-Ratings of Individual Tone for Each Experimental Condition: Choir Two (n = 33)*

| Experimental Condition | *M* | *SD* | 95% Confidence Interval *LL–UL* |
|---|---|---|---|
| Perform | 3.27 | 0.91 | 2.95–3.6- |
| Literal | 3.48 | 0.97 | 3.14–3.83 |
| Imagine | 3.39 | 1.00 | 3.04–3.75 |
| Favorite | 3.79 | 0.86 | 3.48–4.09 |
| Oil | 3.97 | 0.81 | 3.68–4.26 |

**Figure 25**

*Choir Two Singer Self-Perceptions of Individual Tone Quality Under Experimental Conditions*




Post hoc pair-wise comparisons with a Bonferroni adjusted alpha level ($p = 0.05/10 =$

0.01) were used to determine where differences occurred between group pairs (Brunkan, 2012; Daugherty et al. 2012). The mean difference between all experimental condition pairings in Choir Two was found to be significant at the 0.05 level in the following pairings: Perform and Favorite ($p$ <.001); Perform and Oil ($p$ = 0.01). Table 45 displays pairwise comparisons of singer self-perceptions of individual tone quality by experimental condition for Choir Two.

**Table 45**

*Pairwise Comparisons of Singer Self-Perceptions of Individual Tone: Choir Two*

| | | | | | 95% Confidence Interval for Difference[b] | |
|---|---|---|---|---|---|---|
| (I) factor1 | (J) factor1 | Mean Difference (I-J) | Std. Error | Sig.[b] | Lower Bound | Upper Bound |
| 1 Perform | 2 Literal | -0.21 | 0.12 | 0.90 | -0.58 | 0.15 |
| | 3 Imagine | -0.12 | 0.14 | 1.00 | -0.55 | 0.31 |
| | 4 Favorite | -0.52* | 0.10 | <.001 | -0.81 | -0.22 |
| | 5 Oil | -0.70* | 0.11 | <.001 | -1.03 | -0.36 |
| 2 Literal | 1 Perform | 0.21 | 0.12 | 0.90 | -0.15 | 0.58 |
| | 3 Imagine | 0.09 | 0.13 | 1.00 | -0.31 | 0.49 |
| | 4 Favorite | -0.30 | 0.11 | 0.10 | -0.64 | 0.03 |
| | 5 Oil | -0.49* | 0.12 | 0.01 | -0.86 | -0.11 |
| 3 Imagine | 1 Perform | 0.12 | 0.14 | 1.00 | -0.31 | 0.55 |
| | 2 Literal | -0.09 | 0.13 | 1.00 | -0.49 | 0.31 |
| | 4 Favorite | -0.39* | 0.13 | 0.05 | -0.79 | -0.00 |
| | 5 Oil | -0.58* | 0.12 | <.001 | -0.95 | -0.20 |
| 4 Favorite | 1 Perform | 0.52* | 0.10 | <.001 | 0.22 | 0.81 |
| | 2 Literal | 0.30 | 0.11 | 0.10 | -0.03 | 0.64 |
| | 3 Imagine | 0.39* | 0.13 | 0.05 | 0.00 | 0.79 |
| | 5 Oil | -0.18 | 0.11 | 1.00 | -0.52 | 0.15 |
| 5 Oil | 1 Perform | 0.70* | 0.11 | <.001 | 0.36 | 1.03 |
| | 2 Literal | 0.49* | 0.12 | 0.01 | 0.11 | 0.86 |
| | 3 Imagine | 0.58* | 0.12 | <.001 | 0.20 | 0.95 |
| | 4 Favorite | 0.18 | 0.11 | 1.00 | -0.15 | 0.52 |

Based on estimated marginal means
*. The mean difference is significant at the 0.05 level.
b. Adjustment for multiple comparisons: Bonferroni.

### *Choir Three*

#### Self-Perceptions of Choral Tone

A one-way repeated-measures analysis of variance (ANOVA) was performed to examine the effect of experimental conditions (perform, literal, imagine, favorite, and oil) on singer self-perceptions of overall choral tone (Likert-type scale, 1–5) of Choir Three. Sphericity assumptions were not met (Mauchly's $W = 0.25$, $\chi^2$ 29.64, $p < .001$). The estimated sphericity departure was $\varepsilon = 0.58$. The Greenhouse-Geisser correction was applied, and degrees of freedom were adjusted. There was a significant within-subjects effect of experimental conditions on singer self-perceptions of choral tone for Choir Three, $F(1, 2.30) = 20.92$, $p < .001$ (see Table 46).

**Table 46**

| | | | Standardizer[a] | Point Estimate | 95% Confidence Interval | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| Pair 1 | Perform - Literal | Cohen's d | 0.482 | -1.384 | -1.941 | -0.813 |
| | | Hedges' correction | 0.498 | -1.339 | -1.877 | -0.786 |
| Pair 2 | Perform - Imagine | Cohen's d | 0.588 | -1.346 | -1.895 | -0.782 |
| | | Hedges' correction | 0.608 | -1.301 | -1.832 | -0.756 |
| Pair 3 | Perform - Favorite | Cohen's d | 0.751 | -1.277 | -1.812 | -0.726 |
| | | Hedges' correction | 0.776 | -1.235 | -1.752 | -0.702 |
| Pair 4 | Perform - Oil | Cohen's d | 0.908 | -1.147 | -1.658 | -0.621 |
| | | Hedges' correction | 0.939 | -1.109 | -1.603 | -0.601 |
| Pair 5 | Literal - Imagine | Cohen's d | 0.537 | -0.233 | -0.636 | 0.175 |
| | | Hedges' correction | 0.555 | -0.225 | -0.615 | 0.169 |
| Pair 6 | Literal - Favorite | Cohen's d | 0.55 | -0.53 | -0.953 | -0.097 |
| | | Hedges' correction | 0.569 | -0.513 | -0.922 | -0.094 |
| Pair 7 | Literal - Oil | Cohen's d | 0.711 | -0.527 | -0.95 | -0.095 |
| | | Hedges' correction | 0.735 | -0.51 | -0.919 | -0.092 |
| | | Cohen's d | 0.565 | -0.295 | -0.701 | 0.117 |

**Table 46 (continued).**

*Paired Samples Effect Sizes: Choral Tone Choir Three (n = 23)*

| | | | Standardizer[a] | Point Estimate | 95% Confidence Interval | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| Pair 8 | Imagine - Favorite | Hedges' correction | 0.584 | -0.285 | -0.678 | 0.113 |
| Pair 9 | Imagine - Oil | Cohen's d | 0.532 | -0.47 | -0.888 | -0.043 |
| | | Hedges' correction | 0.55 | -0.455 | -0.859 | -0.042 |
| Pair 10 | Favorite - Oil | Cohen's d | 0.504 | -0.165 | -0.567 | 0.239 |
| | | Hedges' correction | 0.521 | -0.16 | -0.548 | 0.231 |

a. The denominator used in estimating the effect sizes.
Cohen's d uses the sample standard deviation of the mean difference.
Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

There were also significant multivariate test results (Wilks' $\Lambda = 0.26$, $F(4, 20) = 14.03$, $p < .001$).

Table 47 displays singer self-perceptions of overall choral tone quality across experimental conditions for Choir Three. Figure 26 displays the estimated marginal means of singer self-perceptions of overall choral tone for Choir Three.

**Table 47**

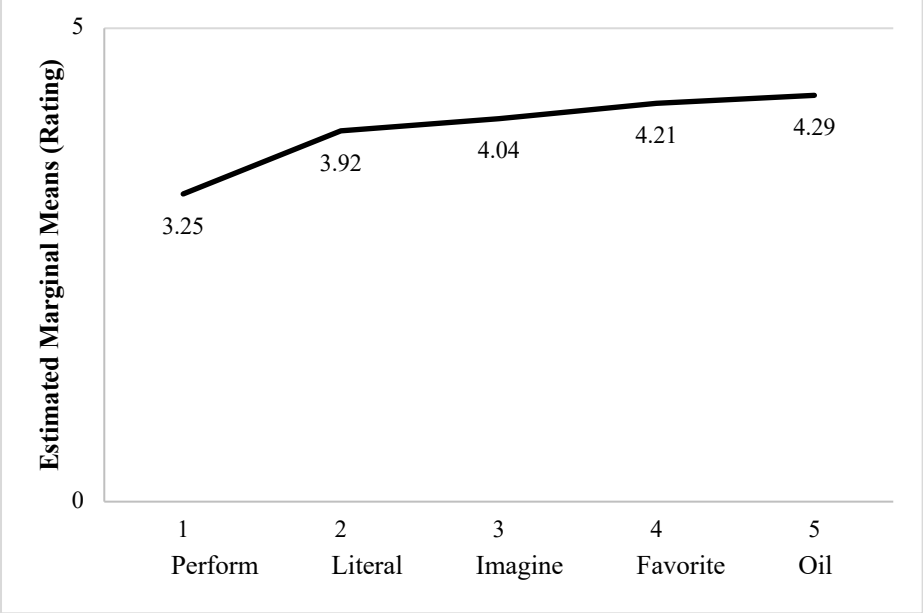
*Mean Self-Ratings of Choral Tone for Each Experimental Condition: Choir Three (*N = *24)*

| Experimental Condition | *M* | *SD* | 95% Confidence Interval *LL–UL* |
|---|---|---|---|
| Perform | 3.25 | 0.68 | 2.97–3.54 |
| Literal | 3.92 | 0.50 | 3.70–4.13 |
| Imagine | 4.04 | 0.46 | 3.85–4.24 |
| Favorite | 4.21 | 0.42 | 4.03–4.38 |
| Oil | 4.29 | 0.46 | 4.10–4.49 |

Post hoc pair-wise comparisons with a Bonferroni adjusted alpha level ($p = 0.05/10 = 0.01$) were used to determine where differences occurred between group pairs (Brunkan, 2012; Daugherty et al. 2012). The mean difference between all experimental condition pairings in Choir Three were found to be significant at the 0.05 level in the following pairings: Perform and Literal ($p < .001$); Perform and Imagine ($p < .001$); Perform and Favorite ($p < .001$); Perform and Oil ($p < .001$). Table 48 displays pairwise comparisons of singer-self perceptions of choral tone by experimental condition for Choir Three.

**Figure 26**

*Choir Three Singer Self-Perceptions of Overall Choral Tone Singing Under Experimental Conditions*




**Self-Perceptions of Individual Tone**

A one-way repeated-measures analysis of variance (ANOVA) was performed to examine the effect of experimental conditions (perform, literal, imagine, favorite, and oil) on singer self-perceptions of overall individual tone (Likert-type scale, 1–5) of Choir Three.

**Table 48**

*Pairwise Comparisons of Singer Self-Perceptions of Choral Tone: Choir Three*

| (I) factor1 | (J) factor1 | Mean Difference (I-J) | Std. Error | Sig.[b] | 95% Confidence Interval for Difference[b] | |
|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound |
| 1 Perform | 2 Literal | -0.67* | 0.10 | <.001 | -0.97 | -0.36 |
| | 3 Imagine | -0.79* | 0.12 | <.001 | -1.16 | -0.42 |
| | 4 Favorite | -0.96* | 0.15 | <.001 | -1.43 | -0.48 |
| | 5 Oil | -1.04* | 0.19 | <.001 | -1.62 | -0.47 |
| 2 Literal | 1 Perform | 0.67* | 0.10 | <.001 | 0.36 | 0.97 |
| | 3 Imagine | -0.13 | 0.11 | 1.00 | -0.47 | 0.22 |
| | 4 Favorite | -0.29 | 0.11 | 0.16 | -0.64 | 0.06 |
| | 5 Oil | -0.38 | 0.15 | 0.17 | -0.83 | 0.08 |
| 3 Imagine | 1 Perform | 0.79* | 0.12 | <.001 | 0.42 | 1.16 |
| | 2 Literal | 0.13 | 0.11 | 1.00 | -0.22 | 0.47 |
| | 4 Favorite | -0.17 | 0.12 | 1.00 | -0.52 | 0.19 |
| | 5 Oil | -0.25 | 0.11 | 0.31 | -0.59 | 0.09 |
| 4 Favorite | 1 Perform | 0.96* | 0.15 | <.001 | 0.48 | 1.43 |
| | 2 Literal | 0.29 | 0.11 | 0.16 | -0.06 | 0.64 |
| | 3 Imagine | 0.17 | 0.12 | 1.00 | -0.19 | 0.52 |
| | 5 Oil | -0.08 | 0.10 | 1.00 | -0.40 | 0.24 |
| 5 Oil | 1 Perform | 1.04* | 0.19 | <.001 | 0.47 | 1.62 |
| | 2 Literal | 0.38 | 0.15 | 0.17 | -0.08 | 0.83 |
| | 3 Imagine | 0.25 | 0.11 | 0.31 | -0.09 | 0.59 |
| | 4 Favorite | 0.08 | 0.10 | 1.00 | -0.24 | 0.40 |

Based on estimated marginal means

*. The mean difference is significant at the 0.05 level.

b. Adjustment for multiple comparisons: Bonferroni.

Sphericity assumptions were met (Mauchly's $W = 0.57$, $\chi^2$ 12.19, $p = 0.20$). There was a significant within-subjects effect of experimental conditions on singer self-perceptions of individual tone quality, $F(1, 4) = 10.40$, $p < .001$ (see Table 49).

**Table 49**

*Paired Samples Effect Sizes: Individual Tone Choir Three (n = 23*)*

| | | | Standardizer[a] | Point Estimate | 95% Confidence Interval | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| Pair 1 | Perform - Literal | Cohen's d | 0.682 | 0.236 | -0.017 | 0.488 |
| | | Hedges' correction | 0.691 | 0.234 | -0.017 | 0.482 |
| Pair 2 | Perform - Imagine | Cohen's d | 0.903 | 0.071 | -0.178 | 0.32 |
| | | Hedges' correction | 0.914 | 0.071 | -0.176 | 0.316 |
| Pair 3 | Perform - Favorite | Cohen's d | 0.757 | 0.533 | 0.265 | 0.797 |
| | | Hedges' correction | 0.766 | 0.526 | 0.262 | 0.787 |
| Pair 4 | Perform - Oil | Cohen's d | 0.658 | 0.245 | -0.008 | 0.497 |
| | | Hedges' correction | 0.666 | 0.242 | -0.008 | 0.491 |
| Pair 5 | Literal - Imagine | Cohen's d | 0.783 | -0.124 | -0.373 | 0.127 |
| | | Hedges' correction | 0.793 | -0.122 | -0.368 | 0.125 |
| Pair 6 | Literal - Favorite | Cohen's d | 0.717 | 0.337 | 0.08 | 0.592 |
| | | Hedges' correction | 0.726 | 0.333 | 0.079 | 0.585 |
| Pair 7 | Literal - Oil | Cohen's d | 0.83 | 0 | -0.249 | 0.249 |
| | | Hedges' correction | 0.84 | 0 | -0.246 | 0.246 |
| Pair 8 | Imagine - Favorite | Cohen's d | 0.723 | 0.468 | 0.204 | 0.729 |
| | | Hedges' correction | 0.732 | 0.463 | 0.202 | 0.72 |
| Pair 9 | Imagine - Oil | Cohen's d | 0.9 | 0.108 | -0.143 | 0.357 |
| | | Hedges' correction | 0.911 | 0.106 | -0.141 | 0.352 |
| Pair 10 | Favorite - Oil | Cohen's d | 0.761 | -0.318 | -0.572 | -0.061 |
| | | Hedges' correction | 0.771 | -0.314 | -0.565 | -0.061 |

a. The denominator used in estimating the effect sizes.
Cohen's d uses the sample standard deviation of the mean difference.
Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

There were also significant multivariate test results (Wilks' $\Lambda = 0.24$, $F(4, 20) = 15.55$, $p < .001$).

Table 50 displays singer self-perceptions of individual tone quality across experimental conditions for Choir Three. Figure 27 displays the estimated marginal means of singer self-perceptions of individual tone quality for Choir Three.

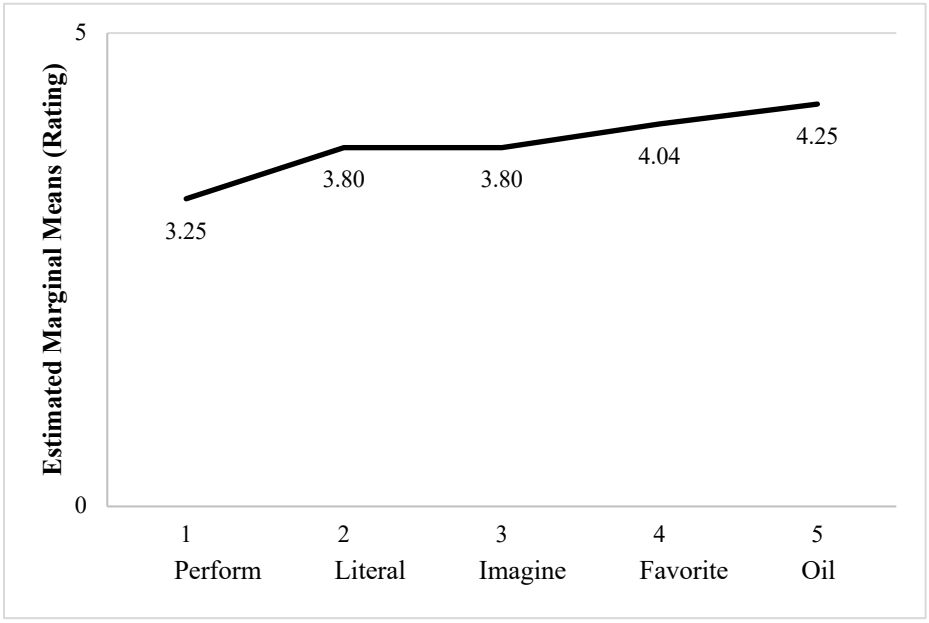
**Table 50**

*Mean Self-Ratings of Individual Tone for Each Experimental Condition: Choir Three (*N = *24)*

| Experimental Condition | *M* | *SD* | 95% Confidence Interval *LL–UL* |
|---|---|---|---|
| Perform | 3.25 | 0.44 | 3.06–3.44 |
| Literal | 3.79 | 0.66 | 3.51–4.07 |
| Imagine | 3.79 | 0.66 | 3.51–4.07 |
| Favorite | 4.04 | 0.62 | 3.78–4.31 |
| Oil | 4.25 | 0.68 | 3.97–4.54 |

**Figure 27**

*Choir Three Singer Self-Perceptions of Individual Tone Quality Under Experimental Conditions*




Post hoc pair-wise comparisons with a Bonferroni adjusted alpha level ($p = 0.05/10 = 0.01$) were used to determine where differences occurred between group pairs (Brunkan, 2012;

Daugherty et al. 2012). The mean difference between all experimental condition pairings in Choir Three was found to be significant at the 0.05 level in the following pairings: Perform and Literal ($p$ = .01); Perform and Imagine ($p$ - .01); Perform and Favorite ($p$ <.001); Perform and Oil ($p$ <.001) (see Table 51). Table 52 displays pairwise comparisons of singer self-perceptions of individual tone quality by experimental conditions for Choir Three.

**Table 51**

*Singer Self-Perceptions: Mean Difference Between Experimental Conditions*

| Condition Pairings | Choral Tone | | | Individual Tone | | |
|---|---|---|---|---|---|---|
| | Choir One | Choir Two | Choir Three | Choir One | Choir Two | Choir Three |
| Perform & Literal | -0.40* | -0.39 | -0.67* | -0.31 | -0.21 | -0.54* |
| Perform & Imagine | -0.26 | -0.46 | -0.79* | -0.23 | -0.12 | -0.54* |
| Perform & Favorite | -0.60* | -0.61* | -0.96* | -0.57* | -0.52* | -0.79* |
| Perform & Oil | -0.51* | -0.85* | -1.04* | -0.46* | -0.70* | -1.00* |
| Literal & Imagine | 0.14 | -0.06 | -0.13 | 0.09 | 0.09 | 0 |
| Literal & Favorite | -0.2 | -0.21 | -0.29 | -0.26 | -0.3 | -0.25 |
| Literal & Oil | -0.11 | -0.46* | -0.38 | -0.14 | -0.49* | -0.46 |
| Imagine & Favorite | 0.34 | -0.15 | -0.17 | -0.34 | -0.39* | 0.25 |
| Imagine & Oil | 0.09 | -0.39* | -0.25 | -0.23 | -0.58* | -0.21 |
| Favorite & Oil | -0.09 | 0.24 | 0.08 | -0.11 | 0.18 | 0.21 |

*Note.* Based on estimated marginal means. *. The mean difference is significant at the .05 level. b. Adjustment for multiple comparisons: Bonferroni.

**Research Question Four: Singer Survey**

***Qualitative Data***

Research question four pertained to themes present in singer questionnaire responses addressing metaphorical and literal language use in the choral rehearsal. Qualitative comments were interpreted by the researcher at the explicit/semantic level using a combination of inductive and deductive approaches (Braun & Clarke, 2006; Sandgren, 2019). Comments were then

grouped into categories ($N = 8$) with similar themes (e.g., positive, negative, neutral, miscellaneous). Validity of categories were discussed with a music education teacher-researcher at the collegiate level familiar with the content of this study. Categories were determined to be valid through discussion.

**Table 52**

*Pairwise Comparisons of Singer Self-Perceptions of Individual Tone: Choir Three*

| | | | | | 95% Confidence Interval for Difference[b] | |
|---|---|---|---|---|---|---|
| (I) factor1 | (J) factor1 | Mean Difference (I-J) | Std. Error | Sig.[b] | Lower Bound | Upper Bound |
| 1 Perform | 2 Literal | -0.54* | 0.15 | 0.01 | -1.00 | -0.09 |
| | 3 Imagine | -0.54* | 0.15 | 0.01 | -1.00 | -0.09 |
| | 4 Favorite | -0.79* | 0.16 | <.001 | -1.29 | -0.30 |
| | 5 Oil | -1.00* | 0.14 | <.001 | -1.42 | -0.58 |
| 2 Literal | 1 Perform | '-0.54* | 0.15 | 0.01 | 0.09 | 1.00 |
| | 3 Imagine | 0.00 | 0.16 | 1.00 | -0.49 | 0.49 |
| | 4 Favorite | -0.25 | 0.14 | 0.83 | -0.68 | 0.18 |
| | 5 Oil | -0.46 | 0.20 | 0.31 | -1.08 | 0.16 |
| 3 Imagine | 1 Perform | -0.54* | 0.15 | 0.01 | 0.09 | 1.00 |
| | 2 Literal | 0.00 | 0.16 | 1.00 | -0.49 | 0.50 |
| | 4 Favorite | -0.25 | 0.18 | 1.00 | -0.82 | 0.32 |
| | 5 Oil | -0.458 | 0.19 | 0.24 | -1.05 | 0.13 |
| 4 Favorite | 1 Perform | '-0.79* | 0.16 | <.001 | 0.308 | 1.29 |
| | 2 Literal | 0.25 | 0.14 | 0.83 | -0.18 | 0.68 |
| | 3 Imagine | 0.25 | 0.18 | 1.00 | -0.32 | 0.82 |
| | 5 Oil | -0.21 | 0.17 | 1.00 | -0.74 | 0.32 |
| 5 Oil | 1 Perform | 1.00* | 0.14 | <.001 | 0.58 | 1.42 |
| | 2 Literal | 0.46 | 0.20 | 0.31 | -0.16 | 1.08 |
| | 3 Imagine | 0.46 | 0.19 | 0.24 | -0.13 | 1.05 |
| | 4 Favorite | 0.21 | 0.17 | 1.00 | -0.32 | 0.74 |

Based on estimated marginal means
*. The mean difference is significant at the 0.05 level.
b. Adjustment for multiple comparisons: Bonferroni.

Singer responses were disaggregated into discrete comments ($N = 551$). Codes were created for each category and applied to each discrete comment by the researcher (see Appendix N). Two independent raters with choral singing experience (7.5 *M* years) were recruited to verify the researcher's coding of qualitative comments. Interrater agreement was calculated by dividing the number of agreements by the total number of agreements and disagreements (Miles & Huberman, 1994). The strength of the agreement was set at 80%, almost perfect agreement as defined by Landis and Koch (1977). A conservative number of the discrete comments (30%) were randomly selected to be reviewed by two independent raters (O'Conner & Joffe, 2020). The independent raters reviewed the randomly selected discrete comments via an online questionnaire (see Appendix O).

Disagreement between raters were resolved though discussion between all three raters. Interrater agreement was calculated by dividing the number of agreements by the total number of agreements and disagreements (Miles & Huberman, 1994). The strength of the agreement was set at 80%, almost perfect agreement as defined by Landis and Coch (1977). In cases where agreement fell below 80%, discussion was used by the raters to reach consensus. Table 38 displays the frequency and percentage of coded qualitative comments. Comments were either coded as being positive, negative, neutral, or miscellaneous. For the first four categories discrete comment frequencies were as follows: Literal, $n = 79$; Imagine, $n = 70$; Favorite, $n = 84$; and Oil, $n = 82$. Interrater agreement for the same categories were: Literal, 100%; Imagine, 100%; Favorite, 100%; and Oil, 96%.

***Perceived Effects***

The stimulus video instructed singers to sing all experimental conditions as if they were performing. Sung repetition number one served as a control, the language prompt was "sing as if

you are performing." Language data were not collected for the control. After the control, following each experimental condition singers were prompted to respond yes/no regarding whether the language prompt used to elicit singing effected their tone quality.

**Table 53**

*Singer Comment Frequency and Percentage Table: Perceived Effects of Experimental Condition on Tone Quality*

Singer Questionnaire Prompt

*How did breathing in slowly and deeply with an open throat effect your tone quality?*

| Code | *n* = 113 | Frequency | Percent | Valid Percent |
|---|---|---|---|---|
| Positive | | 96 | 48.50 | 85.00 |
| Negative | | 8 | 4.50 | 7.10 |
| Neutral | | 0 | 0.00 | 0.00 |
| Miscellaneous | | 9 | 4.50 | 8.00 |

*How did imagining you are inhaling the aroma of a fragrant rose effect your tone quality?*

| Code | *n* = 102 | Frequency | Percent | Valid Percent |
|---|---|---|---|---|
| Positive | | 63 | 31.80 | 61.80 |
| Negative | | 30 | 25.30 | 29.40 |
| Neutral | | 0 | 0.00 | 0.00 |
| Miscellaneous | | 9 | 4.50 | 8.80 |

*How did your choice (favorite) effect your tone quality?*

| Code | *n* = 123 | Frequency | Percent | Valid Percent |
|---|---|---|---|---|
| Positive | | 112 | 56.60 | 91.10 |
| Negative | | 3 | 1.05 | 2.40 |
| Neutral | | 0 | 0.00 | 0.00 |
| Miscellaneous | | 8 | 4.00 | 6.50 |

**Table 53 (continued).**

Singer Questionnaire Prompt

*How did inhaling the aroma of a fragrant rose effect you tone quality?*

| Code | *n* = 120 | Frequency | Percent | Valid Percent |
|---|---|---|---|---|
| Positive | | 88 | 44.40 | 73.30 |
| Negative | | 23 | 11.60 | 19.20 |
| Neutral | | 0 | 0.00 | 0.00 |
| Miscellaneous | | 9 | 4.50 | 7.50 |

*Note.* After the performance of each experimental condition singers were asked if the singing prompt effected their singing. If singers answered yes, they were prompted to respond to the above prompts. Singers that responded to the prompt are indicated as *n.* The valid percent is the percentage of singers that answered yes to the prompt, then commented.

**Literal**

Singers were asked if the literal language prompt "breathe in slowly and deeply with an open throat" effected their tone quality, resulting responses were 81.5% ($n = 75$) "yes" answers and 18.5% ($n = 17$) "no" answers; $\chi^2 (1, 92) = 36.57$, $p < .001$.

If singers answered "yes" to the prompt, then they were asked to comment on how the prompt affected their tone quality. Positive comments from singers often referenced the elements of the singing mechanism. One singer referencing breathing "I was more aware to focus on my breathing in general and that helped." Another mentioned multiple elements of the mechanism, "I was more aware of my space and vowels. I felt more supported in the phrasing. My tone was more warm and rich." Relaxation was mentioned as well, "It helped me to relax the muscles in my throat and take a slow and full breath." Negative comments mentioned focus, "I felt focusing on this prompt distracted me from other technique things." Another mentioned onset, "Onsets were cleaner (but were a little late)." Similarly, another said, "but harder to enter on time."

**Imagine**

Singers ($N = 93$) were asked if the imagine language prompt "imagine you are inhaling the aroma of a fragrant rose" effected their tone quality, responses were as follows: 62.4% (n = 58) "yes" responses and 37.6% ($n = 35$) "no" responses; $\chi^2$ (1, 93) = 5.69, $p = .017$. Following all performances singers were asked if they have ever been asked in a choir or voice lesson to imagine they are inhaling the aroma of a fragrant rose, 28% ($n = 26$) said yes, 72% ($n = 67$) said no; $\chi^2$ (1, 93) = 18.08, $p < .001$.

If singers answered "yes" to the prompt, then they were asked to comment on how the prompt affected their tone quality. Positive comments from singers often referenced the elements of the singing mechanism. One singer mentioned the route on inhalation, "It encouraged to inhale solely through my nose which gave me a more moist inhalation which opened my throat." Another referenced placement, "By imagining smelling a rose I was able to be mindful of my voice coming out brightly from my forehead." There was also reference to emotional affect, "It seems more musical, sweet, reverent this time." Negative comments often referenced the nasal route of inhalation. One singer said, "it made me breath [sic] through my nose more, which made it feel like it took longer for me to breath [sic] and get the support I needed." Similarly, another said, "but the association with smelling had me breathing through my nose - not ideal, haha." One singer commented on their ability to do the activity and sing, "I think I got too caught up in the accuracy of my imagination and forgot to sing well."

Singers were asked what they think a conductor/music teacher wants the singer to change when prompted to imagine they are inhaling the aroma of a fragrant rose. Singer comments often took the form of a list of singing concepts such as "taking a deep, full breath and sing more open/with less tension." A patterned emerged in singer comments where each could be assigned

a keyword. The concepts linked to these keywords were: aware, breath, emotion, breath support, tone, palate, tension, throat, face, expression, miscellaneous, onset, resonator, relax, and listening. Because many comments included several concepts that could not be disaggregated without losing the integrity of the thought serval keywords were given to comments. Interrater reliability for coding of these singer comments was 82.14% (see Table 54).

**Table 54**

*Singer Interpretations: Imagine Rose Aroma*

| Coded Singer Comments | Frequency | Percent | Valid Percent |
|---|---|---|---|
| Aware | 5 | 2.50 | 3.80 |
| Breath | 45 | 22.70 | 33.80 |
| Emotion | 12 | 6.10 | 9.00 |
| Breath Support | 5 | 2.50 | 3.80 |
| Tone | 27 | 13.60 | 20.30 |
| Palate | 9 | 4.50 | 6.80 |
| Tension | 3 | 1.50 | 2.30 |
| Throat | 5 | 2.50 | 3.80 |
| Face | 4 | 2.00 | 3.00 |
| Expression | 6 | 3.00 | 4.50 |
| Misc. | 6 | 3.00 | 4.50 |
| Onset | 1 | 0.50 | 0.80 |
| Resonator | 2 | 1.00 | 1.50 |
| Relax | 1 | 0.50 | 0.80 |
| Listening | 2 | 1.00 | 1.50 |
| **Total** | **133** | **67.2** | **100** |

### Favorite

Singers were asked to choose their favorite choice out of the two previous (literal or imagine) prompts or a combination of both. Singers chose their favorite prompt as follows: literal 46.20% ($n$ = 43), imagine 23.70% ($n$ = 22), and combination of both 30.10% ($n$ = 28). When singers were asked if their favorite choice of the prompts effected their singing 90.30% ($n$ = 84) responded “yes” while 9.70% ($n$ = 9) responded “no;” $\chi^2$ (1, 93) = 60.49, $p$ < .001.

If singers answered “yes” to the prompt, then they were asked to comment on how the prompt affected their tone quality. Positive comments from singers often referenced the elements of the singing mechanism. One singer said, “I had more breath support and the tone felt freer.” Another mentioned release of tension, “Significantly less tension in my jaw/chords!” Another said, “Smelling the ‘Rose’ made me want to breathe in more deeply to imagine getting more scent.” Another referenced an open throat, “Prepping with an open throat breath instantly prepped me for good tone.” One singer commented on literal and metaphorical language, “Smoother transitions between notes, inhaling openly helped onset and imagining the rose kept tone better throughout.” One singer negatively reflected on the ability to do the task, “but it was a lot to think about.”

**Rose Aroma**

Singers were asked to “inhale the aroma of a fragrant rose” via one drop of rose essential oil on a cotton ball. Singers ($N = 93$) were given the option to hold the cotton ball as far away as possible or to set it on the ground if the aroma was overpowering, three singers (3.2%) chose to set the cotton ball on the ground. When asked if inhaling the aroma effected their tone quality 77.5% ($n = 72$) said “yes” and 22.6% ($n = 21$) said “no;” $\chi^2 (1, 93) = 27.97$, $p < .001$. Singers were asked to use a Likert-like scale to rate how much they agree with the statement “I enjoy the aroma of rose essential oil.” Singer responses were as follows: agree 43% ($n = 40$), strongly agree 36.6% ($n = 34$), neutral 12.9% ($n = 12$), disagree 5.4% ($n = 4$), and strongly disagree 2.2% ($n = 2$).

If singers answered “yes” to the prompt, then they were asked to comment on how the effect affected their tone quality. Positive comments from singers often referenced the aroma framing it as pleasant. One singer said, “Something about the beautiful and strong scent opened

my nasal passage and made that space feel readily and easily accessible in a pinch (during a quick inhale).” Similarly, another said, “It was interesting, inhaling the actual rose fragrance seemed to affect the breath I took in, making it full and giving me more breath support.” Another mentioned the aroma as a positive distraction, “Sometimes I think too much about my vocal production and over-control it, and I think the smell sort of distracted me and freed up my sound.” There were also negative reactions to the scent such as, “I think I got distracted a little by the rose smell so I didn't inhale as deeply as I usually do.” Negative comments also mentioned the activity as distracting, “I think it was distracting more than anything.” Two singers mentioned being sensitive to smell. One said, “I don't think I realized how sensitive I am to smell so it was very distracting. I also realized that the room already smelled like the essential oil.” The other said, “Having to resist a sniff when thinking about taking the appropriate breath for tone production. Also I'm kind of sensitive to strong smells so having it fill the room was kind of distracting to singing?”

**Imagined Rose Aroma and Rose Essential Oil**

Singers were asked if they noticed any differences in their inhalation and tone quality when comparing the imaginary aroma of the rose prompt versus the actual aroma. Singer responses were as follows: I noticed a big difference 43% ($n$ = 40), I noticed a small difference 43% ($n$ = 40), I didn’t notice a difference 11.8% ($n$ = 11), and not sure 2.2% ($n$ = 2). Singers were asked to comment on any difference they noticed. Singer comments ($N$ = 83) were coded by condition and whether the comment was positive, negative, or neutral, there was also a miscellaneous category, interrater reliability was 89.66%. Valid percent is reported as *VP*. Results were as follows: Oil-positive, $n$ = 52, 26.30%, *VP* = 38.8; Oil-neutral, $n$ = 5, 2.50%, *VP* = ; Oil-negative, $n$ = 12, 6.10%, *VP* 9.0%; Imagine-positive, $n$ = 9, 4.50%, *VP* = 6.70%; Imagine-

neutral, *n* = 2, 1.00%, *VP* = 1.50%; Imagine-negative, *n* = 21, 10.60%, *VP* = 15.70%; Miscellaneous, *n* = 33, 16.70%, *VP* = 24.6%.

Several singers commented via comparison. One singer said, “Actually inhaling the scent opened my nasal passage and encouraged it to stay open verses imagining the scent.” Another said, “When actually inhaling the aroma, I automatically breathed deeper than when imagining it.” Similarly, another said, “When I imagined the rose I didn't breathe as deeply as when I had to put in more physical effort to smell it.” This person preferred the imagery, “I noticed that imagining the smell of rose worked better for me because I got distracted by the actual smell of rose.” Another wasn’t able to imagine the scent, “I wasn't able to imagine the scent of a rose, so it didn't change anything until I actually smelled it.”

**Language Preference: Choral Tone**

There were several singers who left one or two answers blank on their singer questionnaire. The fluctuation in *N* values for this section is due to missing data. Singers (*N* = 92) were asked which of the language/experience prompts helped the choir to have the best overall tone. Results were as follows: Favorite 39.8% (*n* = 37), Oil 21.5% (*n* = 20), Literal 14% (*n* = 13), I didn’t notice a difference 11.8% (*n* = 11) and Imagine 9.7% (*n* = 9). Singers (*N* = 93) were asked to indicate which experimental condition they most preferred the choral tone in, answers were as follows: Favorite (32.3%, *n* = 30), Oil (28%, *n* = 26), Literal (10.8%, *n* = 10), Perform (7.5%, *n* = 7), Imagine (6.5%, *n* = 6), All sounded the same to me (5.4%, *n* = 5) and Not sure (6.5%, *n* = 6).

Singers (*N* = 93) were asked to what extent they could detect differences in the choral tone of the performances. Singer responses were as follows: I heard no difference (2.2%, *n* = 2), I

heard a little difference (64.5%, *n* = 60), I heard much difference (30.1%, *n* = 28), I heard very much difference (1%, *n* = 1.1), not sure (1.1%, *n* = 1).

Singers (*N* = 91) were asked what effect, if any, did they think the prompts had on the sound of the choir, results were: a moderate effect (53.8%, *n* = 50), a little effect (34.4%, *n* = 32), a big effect (9.7%, *n* = 9), no effect (2.2%, *n* = 2), and not sure (0%, *n* = 0).

**Language Preference: Individual Tone**

The fluctuation in *N* values for this section is due to missing data from the singer questionnaire. Following all performances singers (*N* = 93) were asked which type of language/experience, if any, helped them to have their best individual tone. Results were as follows: Literal 38.7% (*n* = 36), Oil 28% (*n* = 26), Favorite 18% (*n* = 18), Imagine 6.5% (*n* = 6), and I didn't notice a difference 2.3% (*n* = 2). Singers (*N* = 93) were asked to indicate which experimental condition they most preferred their individual tone in, answers were as follows: Oil (36.6%, *n* = 34), Favorite (25.8%, *n* = 24), Literal (19.4%, *n* = 18), Perform (5.4%, *n* = 5), Imagine (6.5%, *n* = 6), all sounded the same to me (4.3%, *n* = 4) and not sure (0%, *n* = 0).

Singers (*N* = 91) were asked what effect, if any, did they think the prompts had on their individual sound, results were: A moderate effect (58.1%, *n* = 54), A little effect (24.7%, *n* = 23), a big effect (15.1%, *n* = 14), no effect (2.2%, *n* = 2), and not sure (0%, *n* = 0).

**Instructional Language Preference**

Singer participants (*N* = 93) were asked which type of language they prefer to receive from their teacher. Singer responses were 66.7% (*n* = 62) prefer a combination of both metaphorical and literal language, 20.4% (*n* = 19) prefer metaphorical language (ex. imagine inhaling the aroma of a fragrant rose), and 10.8% (*n* = 10) prefer literal language (ex. inhale deeply and slowly with an open throat).

Singers ($N = 93$) were asked to use a 7-point Likert-type scale (1 strongly disagree– 7 strongly agree) to reflect their beliefs about the following statement, "I prefer conductors/voice teachers that describe how the voice works anatomically." Singer responses were as follows: somewhat agree 30.1% ($n = 28$), agree 28% ($n = 26$), neutral 22.6% ($n = 21$), strongly agree 14% ($n = 13$), disagree 4.3% ($n = 4$), somewhat disagree 1.1% ($n = 1$), and strongly disagree 0% ($n = 0$).

Singers ($N = 93$) were also asked to use a 7-point Likert-type scale (1 strongly disagree– 7 strongly agree) to reflect their beliefs about the following statement, "I prefer conductors/voice teachers that describe how the voice works using imagery/metaphorical language." Singer responses were as follows: somewhat agree 30.1% ($n = 28$), agree 20.4% ($n = 19$), neutral 20.4% ($n = 19$), strongly agree 12.9% ($n = 12$), disagree 11.8% ($n = 11$), somewhat disagree 2.2% ($n = 2$), and strongly disagree 2.2% ($n = 2$).

Singers were given the opportunity to share additional information. They were given the prompt *did you notice any changes in your singing that you'd like to share*. Additionally, they were asked *is there anything else you'd like to share about the experience*. Singer responses to both prompts were coded as, singer preference/benefit towards a particular condition, application of an experiment condition to future singing, other factors that influenced tone quality, and miscellaneous. Interrater reliability of coding for both singer prompts was 100%. Changes in singing were coded as preference/benefit, $n = 38$, 19.20%, $VP = 65.50\%$; application $n = 3$, 1.50%, $VP = 5.20\%$; other factors $n = 7$, 3.50%, $VP = 12.10\%$; miscellaneous $n = 10$, 5.10%, $VP = 17.20\%$. Is there anything else you'd like to share was coded as: preference/benefit, $n = 5$, 2.50%, $VP = 11.40\%$; application $n = 7$, 3.50%, $VP = 15.90\%$; other factors $n = 2$, 1.00%, $VP = 4.50\%$; miscellaneous $n = 30$, 15.20%, $VP = 68.20\%$.

# CHAPTER FIVE

## Discussion

### Summary

The primary purpose of this study was to explore the metaphorical imagery of rose aroma inhalation, the experience of inhaling rose aroma, and the use of semi-direct anatomical language (i.e., open throat) with the aim of determining what acoustic and perceptual effects these conditions have on choral tone. Specifically, the following research questions were addressed:

1. Will acoustic differences in choral tone quality be found between experimental conditions as measured by Long-Term Average Spectrum (LTAS)?
2. Will perceptual differences in tone quality be found between experimental conditions as measured by expert panel ratings?
3. Will perceptual differences in tone quality be found between experimental conditions as measured by singer self-perceptions ratings?
4. What themes are present in singer questionnaire responses pertaining to metaphorical and literal language use in the choral rehearsal?

### Acoustic Difference in Tone Quality

Grady and Gilliam (2020), who examined LTAS change paired with choral performance movement, reported average noticeable difference across the entire spectrum wherein one condition (full-body swaying) averaged to be 2.50 dB higher than the other two. In my study, there are five conditions as opposed to two and there was not one clear experimental condition that consistently averaged to have higher spectral energy levels than all other conditions across the full spectrum, and across all choirs, in terms of LTAS dB level. Unlike the physical movements employed by Grady and Gilliam (2020), the verbal prompts and experiential task did

not elicit a clear increase of spectral energy. Had one condition registered as having higher LTAS levels, than objectively, one could say there was a change in tone. The expert panel perceptions of choral tone seem to substantiate the claim that the language prompts and experiential task did not affect tone quality in a consistent manner. Before examining the link between spectral energy and the expert panel, individual choir LTAS will be discussed.

When looking at individual choirs in the present study, there is average noticeable difference across the spectrum that meets or exceeds the Grady and Gilliam reported 2.50 dB level. For Choir One, that average exceeded the 2.50 dB level for the full spectrum pairings of Perform & Favorite, Perform & Oil, Literal & Oil, and Imagine & Oil. Between Perform & Oil there was an average noticeable difference of 4.63 dB. The JND is approximately 1dB, so this difference is potentially quite important within the current context as these changes in dB level are perceivable. For Choir Two, no pairings exceeded the 2.50 dB difference stated earlier, but the pairing of Imagine and Oil did approach that number with an average difference of 2.19 dB. Objectively, for Choir One and Choir Two there was a change in sound that is noticeable to the human listener. This means that potentially these language prompts and the experiential task can be used to change tone. For Choir Three, the difference in spectral energy was much less. For Choir Three, no pairing reached the level of 2.50 dB. The highest average difference across the full spectrum was 1.78 dB in the Perform and Imagine pairing. This result while not as high as 2.50 dB is above the JND. Perhaps this difference in spectral energy was to the smaller size of the choice, experience level of participants, and the change of rehearsal room.

The largest full spectrum pairing differences by choir were Perform and Oil (4.63 dB, Choir One), Imagine and Oil (2.19 dB, Choir Two), and Perform and Imagine (1.78 dB, Choir Three). When looking at the full spectrum average differences between the performance

condition and all other conditions for all three choirs, there is a significant difference between perform and any other experimental condition in this study.

When examining the 2.0- to 4.0-kHz range, as Daugherty (et al. 2019) did in a similar study involving LTAS change paired with riser height and choir singer spacing, there were again significant differences when pairing the Perform condition with the other conditions, except in one instance. For Choir Two, there was not a significant difference between Perform and Oil, the change was very low at 0.07 dB. All other pairings were statistically significant at the .05 level and were above the 1 dB JND.

Upon looking at LTAS data for the lowest average noticeable change in dB across either the full spectrum or the 2.0- to 4.0-kHz range region there is similarity between Imagine and Favorite for all three choirs. All choirs across both regions resulted in a difference below the JND.

The differences between Perform and Literal and Perform and Imagine are potentially important in terms of pedagogic language choice for this study. The Perform and Imagine condition resulted in a mean difference across all choirs and both regions that was above the JND. This was not the case for Perform and Literal. In the full spectrum, Choir Three only had a mean difference of 0.53 dB. Choir One approached the JND with a level of 0.99 dB. All other results for Perform & Literal were above the JND. When rose oil was administered there were contrasting LTAS range differences. For Choir One that difference was above 4 dB in both frequency regions. For Choir Two, there was not a JND. For Choir Three, there was a JND with levels in both frequency regions above 1.4 dB.

So, how does the above LTAS information benefit choral directors? Language prompts used in this study can potentially be used to elicit perceptible change, in terms of LTAS dB level,

if the baseline is a condition in which singers are *singing as if performing*. Teachers of singers can use the prompts to see if there is a change in spectral energy. While it may not be convenient to run LTAS analysis following each rehearsal, a spectrograph can be used in the classroom to show real time feedback as to how prompts are affecting tone objectively.

Within the confines of this study, the juxtaposition between Perform & Imagine was more effective in LTAS dB level change overall, than Perform & Literal. However, it is important to note that the direct comparison between choirs should be regarded with caution due to the variability in the two research rooms. Further, rose oil was somewhat unpredictable. Within the confines of this study, it both resulted in a comparatively large change in average noticeable difference in terms of LTAS dB level, a noticeable JND level, and a level that did not reach the JND threshold.

It is also important to note that spectral energy boosts occurring in the singer's formant region (2.4–3.2 kHz) for choral singers may not be desirable for choral conductors from a preferential standpoint as this could potentially lead to issues with choral blend (McCoy, 2020).

**Expert Panel perceptual differences in tone quality**

While LTAS differences in experimental conditions, or lack of differences, were apparent by condition within individual choirs, to the expert panel, there was not a clear difference in the prompts. This substantiates LTAS data which did not indicate a trend of acoustic energy across conditions. Expert panel perceptions of choral tone were significantly different. These data suggest that although the expert panelists were given a definition for good tone quality, there were individual interpretations that potentially influenced ratings of choral tone. When looking at the Perform condition as the baseline, mean choral tone ratings by the expert panel were

significant between the Perform and Favorite condition in Choir Two and the Perform and Literal and Perform and Imagine condition for Choir Three.

The expert panel did not hear a significant difference between conditions in Choir One. Perhaps the expert panel did not detect clear changes in tone quality in Choir One because they overall were more experienced singers than those in the other two choirs. Choir One was successful in sight reading the musical excerpt the first time. Anecdotally, as an observer in the room I noticed singers seemed confident as they sang right from the start. I did not notice this same confident singing from Choirs Two and Three who required additional practice to learn the piece. Further, Choir Two and Choir Three changes in sound may have been detected not because of the prompt, but instead because the less experienced singers who could not sight read the piece as easily were becoming more comfortable with the piece over repeated singing instances. To gain insights into these changes, singer perception of the events need to be discussed.

**Singer perceptual differences in tone quality**

Contrary to the findings above, to the singers of all choirs, there were significant differences in choral tone between the Perform and Oil and Perform and Favorite conditions (in terms of mean choral tone rating). For Choir Three, there was a significant difference in all conditions when compared to Perform. For Choir One, there was a significant difference between Perform and Literal, but not Perform and Imagine.

In terms of teaching, this could potentially mean that these language prompts are linked to singer perception of choral tone and individual tone thus making them valuable teaching tools. If a singer believes one prompt helps them to sing better, than it is an important tool for educators to utilize.

When examining singer perceptions of individual tone quality change (in terms of mean individual tone rating), there again is a significant difference between Perform and all other conditions for Choir Three. For choirs One and Two, there was again significant difference between Perform and Oil and Perform and Favorite. Choir Two again did not perceive a significant difference between Perform and Literal or Perform and Imagine. For Choir One there was a change in perception between choral tone and individual tone. Singers in Choir One perceived a change in choral tone between the Perform & Literal conditions but did not perceive a change between Perform and Literal when evaluating change in individual tone.

In the post-hoc singer questionnaire singers were asked to identify the experimental condition in which the choir had the best tone quality and 32.3% of singers choose Favorite as the condition in which choral tone was perceived to be best. The Oil condition scored 28% of the votes, followed by Literal (10.8%), Perform (5.4%), and finally Imagine (6.5%). Singers were also asked to identify the experimental condition in which individual tone quality was perceived to be best. In this case, Oil was the favorite experimental condition with 36.6% of the votes. The remaining experimental conditions maintained the same preference order as with choral tone (Favorite 25.8%, Literal 19.4%, Perform 5.4%, Imagine 6.5%).

**Comparing choirs**

It should be noted that Choir One and Choir Two performed the singing task in their usual choir rehearsal space while Choir Three performed the task in an alternate choir rehearsal room. Due to this difference in singing location, direct comparisons between choral sound cannot be made across all three choirs. It is interesting to note the ranges of expert panel and singer self-perceptions between Choir One and Choir Two, as they were in the same space, but caution should be employed when accounting for Choir Three ratings.

Choir One mean ratings by the expert panel for each experimental condition ranged from 3.94 to 4.53. Choir One rated their own choral tone as 4.03–4.54 and individual tone as 3.77–4.34. Choir Two had lower expert panel ratings with a range of 1.79–2.18. Choir Two perceived their choral tone to be 3.45–4.30 with individual tone quality having a range of 3.27–3.97. For Choir Three the expert panel ratings of choral tone ranged from 2.14–3.27. The singers rated their own choral tone as 3.25–4.29, with an individual tone range of 3.25–4.25.

It is interesting to revisit singer demographics when considering these data. Choir One had the singers with the highest average age, the most average years of both choral and voice lesson singing experience, and the most average years of experience as an instrumentalist. Choir Two had the least number of years in regard to age and singing/instrumental experience. There are potentially more factors at play here than just the demographics collected (i.e., social and environmental). It is beyond the scope of the current research question to study these factors, but knowing the musical experience of the choirs may potentially influence individual interpretations of the above results.

**Themes: Metaphorical and literal language in the choral rehearsal**

Singers were asked via the post-hoc questionnaire if the language prompts effected tone quality. The condition with the most yes votes by singers was Favorite with 90.3% of singers believing the Favorite condition effected their tone quality. After Favorite, singers vote popularity by condition was Literal (81.5%), Oil (77.5%), and finally Imagine (52.4%). This order is similar to singer perceptions of which prompt was most helpful for overall choral tone which in descending popularity order were Favorite 39.8%, Oil 21.5%, Literal 14%, and Imagine 9.7%. It should be noted that 11.8% of singers said they didn't notice a difference in the choral tone between the experimental conditions.

When singers were asked which language prompt most helped individual tone quality the resulting order was different than the order for choral tone. For choral tone the percentage order from highest to lowest was Favorite, Literal, Oil, Imagine. For individual tone quality the Literal (38.70%) and the Oil (28.00%) experimental conditions surpassed Favorite. Like with choral tone, the Imagine (6.50%) prompt was the least popular in terms of percentage.

Over half of the singers (72.1%) expressed a preference for anatomical language from conductors/voice teachers when describing how the voice works. Some singers (22.6%) were neutral towards anatomical language with 5.4% expressing disagreement with anatomical language. When asked their opinion of imagery/metaphorical language when describing how the voice works 64.4% of singers agreed that they favored this type of language with 16.2% of singers expressing dislike for metaphorical language/imagery in this context. A similar percentage of singers (20.4%) again chose the neutral response this time in regard to metaphorical language/imagery.

A large percentage of singers (79.6%) reported the rose oil as an enjoyable aroma. Some (12.9%) reported feeling neutral towards it and 7.6% reported the rose oil aroma as unenjoyable. The majority of singers (86%) noticed a difference (ranging from small to large) between the experience of the rose imagery and the rose oil aroma. This is important, as the experience of the imagery is perceived to be different by singers than the experience of the rose oil.

When asked if singers had been exposed to the rose imagery metaphor in singing prior to this experience, the majority of singers said no (72%). This was surprising as the rose imagery was so pervasive in pedagogic texts. It is interesting, and quite frankly I was surprised, at the individual interpretations of the rose imagery. When singers were asked what they thought a conductor/voice teacher wanted to happen when the rose imagery was utilized in rehearsal

singers had varied responses. There were responses (33.8%) linking the imagery to breath, tone quality (20.30%), and emotion (9.00%). The rest of the responses were linked to the following concepts by singers, with no more than 7% agreeing on one concept, awareness, support, the soft palate, tension, throat, face, expression, onset, resonator, relaxation, listening, miscellaneous.

Using metaphor interpretation concepts from Lakoff and Johnson (1980) and Begy (2013) one can speculate as to why singers interpreted imagery differently from one another. The source domain can be assigned to imagined inhalation of the fragrance of a rose. The target domain is the image schemata of singing. While one cannot predict individual reactions to this experiential metaphor, we can infer as to possible reactions. The rose might be interpreted as a flower that has fragrance, open to interpretation by the interpreter's experiences with roses, *or flowers if roses have not been interacted with experientially*, and rose symbolism. Singing can be interpreted as the acts of motivation (mind-body connection), respiration, phonation, resonation, and articulation (Rosine, 2021). The structural similarities between both gestalts can be interpreted as both physical act (inhalation, possibly even holding the rose) and affective (experiencing emotional connection to the rose/flower).

For the individual who associates rose aroma with pleasantness the imagined inhalation of the rose aroma might lead to a slower inhalation time in order to experience the imaginary pleasant smell. The emotional reaction could be a positive one, perhaps even inducing relaxation, a release of tension, or an emotion unique to the individual related to their positive experience with the rose or rose symbolism, such as joy or love. Further, negative vocal habits that fall outside the metaphorical projection may reduce because those habits, such as excess tension in the singing mechanism, do not align with smelling a pleasant thing.

Those that experience a negative reaction to the smell of roses, perhaps someone with allergies or an individual who has only experienced roses at a funeral, could potentially associate the inhalation of the rose aroma with unpleasant emotions such as anxiety, stress, despair, or other emotional tension. The physical act inspired by that negative emotional reaction may be a reduction in the amount of air inhaled, a tightening up of the breathing mechanism, or a change in body alignment. When imagining inhaling the aroma of a fragrant rose, some singers who associate flowers with negative emotions might choose to create an experience in which this imaginary flower is pleasant, in which case the two gestalts might align more with the intentions of the instructor using the experiential metaphor. For the individual who has had prior experience with this metaphor within the context of singing lessons or choir, there may be an association between the inhalation of the rose and further changes in the singing mechanism, such as an opening of the throat or a lifting of the soft palate.

The experience of singing using the rose metaphor potentially does not align across individuals, the affective reaction to the structure of the experience is varied by individual experience with roses and rose symbolism (i.e., different interpretations by different people). Connection via metaphorical projection between singing and the rose metaphor influence the singer's concept of singing. When the flower gestalt is positive, perhaps singing is also regarded as positive. When the flower is a negative gestalt, how does that influence the singer's concept of singing? It's interesting to consider the ideas above in relation to data indicating differences in singer preference and interpretation of the language prompts.

Also of interest are the singer responses to the rose oil with regard to perceived release of tension and increased relaxation, as reported by some singers in their comments. Hongratanaworakit (2009) reported a relaxing-calming effect in participants exposed to rose

essential oil in his study. It is interesting to consider Hongratanaworakit's findings in relation to these singer responses.

**Strengths of the Study**

This experimental study was created using methods adapted from work by researchers who have studied choral tone using LTAS and perceptual measures (expert panel, singer self-ratings). The singer questionnaire and stimulus video were created with great care so as to be understandable by participants while also collecting all relevant data. The questionnaire and stimulus video were piloted with music majors (undergrad and graduate level) in order to strengthen validity of these tools. The expert panel questionnaire was also piloted by a music education PhD candidate in order to make sure the tool was easy to use by participants, understandable, and valid. Questions on the questionnaire were adopted from tools used in similar studies. The researcher consulted though virtual interviews with experts in the field in order to gain a better understanding of all procedures. Finally, each research space was set up with care to control experimental conditions from choir to choir and avoid potential bias in the investigation. All audio/video settings were set, and placement of the recording devices was measured in order to be consistent between choir experiments. Though care was taken in recreating conditions between experiments, there were limitations to this study.

**Limitations of the Study**

Generalizability of the current study may be limited to the individual singers and choirs that made up the convenience sample. There are confounding variables in this study that are were not accounted for. These biopsychosocial factors (i.e., relationships, mood of participants, attendance) and environmental factors (i.e., Choir Three was unable to be recorded in the same space as choirs one and two, experts listened to recordings in the location of their choosing) all

potentially affected singer and expert panel participants whose prior experience with the concepts in this study would have helped to shape their perception of events. This reminds me of the quote by Dr. Gabor Maté (2022, p. 52), “Ancient cultures have long understood that we exist in relationship to all, are affected by all, and affect all.” Perhaps this concept is at play here, in that, each participant brought personal experience with regard to the language prompts and tone quality to the study. For example, singers who have had prior experience with rose imagery in voice lessons or in the choral classroom and connect that imagery to a specific vocal technique may have altered their performance based on what they thought the researcher wanted to happen.

There is potentially a novelty effect here for rose oil. Singers may have been excited to try something new in choir. It is possible if this were to be repeated, that novelty effect of the rose aroma may wear off and singers may not like it as much as the first exposure.

Singers practiced “Jubilate Deo” 2-4 times in order to be prepared for the experiment. Choir One did not wish to practice the music more than twice before proceeding to the recording phase of the experiment. For choirs two and three, additional practice was requested by singers. After the practice phase, singers then performed the excerpt five more times. This repetition of the singing could have affected choral tone. Several singers commented that they felt the act of singing over time warmed them up, and it was through singing, not the prompts, that they thought the choirs improved. Further, this additional singing of the same piece of music may have resulted in a maturation effect. For the expert panel that was required to listen to fifteen recordings in total, that same maturation effect could have affected results.

Rose oil was used in this experiment because it is potentially cost effective for anyone wishing to implement its use for singing. Fresh roses are expensive, have a short lifespan, and offer varying levels of aroma intensity (as I discovered when using fresh roses with solo singers

for another study). The oil was chosen for its practicality and potential therapeutic benefits. The smell of rose oil is not the same experience as inhaling the aroma of a fresh rose. While the aroma may be similar, experientially, it is different (as reported by singers in this study).

**Implications for Teachers of Singing**

The current investigation produced results that may impact teaching in the voice studio as well as the choral classroom. One such implication may be teacher perception of pedagogical language use. Instructors of voice who typically utilize literal or metaphorical language may want to reconsider what type of language strategies are used in teaching. Sadoway (2021) recommended using both types of language with equal distribution when teaching voice. Based on singer preferences in the current study, it seems that this practice could be desirable within the choral classroom in addition to within voice studios. It should also be noted that some students expressed dislike for each language strategy. This is important to take into consideration when learning about individual preferences and needs of students within the choral classroom and voice studio.

Perceived tone quality was not uniformly higher in one singing condition over another. There was change of sound based on language prompts, that change was not parallel for individual singers or choirs. Teachers must have the ability to react in the moment to the sound they are hearing in order to change it as they see fit for the educational purpose. The information presented here has demonstrated that these language prompts and the rose essential oil had an effect on choral tone both acoustically and perceptually for the singers involved in the singing. Because the effect was not congruent across choirs, we cannot say one prompt is better than another for effecting tone in all involved singers, but instead, that the language prompts and oil

task potentially have the ability to change tone. It is through using these prompts and the oil task that teachers of singers can experiment to find what works for their individual educational needs.

It is important to note that the expert panel and singers did not agree on tone quality. Singer self-perceptions were often out of line with expert ratings. As a teacher, it is important to know when a student believes something is working and is potentially giving them confidence in singing. Further, if a teacher finds that a student is perceiving something differently than the teacher, it is important to acknowledge this and help the student to adapt.

**Directions for Future Research**

Margaret Daniel (1993) reminds that imagery may not work uniformly for all students and that the imagery may not produce the same result with each use. Future researchers may wish to test Daniel's theory that imagery may not produce the same result for singers when employed over repeated singing attempts using these same language prompts and the oil. It would be interesting to see how singer self-perceptions of choral tone and perception of the effectiveness of the prompts may change over repeated instances.

In the present study 28% of singers felt that their individual tone quality as best after inhaling the aroma of the rose essential oil. Due to the potential therapeutic benefits of both fresh roses and rose essential oil, it would be interesting to see how singers with performance anxiety perform with these treatments. Is there benefit in using scents in our voice studios and choral classrooms? If it is discovered that the rose oil scent alters the perception of tone in a positive manner, there are potential applications to the use of scent in the studio. Further, what are the effects of odors that are perceived as pleasant by singers on their tone?

There is important research that needs to be conducted on the effects of odors which are perceived by singers to be unpleasant while they are expected to be singing/performing.

Anecdotally, I can say that after teaching many years of high school choirs, there are unpleasant odors that can make their way into our classrooms. Therefore, it is important to consider how that impacts our singers. If scent negatively impacts perception of tone, then teachers may wish to reconsider the use of scent in the studio and strive for scent elimination in the music classroom.

Both Brown (2021) and Jacobsen (2004) encouraged the use of scientifically informed imagery. Jacobsen advocated the use of instructional language that is both pedagogically sound and physiologically correct in order to better help singers understand the vocal intent of imagistic pedagogic language. Experiments examining effects of co-constructed (student and teacher) scientifically informed imagery would be beneficial for teachers of singing. It would also be of interest to expand on Parker's (2012) work with color imagery and singing.

**Concluding Remarks**

While generalizability is limited to the choirs in this study, this experiment has provided interesting information that teachers of singing may wish to experiment with in order to evoke change in choral tone. Objectively, in many cases, there were changes in choral tone due to language prompts used in this study when comparing the Perform condition to the other conditions.

In terms of the rose oil for this study there were both noticeable and not noticeable changes in average LTAS dB level depending on the choir. This is important information because the rose oil may or may not have an effect on tone quality, thus opening the possibility of experimenting with rose oil aroma for singers who perceive it to be beneficial to their singing. Through experimentation singers can determine if rose oil is beneficial, or not, to their singing.

Rose oil was chosen for this experiment as the experiential version of the rose imagery. Through singer responses it was discovered that 86% of singers noticed a difference between the experience of the oil and imagining the aroma of the rose. I think this can inform teachers of singers in regard to imagery use. When using figurative language, it is important to consider the embodied experience with the concept in the figurative language and the embodied experience of the imagery. Singing teachers should consider both when choosing their figurative language.

While there were some singers who expressed dislike for conductor/teacher use of imagery or literal language, overall, most singers like when their instructors use both. Sadoway (2021) suggests voice practitioners train for use of both types of language with the aim of using balanced and diverse language with students/clients. I think teachers and conductors can benefit from that same training. Teachers/conductors of choirs need to be able to use varied language to connect with everyone. Further, educators of future teachers and conductors can ensure the next generation of educators are equipped to communicate with their students using both literal and figurative language by teaching both language strategies, educating on the use of scientifically informed imagery, and employing all in rehearsal and lesson settings.

# APPENDIX A

## IRB Approval

UNIVERSITY OF OREGON | Research Compliance Services

**EXEMPT DETERMINATION**

March 6, 2023

Kendra Taylor

ktaylor4@uoregon.edu

Dear Kendra Taylor:

The following research was reviewed and determined to qualify for exemption.

| | |
|---|---|
| Type of Review: | Modification / Update |
| Study Title: | Effects of literal and metaphorical language use on acoustic and perceptual measures of choral tone |
| Principal Investigator: | Kendra Taylor |
| Parent Study ID: | STUDY00000680 |
| Transaction ID: | MOD00001300 |
| Documents Reviewed: | • Appendix B-Expert Judge Panel Questionnaire v2(post pilot).pdf, Category: Survey Instrument;<br>• Research Plan IRB Choral Language v.2.pdf, Category: IRB Protocol; |
| Approval Date: | 3/6/2023 |
| Effective Date: | 3/6/2023 |
| Expiration Date: | 9/28/2024 |

**For this research, the following determinations have been made:**

- This study has been reviewed under **the 2018 Common Rule** and determined to qualify for exemption under **Title 45 CFR 46.104(d) ((3)(i)(A) Benign behavioral interventions (non-identifiable)).**

The research is approved to be conducted as described in the approved protocol using the approved materials. Approved materials can be accessed in the protocol workspace in the IRB module of the research administration portal (RAP).

All changes to this research must be assessed to ensure the study continues to qualify for exemption. Research Compliance Services has developed specific guidance to help you understand when a modification is required before a change can be implemented. It is your responsibility to ensure modifications are submitted when required and approval secured before implementing changes to the protocol

Continuing Review is not required for this study. **An institutional approval period has been established based on your application materials.** If you anticipate the research will continue beyond the approval period, you must submit a **Continuing Review Application** at least 45-days days prior to the expiration date. A closure report must be submitted once

human subject research activities are complete. Failure to maintain current approval or properly close the protocol constitutes non-compliance.

With the submission of your request, you agreed to uphold the responsibilities of the Principal Investigator and have agreed to follow the requirements listed in the Investigator Manual (HRP-103), which can be found by navigating to the IRB Library within the IRB module of the RAP.

If you have any questions regarding your protocol or the review process, please contact Research Compliance Services at ResearchCompliance@uoregon.edu or (541)346-2510. The University of Oregon and Research Compliance Services appreciate your commitment to the ethical and responsible conduct of research with human subjects.

***Please consider completing our user satisfaction survey. It only takes a few minutes, and we would like to hear about your experience working with our office!***

Sincerely,

Research Compliance Services
*on behalf of the Committee for Protection of Human Subjects*

cc: Melissa Brunkan

# APPENDIX B

Singer Recruitment Materials

Dear singers,

This Thursday you'll be asked to participate in a research study. Attached, you'll find information on what will take place. There is nothing you need to do at this time aside from looking at the attached form. I just wanted you to have the opportunity to learn more about Thursday so you can make an informed decision about participation. I would encourage you to read this form ahead of time in order to save time in class on Thursday. If you read it now, and choose to participate, then all you need to do is sign the form in class. This will allow us to get started faster.

*Note.* Singers were given informed consent materials (see Appendix G).

# APPENDIX C

## Expert Panel Demographics

| Participant | Age | Gender (1 male, 2 female, 3 nonbinary, 4 other) | Highest degree (1 BA/BS, 2 MM, 3 PhD/DMA) | Total years voice teaching/coaching/professional experience | Total years choir teaching/conducting/professional experience | Children's choir 0 no, 1 yes | MS choir 0 no, 1 yes | HS choir, 0 no, 1 yes | Church 0 no, 1 yes | Community 0 no, 1 yes | Collegiate 0 no, 1 yes | Levels of choir taught (1-6) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 96 | 48 | 2 | 2 | 25 | 25 | 1 | 1 | 1 | 1 | 1 | 0 | 5 |
| 97 | 70 | 2 | 1 | 45 | 30 | 1 | 0 | 0 | 1 | 1 | 0 | 3 |
| 98 | 36 | 1 | 1 | 11 | 15 | 1 | 1 | 1 | 0 | 1 | 0 | 4 |
| 99 | 29 | 1 | 2 | 1 | 5 | 0 | 0 | 1 | 0 | 0 | 1 | 2 |
| 102 | 64 | 2 | 2 | 40 | 30 | 0 | 0 | 0 | 1 | 1 | 0 | 2 |
| 103 | 48 | 1 | 2 | 20 | 20 | 1 | 1 | 1 | 1 | 1 | 1 | 6 |
| 104 | 63 | 2 | 2 | 40 | 40 | 1 | 1 | 1 | 1 | 0 | 0 | 4 |
| 105 | 59 | 2 | 3 | 25 | 25 | 0 | 1 | 1 | 1 | 1 | 0 | 4 |
| 106 | 71 | 2 | 2 | 35 | 47 | 1 | 1 | 1 | 1 | 1 | 1 | 6 |
| 107 | 25 | 2 | 2 | 3 | 6 | 0 | 1 | 1 | 1 | 1 | 1 | 5 |
| 108 | 37 | 2 | 2 | 15 | 15 | 1 | 1 | 1 | 0 | 0 | 0 | 3 |
| 109 | 65 | 1 | 3 | 0 | 30 | 0 | 0 | 0 | 1 | 1 | 1 | 3 |
| 110 | 82 | 2 | 2 | 40 | 61 | 1 | 1 | 1 | 1 | 1 | 1 | 6 |
| 111 | 64 | 2 | 2 | 35 | 33 | 1 | 1 | 1 | 1 | 0 | 1 | 5 |
| 112 | 46 | 1 | 2 | 24 | 24 | 1 | 0 | 0 | 0 | 1 | 0 | 2 |
| 113 | 30 | 1 | 2 | 6 | 6 | 0 | 1 | 1 | 1 | 0 | 1 | 4 |
| 114 | 40 | 1 | 3 | 15 | 18 | 1 | 1 | 1 | 1 | 1 | 1 | 6 |
| 115 | 63 | 1 | 3 | 47 | 47 | 1 | 1 | 1 | 1 | 1 | 1 | 6 |
| 117 | 41 | 2 | 2 | 5 | 20 | 1 | 1 | 1 | 0 | 0 | 0 | 3 |
| 118 | 59 | 1 | 3 | 38 | 35 | 1 | 1 | 1 | 1 | 1 | 0 | 5 |
| 119 | 65 | 2 | 3 | 6 | 43 | 1 | 1 | 1 | 0 | 0 | 1 | 4 |
| 120 | 45 | 2 | 2 | 22 | 22 | 1 | 1 | 1 | 1 | 1 | 0 | 5 |
| 121 | 38 | 1 | 3 | 3 | 16 | 1 | 1 | 1 | 1 | 0 | 1 | 5 |
| 122 | 31 | 1 | 2 | 8 | 8 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 123 | 72 | 1 | 2 | 47 | 42 | 1 | 1 | 1 | 1 | 1 | 0 | 5 |
| 124 | 43 | 1 | 3 | 21 | 21 | 1 | 1 | 1 | 1 | 1 | 1 | 6 |
| 125 | 47 | 2 | 2 | 25 | 25 | 1 | 1 | 1 | 0 | 0 | 0 | 3 |
| 126 | 35 | 1 | 1 | 20 | 15 | 0 | 0 | 1 | 0 | 0 | 1 | 2 |
| 127 | 33 | 1 | 2 | 8 | 10 | 1 | 0 | 1 | 1 | 1 | 1 | 5 |
| 128 | 54 | 2 | 1 | 30 | 30 | 1 | 1 | 1 | 1 | 0 | 0 | 4 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 129 | 58 | 2 | 2 | 38 | 38 | 0 | 0 | 0 | 1 | 1 | 1 | 3 |
| 131 | 35 | 2 | 3 | 15 | 15 | 1 | 1 | 1 | 1 | 1 | 1 | 6 |
| 132 | 70 | 1 | 1 | 20 | 30 | 1 | 1 | 1 | 0 | 0 | 0 | 3 |
| 133 | 50 | 1 | 3 | 30 | 30 | 1 | 1 | 1 | 1 | 0 | 1 | 5 |
| 134 | 39 | 1 | 2 | 14 | 14 | 1 | 1 | 1 | 1 | 1 | 1 | 6 |
| 137 | 61 | 1 | 3 | 47 | 47 | 1 | 1 | 1 | 1 | 1 | 1 | 6 |
| 138 | 64 | 2 | 2 | 41 | 41 | 1 | 1 | 1 | 1 | 1 | 0 | 5 |
| 139 | 66 | 2 | 2 | 20 | 40 | 1 | 0 | 1 | 1 | 1 | 0 | 4 |
| 140 | 66 | 1 | 2 | 35 | 35 | 0 | 1 | 1 | 0 | 1 | 1 | 4 |
| 141 | 66 | 2 | 3 | 22 | 11 | 0 | 1 | 1 | 1 | 1 | 1 | 5 |
| 142 | 36 | 2 | 2 | 4 | 8 | 1 | 1 | 1 | 0 | 0 | 1 | 4 |
| 143 | 29 | 2 | 1 | 0 | 6 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| 144 | 57 | 2 | 2 | 35 | 35 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| 145 | 38 | 1 | 2 | 15 | 15 | 0 | 0 | 1 | 1 | 1 | 1 | 4 |
| 146 | 42 | 2 | 3 | 20 | 17 | 1 | 1 | 1 | 1 | 1 | 1 | 6 |
| 147 | 63 | 2 | 3 | 37 | 35 | 1 | 1 | 1 | 1 | 1 | 1 | 6 |
| 148 | 59 | 2 | 2 | 37 | 37 | 1 | 1 | 0 | 1 | 0 | 0 | 3 |
| 149 | 41 | 2 | 3 | 18 | 18 | 0 | 0 | 1 | 1 | 0 | 1 | 3 |
| 150 | 66 | 1 | 2 | 30 | 30 | 0 | 0 | 1 | 1 | 1 | 0 | 3 |
| 151 | 44 | 2 | 3 | 21 | 21 | 1 | 1 | 0 | 1 | 0 | 1 | 4 |
| 152 | 30 | 1 | 1 | 15 | 8 | 0 | 1 | 1 | 1 | 0 | 0 | 3 |
| 153 | 43 | 1 | 1 | 13 | 13 | 0 | 1 | 1 | 1 | 0 | 0 | 3 |
| 154 | 38 | 1 | 2 | 17 | 17 | 1 | 1 | 1 | 1 | 1 | 1 | 6 |
| 155 | 55 | 1 | 2 | 32 | 32 | 1 | 1 | 1 | 1 | 1 | 1 | 6 |
| 156 | 44 | 2 | 3 | 22 | 22 | 1 | 1 | 1 | 0 | 1 | 1 | 4 |
| 157 | 71 | 2 | 3 | 47 | 47 | 1 | 0 | 0 | 1 | 1 | 1 | 4 |
| 158 | 34 | 1 | 2 | 9 | 9 | 1 | 0 | 0 | 1 | 1 | 1 | 4 |
| 159 | 51 | 1 | 2 | 26 | 26 | 0 | 1 | 1 | 1 | 1 | 1 | 5 |
| 160 | 42 | 2 | 2 | 20 | 20 | 1 | 1 | 1 | 0 | 0 | 0 | 3 |
| 161 | 75 | 1 | 2 | 48.0 | 51.0 | 1 | 1 | 1 | 0 | 0 | 0 | 3 |
| 162 | 37 | 2 | 2 | 13.0 | 13.0 | 0 | 1 | 1 | 1 | 1 | 1 | 5 |
| 164 | 54 | 1 | 2 | 32.0 | 30.0 | 1 | 1 | 0 | 1 | 1 | 0 | 4 |

# APPENDIX D

Expert Panel Recruitment Materials

We are seeking participants for a study of music teachers' perceptions. Are you a choral director? Are you a music teacher/professional with experience teaching choir (K-12, community, collegiate, youth)? If so, your responses would be helpful in a research project examining choral tone. The questionnaire is available online and takes about 15-20 minutes to complete. This study has been approved by the University of Oregon Institutional Review Board, and all responses are anonymous and confidential.

Click (or copy and paste) the link below to participate:
https://forms.gle/mmNqzmm3pf6oyyrM9

Thank you in advance for your participation. Should you have any questions, please feel free to contact me:

Kendra Taylor (PhD candidate), principal investigator

# APPENDIX E

Stimulus Video Script

1a. Instructional text displayed on screen (audio doubles written text): Participating in research is voluntary. It won't affect you or your grade if you choose not to participate. There are no foreseeable risks or discomforts, although singers that may have an adverse reaction to the smell of flowers should not participate. You may drop out of this study at any time without penalty. You will be asked to sing "Jubilate Deo" while imagining the aroma of a fresh rose, you will also be asked to sing with the aroma present in the room. Following the singing, you will be asked to complete a questionnaire about your experience. The anticipated time commitment is 20 minutes plus time required to answer the questionnaire. Please contact Kendra Taylor at XXXX@uoregon.edu if you have any questions. Please compete part 1 of the singer questionnaire. Please pause the video now until all have completed part 1.

2.You will be asked to sing "Jubilate Deo" five times today. You will be given different instructions for each repetition. After singing each repetition you will be asked to answer a few questions about your tone and the overall choral tone. In a moment, we'll practice singing "Jubilate Deo" with the video conductor. You will all sing in unison, then sing the excerpt as a round, offset by 4 beats. Group 1 starts, followed by group 2, then group 3, and finally group 4. Please sing the round a total of four times, once unison, and three more times as a canon. When you arrive on your final /ɑ/ of "alleluia" on that fourth repetition hold the /ɑ/ until the conductor releases the note. Let's practice.

3. Conductor video

*Note for conductor: 75 bpm, give 1 bar prep, excerpt is sung in unison, then in a four-part canon*

*three more times, then the final /a/ is held and released together. Group 1 (soprano), 2 (tenor), 3 (alto), 4 (bass).*

4. Instructional text displayed on screen (audio doubles written text): Now that you have an idea of the roadmap, let's practice one more time. You will now sing without accompaniment.

5. Conductor video

6. Instructional text displayed on screen (audio doubles written text): You will be given a prompt before singing each time. Think about the prompt and apply it as you sing for the entire duration of that performance. After singing you will be asked to answer a few questions about your experience, please pay attention to your tone and the tone of the ensemble. Here is your first prompt.

7. Instructional text displayed on screen (audio doubles written text): Think about the prompt and apply it as you sing for the entire duration of the performance. Prompt 1: Sing as if you are performing.

8. Conductor Video

9. Instructional text displayed on screen (audio doubles written text): In part two of your questionnaire, complete the questions for prompt 1. You have 60 seconds. *Animation depicting 60 second timer displayed.* Next prompt. Think about the prompt and apply it as you sing for the entire duration of the performance. Prompt 2: For every inhalation, inhale slowly and deeply with an open throat.

10a. Conductor Video

10b. Instructional text displayed on screen (audio doubles written text): In part two of your questionnaire, complete the questions for prompt 2. You have 60 seconds. *Animation depicting 60 second timer displayed.*

11. Next prompt. Think about the prompt and apply it as you sing for the entire duration of the performance. Prompt 3: For every inhalation, imagine you are inhaling the aroma of a fragrant rose.

12a. Conductor Video

12b. Instructional text displayed on screen (audio doubles written text): In part two of your questionnaire, complete the questions for prompt 3. You have 60 seconds. *Animation depicting 60 second timer displayed.*

13. Instructional text displayed on screen (audio doubles written text): Next prompt. Think about the previous two prompts. Option 1: For every inhalation, inhale slowly and deeply with an open throat. Option 2: For every inhalation, imagine you are inhaling the aroma of a fragrant rose. Choose your favorite prompt. It can be the imagery of the rose or thinking about an open throat, or a combination of both. Choose your favorite prompt to think about for this performance.

14a. Conductor Video

14b. Instructional text displayed on screen (audio doubles written text): In part 2 of your singer questionnaire complete questions for prompt 4. You have 60 seconds. *Animation depicting 60 second timer displayed.*

15. Instructional text displayed on screen (audio doubles written text): For your next task you will be asked to inhale the aroma of a fragrant rose. In a moment you'll be asked to pause the video so the rose aroma can be distributed. All singers will receive a Ziplock bag containing a cotton ball with one drop of rose essential oil in it. As you obtain your bag, you are welcome to grab gloves so as to avoid touching the oil. When you receive your bag, take your cotton ball out of the bag then seal the bag. After everyone is holding a cotton ball in their hand, you may resume the video. Do not hold the cotton ball up to your nose yet. Please distribute the bags now as you pause the video.

16. Pause Video Screen

17. Hold the cotton ball away from your body. By changing the distance of the cotton ball from your nose you can alter the potency of the aroma. Right now, you can experiment with the cotton ball; find the distance in which you can smell the aroma of the rose and it is neither too weak to smell nor overpowering. Remember this distance and smell the rose aroma from your cotton ball from this distance each time you inhale in the next portion of our singing.

18. Prompt 4 Think about the prompt and apply it as you sing for the entire duration of the performance. For every inhalation, inhale the fragrance of a rose.

19a. Conductor Video

19b. Instructional text displayed on screen (audio doubles written text): In part 2 of your singer questionnaire complete questions 5. You have 60 seconds. *Animation depicting 60 second timer displayed.*

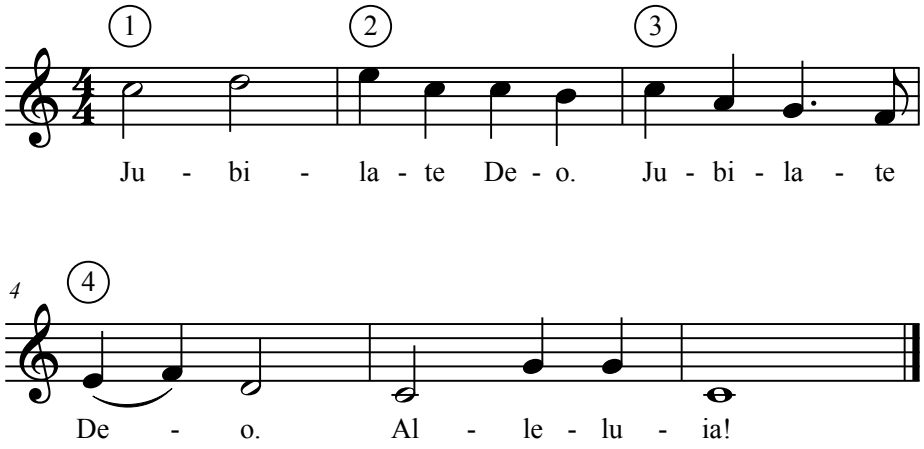
20. Please seal your cotton ball back in the Ziploc bag then complete the rest of the questionnaire about your experience today. You are welcome to take your rose scented cotton ball with you when you leave today, or you can throw it away. Thank you for your participation today. Please complete part III of your questionnaire now.

**APPENDIX F**

Sheet Music

# Jubilate Deo

**Michael Praetorius**




Sing the round a total of four times

- Once in unison (in your octave)
- Three more times as a canon

When you arrive on your final/a/ of “alleluia”
hold the /a/ until the conductor releases the note

# APPENDIX G

Singer Informed Consent

**Consent for Research Participation**

**Title:** Jubilate Deo
**Researcher:** Kendra Taylor, University of Oregon
**Researcher Contact Info:** XXXX@uoregon.edu

You are being asked to participate in a research study. The box below highlights key information about this research for you to consider when making a decision whether or not to participate. Carefully consider this information and the more detailed information provided below the box. Please ask questions about any of the information you do not understand before you decide whether to participate.

| **Key Information for You to Consider** |
|---|
| • **Voluntary Consent**. You are being asked to volunteer for a research study. It is up to you whether you choose to participate or not. There will be no penalty or loss of benefits to which you are otherwise entitled if you choose not to participate or discontinue participation.<br>• **Purpose**. The purpose of this research is to examine singing under multiple conditions.<br>• **Duration.** It is expected that your participation will last ~40 minutes.<br>• **Procedures and Activities.** You will be asked to sing "Jubilate Deo" while imagining the aroma of a fresh rose, you will also be asked to sing with the aroma present in the room. Following the singing, you will be asked to complete a questionnaire about your experience.<br>• **Risks.** There are no foreseeable risks or discomforts, although singers that may have an adverse reaction to the smell of flowers should not participate.<br>• **Benefits**. Some of the benefits that may be expected include information for the choral profession.<br>• **Alternatives.** Participation is voluntary and the only alternative is to not participate. It won't affect you or your grade if you choose not to participate. You may drop out of this study at any time without penalty. |

**STATEMENT OF CONSENT**

I consent to participate in this study.

| Name of Adult Participant | Signature of Adult Participant | Date |
|---|---|---|

**Researcher Signature** (to be completed at time of informed consent)
I have explained the research to the participant and answered all of his/her questions. I believe that he/she understands the information described in this consent form and freely consents to participate.

| | | |
|---|---|---|
| Name of Research Team Member | Signature of Research Team Member | Date |

---

**Who is conducting this research?**
The researcher (Kendra Taylor) from University of Oregon is asking for your consent to this research.

**Why is this research being done?**
The purpose of the research is to examine singing under multiple conditions. You are being asked to participate because you sing in a choir. About 120 people will take part in this research.

**How long will I be in this research?**
We expect that your participation will last about 40 minutes.

**What happens if I agree to participate in this research?**
If you agree to be in this research, your participation will include singing to a stimulus video, and you will inhale the aroma of rose essential oil. We will tell you about any new information that may affect your willingness to continue participation in this research.

**What happens to the information collected for this research?**
Information collected for this research will be used advance the choral profession.

**How will my privacy and data confidentiality be protected?**
We will take measures to protect your privacy including assigning participant identification numbers. We will not collect an identifying information. Despite taking steps to protect your privacy, we can never fully guarantee your privacy will be protected.
We will take measures to protect the security of all your personal information including storing all responses on a password protected computer. Despite these precautions to protect the confidentiality of your information, we can never fully guarantee confidentiality of all study information.
Individuals and organization that conduct or monitor this research may be permitted access to and inspect the research records. This may include access to your private information and choral audio recording. These individuals and organizations include: University of Oregon.

**What are the risks if I participate in this research?**
The risks or discomforts of participating in this research include an adverse reaction to the inhalation of the aroma of 10% rose essential oil.

**What are my responsibilities if I choose to participate in this research?**
If you take part in this research, you will be responsible to sing "Jubilate Deo" while imagining the aroma of a fresh rose, you will also be asked to sing with the aroma present in the room. Following the singing, you will be asked to complete a questionnaire about your experience.

**What other choices do I have besides participation in this research?**
It is your choice to participate or not to participate in this research.

**What if I want to stop participating in this research?**
Taking part in this research study is your decision. Your participation in this study is voluntary. You do not have to take part in this study, but if you do, you can stop at any time. You have the right to choose not to participate in any study activity or completely withdraw from continued participation at any point in this study without penalty or loss of benefits to which you are otherwise entitled. Your decision whether or not to participate will not affect your relationship with the researchers or the University of Oregon.

**Will it cost me money to take part in this research?**

No.

**What if I am injured because of participating in this research?**
If you are injured or get sick because of being in this research, contact the researcher immediately.

**Will I be paid for participating in this research?**
No.

**Who can answer my questions about this research?**
If you have questions, concerns, or have experienced a research related injury, contact the research team at:

Kendra Taylor
XXXX@uoregon.edu

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**APPENDIX H**

Singer Questionnaire

**Singer Questionnaire**

# Part I

1. What is your participant ID? _

2. What is your age? _____ years

3. What part do you generally sing in choir? (circle one)

Soprano Alto Tenor Bass

4. How many years have you worked with a teacher in one-on-one voice lessons? _____years

5. How many years have you sung in choirs? _____ years

6. Are you an instrumentalist? (circle one) Yes No

6A. If yes: What instruments do you play?

_____

6B How many years have you played those instruments?

Instrument 1: _____ for _____ years

Instrument 2: _____ for _____ years

6C Were you an instrumentalist before singing in choir or taking voice lessons?

(circle one) Yes No

**Please rate how much you agree with the following prompts according to the scale:**

| Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

7. I often react to odors that others do not initially notice

| Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

8. I seem to notice smells that other people do not

| Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

9. I rarely notice smells

| Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

10. On a scale of 1-7 how would you rate your vocal health today? (choose and circle one number on the scale)

UNHEALTHY 1 2 3 4 5 6 7 HEALTHY

# Part II

*For this questionnaire good tone quality is defined as consistent, clear, free, rich, ringing, and resonant.*

## Prompt 1

Rate **your overall tone quality** for this performance (circle one number)

(poor tone quality) 1 2 3 4 5 (good tone quality)

Rate **the choir's overall tone quality** for this performance (circle one number)

(poor tone quality) 1 2 3 4 5 (good tone quality)

# Prompt 2

Rate **your overall tone quality** for this performance (circle one number)

(poor tone quality) 1 2 3 4 5 (good tone quality)

Rate **the choir's overall tone quality** for this performance (circle one number)

(poor tone quality) 1 2 3 4 5 (good tone quality)

Did the prompt "breathe in slowly and deeply with an open throat" effect your tone quality? (circle one)

Yes No

If you answered yes, how did breathing in slowly and deeply with an open throat effect your tone quality? Please comment:

# Prompt 3

Rate **your overall tone quality** for this performance (circle one number)

(poor tone quality) 1 2 3 4 5 (good tone quality)

Rate **the choir's overall tone quality** for this performance (circle one number)

(poor tone quality) 1 2 3 4 5 (good tone quality)

Did the prompt "imagine you are inhaling the aroma of a fragrant rose." effect your tone quality? (circle one)

Yes No

If you answered yes, how did imagining you are inhaling the aroma of a fragrant rose effect your tone quality? Please comment:

# Prompt 4

Rate **your overall tone quality** for this performance (circle one number)

(poor tone quality) 1 2 3 4 5 (good tone quality)

Rate **the choir's overall tone quality** for this performance (circle one number)

(poor tone quality) 1 2 3 4 5 (good tone quality)

When asked to pick your favorite direction, or to combine the directions, what did you choose to think about? (check one)

- ___ Option 1: For every inhalation, breathe in slowly and deeply with an open throat.
- ___ Option 2: For every inhalation, imagine you are inhaling the aroma of a fragrant rose.
- ___ Option 3: Combination of both (imagery and breathe slowly/deeply with an open throat)

Did your choice effect your tone quality? (circle one)

Yes No

If you answered yes, how did your choice effect your tone quality? Please comment:

# Prompt 5

Rate **your overall tone quality** for this performance (circle one number)

(poor tone quality) 1 2 3 4 5 (good tone quality)

Rate **the choir's overall tone quality** for this performance (circle one number)

(poor tone quality) 1 2 3 4 5 (good tone quality)

Did the prompt "inhale the aroma of a fragrant rose" effect your tone quality? (circle one)

Yes No

If you answered yes, how did inhaling the aroma of a fragrant rose effect your tone quality? Please comment:

# Part III

For this questionnaire good tone quality is defined as consistent, clear, free, rich, ringing, and resonant. Please answer based on your first instinct, answers can be concise.

**Singing Prompts**

- 1: Sing as if you are performing
- 2: For every inhalation, inhale slowly and deeply with an open throat.
- 3: For every inhalation, imagine you are inhaling the aroma of a fragrant rose.
- 4: Choose your favorite prompt. It can be the imagery of the rose or thinking about an open throat, or a combination of both.
- 5: For every inhalation, inhale the aroma of the fragrant rose.

1. As an individual singer, which type of language/experience, if any, helped **you** to have your best tone? (check one)
    - ___ Breathe in slowly and deeply with an open throat
    - ___ Inhale as if you are breathing in the fragrance of a rose
    - ___ Choose your own (imagine rose, breathe slow/open throat, combination)
    - ___ Breathe in the aroma of a rose
    - ___ I didn't notice a difference

2. In your opinion, which type of language/experience, if any, helped **the choir** to have the overall best tone? (check one)
    - ___ Breathe in slowly and deeply with an open throat
    - ___ Inhale as if you are breathing in the fragrance of a rose
    - ___ Choose your own (imagine rose, breathe slow/open throat, combination)
    - ___ Breathe in the aroma of a rose
    - ___ I didn't notice a difference

3. Did you detect differences in the choral tone of the performances? (check one)
    - ___ I heard no difference
    - ___ I heard a little difference
    - ___ I heard much difference
    - ___ I heard very much difference
    - ___ Not sure

4. I preferred the choral tone of the: (check one)
   - ___ First performance (Sing as if you are performing)
   - ___ Second performance (breathe in slowly and deeply with an open throat)
   - ___ Third performance (inhale as if you are breathing in the fragrance of a rose)
   - ___ Fourth performance (choose your own [imagine rose, breathe slow/open throat, combination])
   - ___ Fifth performance (Breathe in the aroma of a rose)
   - ___ All sounded the same to me
   - ___ Not sure

5. I preferred my individual tone in (check one)
   - ___ First performance (Sing as if you are performing)
   - ___ Second performance (breathe in slowly and deeply with an open throat)
   - ___ Third performance (inhale as if you are breathing in the fragrance of a rose)
   - ___ Fourth performance (choose your own [imagine rose, breathe slowly/deeply with an open throat, combination])
   - ___ Fifth performance (Breathe in the aroma of a rose)
   - ___ All sounded the same to me

6. What effect, if any, do you think the prompts had on the **sound of this choir**? (check one)
   - ___ No effect
   - ___ A little effect
   - ___ A moderate effect
   - ___ A big effect
   - ___ Not sure

7. What effect, if any, do you think the prompts had on your **individual sound**? (check one)
   - ___ No effect
   - ___ A little effect
   - ___ A moderate effect
   - ___ A big effect
   - ___ Not sure
   -

8. You imaged inhaling the aroma of a fragrant rose, then you were asked to actually inhale the aroma of a rose. Did you notice any differences in your inhalation and tone quality between the imaginary aroma versus the actual aroma? (check one)

- ___ I noticed a big difference
- ___ I noticed a small difference
- ___ I didn't notice a difference
- ___ Not sure

If you noticed a difference, please explain what you noticed about your inhalation, your body, or your tone quality.

Please comment:

9. Did you hold the cotton ball as far away as possible and/or place the cotton ball on the ground?

Yes No

10. Please rate how much you agree with the following prompt according to the scale below:

I enjoy the aroma of the rose essential oil.

| Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

11. Have you ever been asked in choir or a voice lesson to imagine you are inhaling the aroma of a fragrant rose? (circle one)

Yes No

12. What do you think conductor/music teacher wants you to change when they ask you to imagine you are inhaling the aroma of a fragrant rose?

Please comment:

13. As a singer, which type of language do you prefer to receive from your teacher? (check one)

- ___ Metaphorical language (ex. Imagine a rose)

- ___ Literal language (ex. inhale with an open throat)
- ___ A combination of both metaphorical and literal language

Circle the answer on the scale below each prompt that best reflects your beliefs about the following statement:

| Strongly Disagree | Disagree | Somewhat Disagree | Neutral | Somewhat Agree | Agree | Strongly Agree |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

14. I prefer conductors/voice teachers that describe how the voice works anatomically.

| Strongly Disagree | | | Neutral | | | Strongly Agree |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

15. I prefer conductors/voice teachers that describe how the voice works using imagery/metaphorical language.

| Strongly Disagree | | | Neutral | | | Strongly Agree |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

16. Did you notice any changes in your singing that you'd like to share?
Please comment:

17. Is there anything else you'd like to share about the experience?
Please comment:

# APPENDIX I

## Singer Comments

| 1. Participant ID | If you answered yes, how did breathing in slowly and deeply with an open throat effect your tone quality? Please comment: | If you answered yes, how did imagining you are inhaling the aroma of a fragrant rose effect your tone quality? Please comment: | When asked to pick your favorite direction, or to combine the directions, what did you choose to think about? 1 literal, 2 imagery, 3 combo | If you answered yes, how did your choice effect your tone quality? Please comment: | If you answered yes, how did inhaling the aroma of a fragrant rose effect your tone quality? Please comment: | (from 8a 8. You imagined inhaling...did you notice diff between imagine vs. actual inhale) 8b. If you noticed difference, please comment | 12. what do you think conductor/music teacher wants when ask you to imagine...rose? comment | 16. Did you notice any changes in your singing that you'd like to share? Comment | 17. Is there anything else you'd like to share about the experience? comment |
|---|---|---|---|---|---|---|---|---|---|
| 1 | I was more aware of my space and vowels. I felt more supported in the phrasing. my tone was more warm and rich. | I think my breaths were more shallow. My tone was less supported. We sang more gently. | 1 For every inhalation....with an open throat | I felt my tone was more full and free. | I was more aware of each breath. It was more shallow than normal because I was using my nose at first. | We sung more sensitively. I was intentional about each breath. | The approach to tone. We listened more. | The combination helped because I could think of both to get a full breath and change my tone with the metaphor. | |
| 2 | Felt more free. Had to adjust more often to stay in that place but it was definitely an easier space to start form. | I actually feel it had a negative effect...My throat felt more closed. The choir sounded thin in timbre. | 1 For every inhalation....with an open throat | Freer, more open, more grounded. | I liked the upward space I felt but then it felt shallow at times. I also felt a little light headed. | I just found it hard to imagine w/o an actual thing in front of me. | Soft palate raise? More delicate onset? | | I like "tangible" things, or structural things to anchor on while singing. |
| 3 | It allowed myself time to think and prepare my space instead of using a quick breath. | It felt as though my soft palate immediately knew to lift, making it easier to sing | 3 combination of both (open and imagery) | The decision elicited a response of relaxation throughout my body, ultimately improving my tone. | Something about the beautiful and strong scent opened my nasal passage and made that space feel readily and easily accessible in a pinch (during a quick inhale). | Actually inhaling the scent opened my nasal passage and encouraged it to stay open verses imagining the scent. | Overall internal placement within the mouth and nasal cavity. Raising the soft palate and depressing the tongue. | My tone on the high E only changed/improved when I actually had the rose scent. | It is very interesting to participate and be introspective. |
| 4 | I felt focusing on this prompt distracted me from other technique things. | The imagery helped inform the musicality of the performance. | 3 combination of both (open and imagery) | | It was hard to tell if mine changed, but I felt the overall sound improved. | I felt like imagining the aroma was most effective. | Tone quality | | |
| 5 | It made me more comfortable, relaxed, and | It made it a little softer and gentler. | 2 for every inhalation...imagine | Again softer and gentler, but | It made it brighter because the | The real smell would | They want a warmer, more legato, | No | No, thank you Kendra! |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | made my sound come out clearer and stronger. | | | not as much as the previous. | smell was pleasant. | catch me off guard but also gave me pleasure that I didn't have to imagine. The surprise of the fragrance made me think more about my inhalation. | relaxed, and lovely sound. | | |
| 6 | Improved my vowel preparation | Made me breathe from my nose making my vowel onsets worse. also my throat felt less clear. | 1 For every inhalation....with an open throat | Helped me have better breath management | made me conscious of when I was breathing and how | The sensory experience attached to my breathing increased my awareness | To breathe through your nose like you are enjoying it | | |
| 7 | Created a more relaxed & free sound (better placement, in the upper register, more attention to vowel purity. | I think it warmed up my sound a little bit, but the association with smelling had me breathing through my nose - not ideal, haha | 2 for every inhalation...imagine | Placement locked in - freer & warmer sound. | Having to resist a sniff when thinking about taking the appropriate breath for tone production. Also I'm kind of sensitive to strong smells so having it fill the room was kind of distracting to singing? | I think the imaginary rose was productive to my tone production, whereas the actual smell was kind of an impediment. | Relax your tone or take a better breath. | | |
| 8 | It encouraged me to open my mouth wider/taller | It helped me opened my soft palate | 3 combination of both (open and imagery) | Taller vowel, better breath support (more air), more shapes in phrasing from the imaging. | I breath through my mouth and therefore could not smell much of the rose while singing. | | To breath more, open the back of our mouth, and sing with warmer tone. | | |
| 9 | It made my tone quality better because my voice felt more supported. | | 1 For every inhalation....with an open throat | Like before, my singing felt more supported which made my tone quality better | Because I was focused on smelling the rose fragrance, I was able to take a really deep breath that supported my tone quality | When I wasn't just pretending to inhale the fragrance, it was easier for me to really take a deep breath so I | I would think that the conductor wants us to feel what it's really like to take a deep enough breath. | I think that in the future I'll think more about inhaling a fragrance to assure I get a good breath. | I'd like to hear about others experience with this. |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | [illegible any?] more. | could smell it. | | | |
| 10 | Emphasis on breath support and proper techniques, focus on an overall more open sound from within | Open my soft pallate as well as providing a visual image for the "sound" | 3 combination of both (open and imagery) | Emphasis on technique but also an emotional and sensory quality to apply | I don't think I realized how sensitive I am to smell so it was very distracting. I also realized that the room already smelled like the essential oil. | Less breath, rose oil was very strong so avoided taking deeper breaths in | Emotion and feeling | Imagery effecting the tone behind a piece | :) |
| 11 | It made me think more about supporting my sound so I had a more resonant and full sound. | It helped my soft pallete rise. So there was more space in my mouth. | 3 combination of both (open and imagery) | My sound was much darker than previously | My tune was more full when smelling the rose scent because it made me want to breathe more deeply to smell the smell | My inhalation was deeper so my sound was most supported when smelling the aroma | raise soft pallete | | |
| 12 | I had time to breath in the vowel I was about to sing and my phrases were fuller in sound due to more support | I think it made my phrases more emotional and happy like Jubilate deo is suppost to imply | 3 combination of both (open and imagery) | Smelling the "Rose" made me want to breathe in more deeply to imagine getting more scent | It made me feel happy and want to put more emotional swells in the music. I also breathed very deeply to try and get more rose scent. | When I imagined the rose I didn't breathe as deeply as when I had to put in more physical effort to smell it. | Think pleasantly about what you are singing to invoke more emotion in the song. I think the deep breath of the rose is more natural. | | It was fun |
| 13 | I feel like it was a good reminder to prep the space before singing and continue to hold. | For me (and as a group) I feel the tone was richer, more resonant but more sensitive. | 3 combination of both (open and imagery) | Open + resonant w/ throat, warm + sensitive w/rose | It was a reminder for the open throat + rose for me, and it was nice! | For imagining a rose, I heard more warmth and for the rose aroma, more overall "pleasantness." | Sing w/ musicality | The mind is powerful! I feel like the actual aroma added to the imagery. | |
| 14 | (up arrow) time for muscle tension while breathing slowly | The rose image made me want to sing more sweetly | 2 for every inhalation...imagine | Thinking pretty rose made me want to phrase and shape things different and pretty like a rose | More delicate inhale to smell the nice aroma made me sing more delicately and sweetly/sensitively | Both were nice but I supported less with the actual scent. more delicate = (down arrow) breath | Gentle inhale | Imagery of rose effects phrasing/shaping while singing, not just what occurs during inhale | "Breathe in slowly" doesn't help me plan out breaths/phrasing? |
| 15 | breathing w/ an open throat helped create the space to enter on a higher note like c | It did not encourage me to create space in my mouth or throat | 1 For every inhalation....with an open throat | fuller and more resonant tone | it improved my tone by encouraging me to take fuller breaths ie pull the air all the way into my body | I think inhaling the actual scent was more beneficial to my internal space and | I think they want a deeper, fuller breath and a more lifted soft palette | not sure which point in the experiment this is referencing, but I felt like smelling the | n/a |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | quantity of air | | rose oil encouraged me to create more back space/lift the soft palette | |
| 16 | I sang with more space and more breath support | I feel like I wanted to breathe through my nose, and that made me lose some space/resonance of tone | 1 For every inhalation....with an open throat | It helped me breathe more deeply and support the sound more | | I think the actual scent helped me remember to breathe, but imagining caused tension for me. | For a more open/free/slower breath | | The rose oil was quite strong/artificial smelling |
| 17 | It made me focus on my actual mechanism more, instead of just going on autopilot. | I think I got too caught up in the accuracy of my imagination and forgot to sing well. | 1 For every inhalation....with an open throat | It made me think about my actual mechanism. | I can't really say for sure. The scent was pleasant, and relaxed my breathing. | It was more relaxed with the actual scent. | Relaxed, fuller breathing | n/a | n/a |
| 18 | I felt more consistent because I had more air available. | I felt more free tone wise and had a more relaxed as well as more variety in dynamics. | 2 for every inhalation...imagine | I feel like relaxation is the best descriptor. I was more relaxed where I feel like "open throat" invites tension for me. | I feel like it was nice but also distracting. A bit too much for trying to facilitate good tone. | I was more relaxed and focused with the imaginary. I think the actual aroma, no matter how slight, was distracting. | I think invite openness and relaxation of muscles in the face/upper throat. | | |
| 19 | warmer/clearer/"taller" vowels | | 1 For every inhalation....with an open throat | Same as before - more resonant, but warmer | Less resonant than the first time and less consistent. This could be for other reasons though. | While I was smelling the actual rose aroma, I wasn't able to take air in as fast as when I imagined it | Raise soft palette, open throat | | |
| 20 | It gave me more time to prep my sound for a better tone and onset | I had a hard time imagining the scent but I don't think it affected my tone much | 1 For every inhalation....with an open throat | I thought more deeply about my onset which led to better tone production | I think the smell made me think pleasant thoughts which encouraged me to open more space, but I heard others who had less consistent tone. | I had a hard time imagining a rose fragrance, but I thought it would be a harsher scent then the cottonball was. | More space. Soft palate raised, relaxed | I found the literal language to be best, although my E was most consistent by the end, mostly I think from warming up to it. | I think the repetitions also gave me more time to improve my tone even without the prompts. |
| 21 | | I think something about breathing in | 2 for every inhalation...imagine | | Sometimes I think too much about my vocal | Freer, taller space with the actual rose scent. | Space in back of throat. | | I was able to faintly smell the rose scent in the |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | through my nose affected the space I made when I sang, making more space in the back possibly | | | production and over-control it, and I think the smell sort of distracted me and freed up my sound. | | | | room before the experiment had started. |
| 22 | My sound had more support, especially on the entrances for the round. I had better intonation on higher notes. | Imagining the rose made me smile which released tension | 3 combination of both (open and imagery) | I had more breath support and the tone felt freer | The physical act of smelling the essential oil made me lift my soft pallete and release jaw tension | Inhaling the actual rose scent forced my body to react to the scent. My body was more relaxed and it was easier to sing. | They wanted more space/height in the tone | I felt like I was more confident that I could sing freely and in tune while I smelled the essential oil | |
| 23 | I felt like I had more air and energy in my tone | It seems more musical, sweet, reverent this time. | 3 combination of both (open and imagery) | It was more sweet and musical, while also maintaining more air and energy | | I felt like imagining the scent of the rose did more for my tone than actually inhaling the scent | I think it makes for a sweeter, more vibrant sound | | |
| 25 | I think "open throat" helped to really deepen my breath through my whole mechanism | I tended to take shallower breaths through my nose which narrowed my tone quality and made it less supported | 1 For every inhalation....with an open throat | it brought back the depth and support I didn't have in prompt 3 [imagine rose] | | | I think maybe the goal is to get you to breathe deeper into your body so the breath travels everywhere it needs to | the literal worked much much better for me | |
| 25 | made it more relaxed and natural | | 1 For every inhalation....with an open throat | Gave me more air, so I felt more supported | I don't really know, it made me feel very relaxed and so my singing felt easier. | I wasn't able to imagine the scent of a rose, so it didn't change anything until I actually smelled it | release tension in your body and voice | Everything about my voice felt better when I smell the cotton ball | cool study, I felt a difference between prompts |
| 26 | I did not have enough breath support for the high note before | | 1 For every inhalation....with an open throat | I think the slow and deep breaths really helped clear some congestion | It distracted me | I was more present when told to breath big | It is hard to imagine scent | | I think our tone got better as we went on because we knew the song better |
| 27 | it caused me to have a richer fuller sound | I approached each note softer and | 3 combination of both (open and imagery) | I was aware of my breathe more than | I was more focused on the scent and was tuned | I became overly aware of my | inhale with mindfulness | Singing with an open throat made me more | This was fun :) |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | more timidly | | previously causing my sound to be fuller. | into my breathing too much | breathing and it distracted me. | | aware about the space in my mouth vs. breathing in the fragrance which made me aware of how much I was breathing. | |
| 28 | I had better support and connection to my breath, and helped keep my soft pallet up. Less tension. Rounder clearer tone. | It made me sing more forward and I used more phrasing. It gave a back story to the music which made me sing more like I was conveying a message. | 3 combination of both (open and imagery) | I sang a bit rounder combing [combining ] both than I did w/ the rose, and a bit more forward than I did w/ the breath. | It helped me achieve better space and more ring in my sound. Focusing on the smell helped get an inhale w/less tension | I had less tension in my body and breath when inhaling the smell of the rose. It made my voice ring, and singing felt easier. | To take a deep full breath | | I had a harder time noticing changes in the tone of the choir than in my own voice. Maybe b/c my voice has physical sensations for me. |
| 29 | I focused more on the breath than the tone | I naturally had a deeper breath and my tone was warmer and more pleasant. | 2 for every inhalation...imagine | Same as prompt 3 [I naturally had a deeper breath and my tone was warmer and more pleasant] | The pleasant aroma gave a sweater tone and made it easier to keep controlled vowel sounds | Deeper more fulfilling breaths | Deeper breaths and pleasant imagery | | |
| 30 | | I felt like I had more support from my breathing when imagining this, making quality tone easier to create. | 2 for every inhalation...imagine | About the same as before. More support leading to better tone quality. | I felt like the action of inhaling the rose made my focus split between singing and inhaling, making me feel distracted regardless of the actual aroma | It wasn't the aroma that changed, it was the action of trying to smell the aroma | To breath deeply as if to savor the pleasant aroma | | Thank you for choosing me/us as your test subjects! |
| 31 | By taking the time to be mindful about the placement of the breathe, I could maintain a more open sound | By imagining smelling a rose I was able to be mindful of my voice coming out brightly from my forehead. | 2 for every inhalation...imagine | Keeping the focus on resonating through the top of my head/forehead works best for my singing | The scent was a little distracting at first, but served as a constant reminder to breathe as if I was smelling a rose to maintain that placement. | The scent was distracting and not necessarily helpful or unhelpful | Maintain a certain resonance and placement of the voice | | |
| 32 | Made me relax, felt like I had more time to set my breath and support my sound. Onsets | I was still thinking about the other prompts | 1 For every inhalation....with an open throat | thinking about an open throat made me relax and helped | I was breathing deeper which helped support my voice - made | The scent was relaxing and helped me take a deeper | Deeper breath that fills you up | Onset was cleaner when breathing in smell from cotton ball. When asked | It was cool! |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | were cleaner (but were a little late). | | | sustain breath throughout phrase | it more relaxed and resonant | breath that wasn't rushed (and I liked the scent! It was hard to imagine the aroma of a rose) | | to sing "as if performing" helped shape phrases | |
| 33 | It opened up my vowels and allowed me to place my sound more forward. I did yawn right after I was done as well. | Candidly, the prompt reminds me that I am currently having an allergy attack, and some of my energy went to not sneezing | 1 For every inhalation....with an open throat | Focusing on an open throat made me sing more soloisticly | This cleared my sinuses, and helped my allergy attack, but I could tell that others were more focused on the new scent than their tone. | While metaphorical language like this usually helps me, I am having an allergy attack, and imagining flowers make me think about that more. | They want you to breathe more deeply, and bring some pleasure to breath in singing. | In a previous version of this study I did last year, the metaphorical rose-smelling helped me more when I wasn't thinking about trying not to sneeze. | Nothing special. Thank you! |
| 34 | It helped me have a more open, free sound. It probably would have improved my tone were my voice not in poor health today. | It helped my phrasing and musicality so much! Every line felt like the satisfying "ahh" you exhale after smelling something good. | 3 combination of both (open and imagery) | The open throat freed my sound and the rose improved my phrasing | | The actual aroma actually hindered my sound. It ensured I didn't take a good breath and while it was pleasant it didn't evoke the same response/mental imagery that just imagining it did. | Phrasing/musicality | | Just to make you aware, my voice felt terrible this week. So my results may be somewhat skewed as a result! |
| 35 | I feel that it allowed me more space | it made me breath through my nose more, which made it feel like it took longer for me to breath and get the support I needed | 3 combination of both (open and imagery) | made more intentional about breathing | | whether I breathed through my mouth or nose, how long it took to breath | being thoughtful about how you are breathing | | I sometimes worried that I was overthinking the prompts too much to really pay attention to my tone |
| 36 | It kept my jaw relaxed and my vowels open. | | 1 For every inhalation....with an open throat | It kept my jaw relaxed, my resonant space open, and my vowels open | It was relaxing and felt as if it gave a unique character to my tone and that of the group. | When asked to imagine the aroma I found myself more focused on that then the singing. When the | I think they are looking for a more relaxed and possible delicate sound. | Both when told to breath with an open throat and when the aroma was present my sound was more relaxed and open. | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | aroma was physically present it was less distracting and more supplementary. | | | |
| 37 | My sound was richer and fuller as well as the rest of the choir | | 1 For every inhalation....with an open throat | made my sound clearer and richer | I felt like I resonated more and my middle C sounded more full. | My tone was thinner with the imagined rose because my mind imagines inhaling with my rose. | Breathe in deeply | n/a | n/a |
| 38 | | I felt like it was harder to create tension in my throat | 1 For every inhalation....with an open throat | | I felt like by inhaling the aroma it made me feel good and I was less tension | It was hard for me to imagine the rose constantly, but with the aroma it was just there. | To sing more sweetly | | |
| 39 | Became clearer and more resonant but harder to enter on time | I became more uncertain about singing, and not focused, because it's hard to imagine a smell and sing at the same time. | 3 combination of both (open and imagery) | | Slightly better tone quality. My nose is a bit stuffed today... | | The way I inhale | | |
| 40 | My tone was noticeably deeper and more resonant. | It was largely the same as the last prompt | 1 For every inhalation....with an open throat | My tone was resonant and I used my air better. | It encouraged me to breathe a little deeper | Better breath support | Take in more air to improve breath support | | |
| 41 | It helped me produce a fuller and more resonating sound | | 1 For every inhalation....with an open throat | More resonant, ringing sound | | When actually inhaling the aroma, I automatically breathed deeper than when imagining it | Inhaling deeply with the purpose of fully breathing | | |
| 42 | It gave me a better sense of body and more control over my voice | | 1 For every inhalation....with an open throat | I am more relaxed, but the repetition also helps | The scent was delicate and I noticed my tone was more gentle which was not a conscious choice | The physical experience was more affecting. It had a more tangible effect on my senses and body | They want a more relaxed, delicate tone | I was surprised by how much a physical change impacted my tone | |

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|---|---|---|---|---|---|---|---|---|---|
| 43 | | It made me want to breathe through my nose, which is not what I normally do while singing. | 1 For every inhalation....with an open throat | I breathed naturally or I do while singing, rather than taking my focus away to imagine a rose. | I was focused on breathing through the aroma rather than singing naturally, this was especially obvious during the sustained notes as my lack of breath made my tone lower in quality. | I prefer to be able to choose to breathe through my nose or mouth at times. Locking into one greatly affects my performance. | The amount of air you are breathing, and to breathe through your nose. | | I don't know how much simply getting more comfortable with the piece/being taken out of a comfort zone by being asked to switch between modes at a rapid pace made or the performance of the choir. It effected mine immensely. |
| 44 | With breathing slowly & deeply I felt it allowed taller vowels | For some reason it made me feel stuffy | 1 For every inhalation....with an open throat | I felt I was able to get taller vowels | I felt that inhaling the fragrance helped control my breathing | When actually inhaling it felt like all the pressure I had in my body went away | | | |
| 45 | It allowed me to open up fully so my notes were cleaner and more resonant | I was breathing through my nose and I felt it impaired how well I could open up for higher notes | 1 For every inhalation....with an open throat | Like earlier, it allowed for more open notes | I sounded more resonant open, the scent cleared my nose and I felt I could breathe better. | I couldn't really imagine the scent so I was just breathing through my nose but the rose scent cleared it up. | Perhaps changing the way you're breathing | Higher notes came much easier to hit both when smelling the rose and singing with an open throat. | |
| 46 | I was thinking about taller vowels which are good for this piece. | | 1 For every inhalation....with an open throat | Taller vowels | I feel like my nose was opened so I could create a more resonant tone. | I felt my nose clear up w/ the scent. | Make sure I'm putting thought into my full breath. | I enjoyed the smell. I may experiment with it again. | |
| 47 | | I do think so for myself!!! | 1 For every inhalation....with an open throat | I'm feeling I have more space to breathe in | | It's not the tone. I'll have different period long of time to breathe in. | :) | I just react this as a mimic of how to breath. I'll guess it with my own habits. | |
| 48 | I felt like I had more breath support | | 1 For every inhalation....with an open throat | It made me more conscious o my breath and overall tone | The action of inhaling a specific scent made me more conscious of how long or deep of a breath I took, and reminded me to breathe deeper and | I found it hard to imagine the scent while actively singing | Being more conscious of how we inhale and the physical sensations | The prompts helped me be more mindful of m throat and breath while singing. | |

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| | | | | | more sustained | | | | |
| 49 | Was able to get more air through to push sound more | | 1 For every inhalation....with an open throat | | I would say yes as it opened my nostrils more allowing for more air. | I took smaller inhalations as the rose aroma was a bit stronger than | your breathing | | It was fun |
| 50 | | Overall I felt like my tone was better after imagining inhaling the rose | 2 for every inhalation...imagine | I felt like imaging inhaling the rose improved tone quality | Tone quality felt much better after inhaling rose | | It forces you to take quality breaths | When imagining scent of rose I felt better about tone quality | Interesting experience |
| 51 | | Seemed much lighter and clearer | 2 for every inhalation...imagine | Again, seemed lighter | Sounded much more supported | Breathed deeper | Diaphram breathing. Breathing with nose? | | |
| 52 | I had more breath support so singing was more consistent and clear | Made it slightly more rich | 3 combination of both (open and imagery) | Brought the consistency and clearness on deep breaths and the richness of imagining the aroma of a fragrant rose. | | | Take deeper, more full breaths | | |
| 53 | My voice was more clarified, but I was a little breathless still | | 2 for every inhalation...imagine | my voice was a lot bouncier and taller | | My tone quality was bouncy and tall when I could actually smell the aroma | They want a change in sound quality/texture | Once more, literally taking in a scent helps my voice become more velvety | the rose aroma helped |
| 54 | | | 1 For every inhalation....with an open throat | It made my tone more steady and clear | It made it more clean and open. | I just think it sounded clearer and more open. | I think they want us to open our mouths and keep our breath more steady. | The actual scent of rose oil helped more than I thought it would | |
| 55 | | | 3 combination of both (open and imagery) | | I was able to add a bit of warmth to the high notes | I was able to add some warmth to my tone | breathe more freely and add support | | |
| 56 | | | 1 For every inhalation....with an open throat | Prompt helped to breathe properly keep mouth dome space open | No, it jus smelled sweet | n/a | Tone? Posture? Resonance? Emotion? Not sure. | N/a | It was good sight singing/sight reading practice. |
| 57 | It made me focus on my breathing more | I found it hard to focus on imaging | 1 For every inhalation....with an open throat | Like I said earlier it helps to focus on breathing | I think it was distracting more than anything | It was easier to actually smell the rose rather | Our tone/facial expressions | I think the second prompt was the most | |

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| | | what a rose smells like | | | | than imagining it | | beneficial [open throat] | |
| 58 | Dry throat right now from flu, makes sound harder to get out | I feel like it makes the singing smoother | 2 for every inhalation...imagine | It was the same as before where it makes the singing feel smoother | I think being able to actually smell the aroma makes it easier to picture singing even smoother | I think if was relaxed and smoother | smoothness of voice (?) | It was smoother with imagination but even smoother with the actual aroma | |
| 59 | I felt more grounded and like I could hold/sing longer with more support. And I kept an open space. | I seemed like there were more emotion, softer, and loving tone | 3 combination of both (open and imagery) | | | | Imagination for tone, distraction | | |
| 60 | Made me move conscious of my vowels and overall placement | It made my tone lighter | 2 for every inhalation...imagine | Made my tone lighter | | | Create lighter tone | The more we sung, the more aware I became of my tone quality | n/a |
| 61 | I had more breath so it was better | | 1 For every inhalation....with an open throat | I don't really know | It made me more relax | I think the real molecule help me to relax | I don't know maybe feel more confident | No | No |
| 62 | | I'm sorry I'm sick so my tone is not changing | 1 For every inhalation....with an open throat | I feel like I could take smaller more efficient breaths. | | | Maybe the style of breathing | n/a | no, but thank you! |
| 63 | | | 2 for every inhalation...imagine | I think just practicing it was what effected my tone | I have no idea, because I can't hear my own voice singled out from the choir. | | They likely want you to inhale deeply. | | |
| 64 | Producing the note felt easier; less strain on the tone | I had to adjust where I was projecting from after taking a breath | 3 combination of both (open and imagery) | By being aware of where I was projecting and breath, my tone felt warmer. | While my nasal passageways felt more open, trying to smell the aroma and sing at the same time made me not focus on my tone as much. | My vowels weren't as tall on the imagine one buy my nostrils felt dilated during the rose one. | Inhale easily and slowly | Being aware of both breathing and how I was projecting, I had a warmer tone. | |
| 65 | Tone was more uniform w/ more pitch accuracy. | Seemed to have more dynamic variation. | 3 combination of both (open and imagery) | When I had the choice I thought more about both | Choir sounded more unified, more confident in what we were collectively doing. | | Be more aware of the air we take in and the shape of all the areas of our body effecting the sound, savor the air, savor the sound | | My results should be taken w/ knowledge that I get headaches from smells and was very congested. |

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| | | | | | | | | | The experiment did not trigger any pain but the dynamic between myself and my sense of smell is a bit testy. |
| 66 | | | 1 For every inhalation....with an open throat | Provided enough breath to carry through phrases | | more breath support | have a sweeter sound | | |
| 67 | | Was softer and more relaxed. More natural. | 2 for every inhalation...imagine | Was more relaxed and immersed, instead of being occupied w/ breath support | Felt nice. More emotional in the tone. | A bit dramatic softening and relaxation of the tone | Slow breaths, more mindful breath a singing | Grew more confident with repetitions, but also roes fragrance made singing more natural | |
| 68 | | | 2 for every inhalation...imagine | | | | I honestly have no idea maybe loosen up/relax the face a bit | | |
| 69 | I did try but only did it like 70% of the time | I breathed in deeply and got more breath | 2 for every inhalation...imagine | | I enjoyed breathing in more because of the good smell | I took more time & focused on my breathing and posture more | I tried this experiment! | I love singing with this group of talented vocalists | I'd like to thank repertoire for being a saving graceful... |
| 70 | Improved overall tone quality | | 3 combination of both (open and imagery) | Open throat was more effective than rose imagery | | | Richer tone quality and "prettier" dynamics | Literal language was the most effective at improving tone quality | |
| 71 | | | 3 combination of both (open and imagery) | Thoughtful breath, better/confident start. | Was able to distract from shot nervous system be out of my brain and in my body | I felt like I was in touch with my body | To feel calm and in touch w/ urselves | I noticed to breathe w/ rose helped me get in my body and out of my brain | thanks for an amazing term |
| 72 | I was able to better prepare myself to sing with better tone quality. | | 1 For every inhalation....with an open throat | I think being aware of my inhalation without the imagery of a rose made me breathe better. | I think I got distracted a little by the rose smell so I didn't inhale as deeply as I usually do,. | I was more focused on the smell of the rose and not breathing properly when I was holding the cotton ball. | I think they want you to breathe deep like you would when smelling a rose | I thought I sang better when I was thinking about breathing w/ an open throat. It was still very interesting learning about the effects of singing with or without a certain prompt. | |

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| 73 | It helped me to relax the muscles in my throat and take a slow and full breath. | It helped, especially when we come in for singing in unison. it was harder to do when I didn't have as much time to breathe. | 2 for every inhalation...imagine | I like the imagery of the rose, and it helped to take a full inhalation and support my tone with breath support | It was interesting, inhaling the actual rose fragrance seemed to affect the breath I took in, making it full and giving me more breath support. | I took a fuller, more relaxed breath. I enjoy the scent of roses and actually smelling the rose seemed to let my body just take it in as I breathed. | I think they want to change the kind of breath you take, i.e. relaxed, full breath | I think that I felt more relaxed when singing and it was cool to see the change in sound. | Not that I an think of. |
| 74 | I had more breath support to get me through the phrase | | 1 For every inhalation....with an open throat | I had better breath support and was able to hit the high notes easier | | It was a deeper inhalation when I was trying to smell the rose on the cotton ball | deeper inhalation | When I have a deeper inhalation I sing better/ have a better tone | I did not really warm up before singing today so that might of effected how my voice sounded. |
| 75 | It gave me a more full breath | It sounded more expressive | 3 combination of both (open and imagery) | The imagery helped me imagine the tone | I am congested today, however, the thought of the rose improved my tone. | I couldn't really smell it. Sorry. | The conductor wants the sound to math the smell of the aroma. | | I am sorry for not being capable of providing better tone. I was sick the last few days. |
| 76 | It helped me support better and kept my vowels open | It made my tone more warm | 2 for every inhalation...imagine | Warm tone | It opened my tone and kept it warm | The aroma of the rose energized my body and feelings thus energizing my tone | They want you to be breathing in more to support your tone | | It was fun! Thanks Kendra! |
| 77 | I was thinking so much about how I was breathing that I didn't pay as much attention to my tone. | | 2 for every inhalation...imagine | | I felt like it was easier for me to keep a more open tone. | When I was imagining it, It didn't do anything and I felt completely the same. When I was smelling it my throat felt more open and it was easier to sing with good tone. | Sing with a more beautiful sound and have more feeling. | Most of the changes were extremely slight. | |
| 78 | The sound was more grounded and vowels sounded taller to me. I think we sounded a bit more mature. | | 1 For every inhalation....with an open throat | Physically, I felt more relaxed, and my tone was more open and resonant. | It felt more open and more resonant than just thinking about an open throat. | It felt more open smelling the rose essential oil than imagining it. I was more resonant | Taking a deep, full breath and sing more open/with less tension. | Every time I sang the excerpt it was a little more open and grounded. | |

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| | | | | | | smelling the rose oil. | | | |
| 79 | Darker. I pulled my tongue back though [unable to read rest] | forward placement | 2 for every inhalation...imagine | | More clear | | Breath deeper with nose | | |
| 80 | better onsets better sustained vowels | | 3 combination of both (open and imagery) | Smoother transitions between notes, inhaling openly helped onset and imagining the rose kept tone better throughout | Very pleasant to smell but did not have noticeable effect on my tone quality. | More relaxed/at ease. Feeling the music more. | Sound quality, color of sound, tension | During the singing w/ an open throat, I liked that I could physically feel myself following the prompt. | |
| 81 | My voice and throat did not feel as tense, and I had much more resonant tone quality. | I think that it affected it somewhat negatively. I was focused more on thinking about the rose than on my performance. | 1 For every inhalation....with an open throat | I had a more consistent and ringing tone. I felt less tense and more involved w/ the music. | I think it made my tone more clear I felt more focused and resonant. | I was more tense when imagining, but felt more open when we had the actual scent. Better tone quality & inhalations w/ actual scent. | Breathe deep & relax, open your throat | Both metaphorical & literal language helped my individual tone quality & whole choir's tone quality. Focusing on imagining things generally does not help as much. | |
| 82 | It made me think more critically about placement and relaxation of my mouth | It encouraged to inhale solely through my nose which gave me a more moist inhalation which opened my throat, however this also made me drop my soft palate a bit. | 1 For every inhalation....with an open throat | It encouraged a relaxed an open throat while keeping my soft palate raised | The actual presence of the scent allowed me to be more aware of when I was actually inhaling through my nose which then encourage me to take deeper and more relaxed breaths. | I think the actual presence of the scent encouraged me to more proactively inhale through my nose with an open throat and a deep breathe. | I've always suspected it was asked in order to encourage a mixture of inhalation through the nose in addition to mouth inhalation. | The effect of thinking the word open always would encourage me to have more space in my mouth which usually resulted in better tone. | Nope! |
| 83 | My tone was more full and supported, It sounded much healthier | I think so – it still allowed be to thing about bigger breaths. Allowing for full/supported tone. It was a bit more lovely. | 3 combination of both (open and imagery) | I believe my tone quality was best of all during this run. | I think it made my tone lovely I had more purpose and story to it, but it wasn't supported as when I focused on breathing quality. | I believe my inhalation, body, and tone were more supported when the actual aroma was present. | Tone quality – pertaining to lightness, openness, authenticity, lifting soft palate? | | I have discovered that I prefer to be given the metaphorical and literal instruction. |

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| 84 | Fuller sound. | To me it brought more high-end to my voice. | 3 combination of both (open and imagery) | Felt like my voice was resonant | Made me think sweeter, richer sound. Very resonance. | My tone was richer, vibrant when actually smelling rose, overall sweeter sound. | Sweeter sound, richer, heartfelt | | I think actually smelling roses to me made my sing better, just because I was so moved by just the scent. |
| 85 | More breath support wile singing | | 1 For every inhalation....with an open throat | More breath support creates a fuller sound | I think it kinda zaps our sinuses and makes us not so nasally but fuller tone | We were more fuller w/ the actual aroma | I think its to prevent nasal sounds and have an open sinus | My tonal quality enhanced w/ the literal smell not imaginary | |
| 86 | I was more aware to focus on my breathing in general and that helped | I feel like it helped my tone sound brighter rather than at the back of my throat | 1 For every inhalation....with an open throat | I think both imagery options are helpful but the open throat one for e helps just a little more. | I feel like it may be kind of distracting to physically hold and smell the cotton ball for me. | I think it was more effective for me to imagine it cause physically breathing in the rose smell was a little distracting. | Tone quality and overall mood of the sound | My tone improved as I became more aware of my throat and imagery of the correct tonality as well. | This was fun! |
| 87 | | It made my tone more energized | 2 for every inhalation...imagine | It made my tone more energized | The pleasant smell made me feel better and breathe deeper, improving the quality of my tone | The actual aroma gave me an incentive to breathe deeper and relax, which helped my tone. | I think that the conductor wants me to change the quality of my breathing | Another side effect of the real aroma was that I sung more romantically? A more technical description might be that I sang with a sweeter tone. | |
| 88 | It made it easier to come in with a dark and open vowel which supported greater resonance and thus a better tone. | Since breathing is so instinctive I almost had to think extra to imagine the smell of the rose and may have had less focus on my tone | 1 For every inhalation....with an open throat | Same reason as before | I think it may have a little bit because it was new stimulation and created a pleasant feeling in my mind which may have translated to my tone. | Trying to imagine the smell was more distracting | Perhaps placement of soft palate | I think a significant effect on tone was how warmed up I was and how comfortable I was with the music, both of which improved over time. | It made me wonder how a choir would sound if they were inhaling the scent of manure. |
| 89 | 666 | 666 | 666 | 666 | 666 | 666 | 666 | 666 | 666 |
| 90 | It causes less tension in the neck while singing! | Encouraged deeper breathing! | 1 For every inhalation....with an open throat | Significantly less tension in my jaw/chords! | It caused me to take deeper breaths, which improved my sound. | Actually smelling something caused me to take deeper breaths than just | To take larger breaths that extend from your nose to the bottom of your stomach. | I enjoyed the relaxation that my throat did with the exercises! | My viewing up the choir was a little skewed because I could only hear a few louder altos |

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| | | | | | | imagining the smell! | | | in the group singing. |
| 91 | It helped me keep space in my mouth and throat easier | | 3 combination of both (open and imagery) | The breath helped me keep an open throat and mouth for better resonance and the rose provided context/emotion | It was kind of hard to breath through my nose enough to get the scent and still have good resonance | When I was imagining it I didn't have to take big breaths but with the oil I had to be able to smell it | Emotion (vowel or facial or both) To lift soft palate through inhaling through the nose | I feel like the prompts helped, but so did the repetition | |
| 92 | I felt I more prepared and soundly grounded | I felt light like the smell and so did my tone | 3 combination of both (open and imagery) | I felt a combination of open and light tone | I felt way more open than before and a slight bit more energy | The imaginary rose started to feel like an act whereas the actual rose created an embodied sound | Open nasal breathing that is silent | My singing began to get easier with each new prompt | It felt very informative without a teaching aspect |
| 93 | It helped me sustain longer notes, more dynamics. | It helped me relax a bit more, my muscles felt less tight. | 3 combination of both (open and imagery) | It helped my tone quality, but it was a lot to think about. | It smelled lovely, so it caused me to breathe in for a longer period of time I ended up being late for entrances! | I noticed that imagining the smell of rose worked better for me because I got distracted by the actual smell of rose. | Breathing technique? (not super sure) Opening of throat? | | |
| 94 | It made my sound immediately more open and the tone had space and resonance. | I don't think the rose detail specifically helped but consciously breathing did. It was hard to picture the scent in I short time between phrases. | 1 For every inhalation....with an open throat | Prepping with an open throat breath instantly prepped me for good tone | Weirdly I noticed a huge difference!!? My tone felt very clear and strong along with the rest of the choir. Somehow I managed to place my tone better instantly... | Trying to imagine the scent distracted me and was difficult. Actually smelling improved the tone. | The vibe of the breath... a positive, sweet breath sets up a positive, sweet sound | The open throat prompt really helped me set up my sound. I will remember that in class. | This was so fun and sweet! |

*Note.* Missing data was coded per Andy Field's instructions; a code was assigned to missing data points that were not represented in the data. His "personal favorite" code was used, "666, (because missing values *are* the devil's work)," (Field, 2018, p.117). Participant spelling and grammar were retained from written responses.

# APPENDIX J

Expert Panel Informed Consent

**Voluntary Consent.** You are being asked to volunteer for a research study. It is up to you whether you choose to participate or not. There will be no penalty or loss of benefits to which you are otherwise entitled if you choose not to participate or discontinue participation.

**Purpose**. The purpose of this research is to examine singing under multiple conditions.

**Duration**. It is expected that your participation will last 15-20 minutes.

**Procedures and Activities**. You will be asked to rate the tone quality of choirs. There will be nine, 1-minute, recordings. You should complete the questionnaire in one sitting while wearing headphones/ear buds. Please complete this questionnaire in a space with minimal external sounds/distractions.

**Risks**. There are no foreseeable risks or discomforts.

**Benefits**. Some of the benefits that may be expected include information for the choral profession.
.
**Alternatives**. Participation is voluntary and the only alternative is to not participate. You may drop out of this study at any time without penalty.

**Who can answer my questions about this research?**

If you have questions or concerns, contact the researcher at:

XXXX@uoregon.edu

**STATEMENT OF CONSENT**

I consent to participate in this study.

Yes
No

# APPENDIX K

## Expert Panel Questionnaire

### Choral Tone

* Indicates required question

**Voluntary Consent**. You are being asked to volunteer for a research study. It is up to you whether you choose to participate or not. There will be no penalty or loss of benefits to which you are otherwise entitled if you choose not to participate or discontinue participation.

**Purpose**. The purpose of this research is to examine singing under multiple conditions.

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**Procedures and Activities.** You will be asked to rate the tone quality of choirs. **You should complete the questionnaire in one sitting while wearing headphones/ear buds. Please complete this questionnaire in a space with minimal external sounds/distractions.**

**Risks.** There are no foreseeable risks or discomforts.

**Benefits**. Some of the benefits that may be expected include information for the choral profession.
**Alternatives.** Participation is voluntary and the only alternative is to not participate. You may drop out of this study at any time without penalty.
**Who can answer my questions about this research?**

If you have questions or concerns contact the researcher at:

Ktaylor4@uoregon.edu

1. **STATEMENT OF CONSENT** *

I consent to participate in this study.

*Mark only one oval.*

- ◯ Yes
- ◯ No

Demographic questions

2. Age

_____

3. Gender

*Mark only one oval.*

- ◯ Male
- ◯ Female
- ◯ Nonbinary
- ◯ Other

4. Highest degree *

*Mark only one oval.*

- ◯ Bachelor's
- ◯ Master's
- ◯ Doctorate

5. Total years voice teaching/coaching/professional experience *

_____

6. Total years choir teaching/conducting/professional experience *

_____

7. Select all types of choirs you have conducted/taught in your career: *

*Check all that apply.*

- ☐ Children's
- ☐ Middle Level
- ☐ High School
- ☐ Collegiate
- ☐ Church
- ☐ Community

For this questionnaire good tone quality is defined as consistent, clear, free, rich, ringing, and resonant.

You will hear fifteen performances of "Jubilate Deo." After each recording, you'll be asked rate choral tone quality.

Directions:
1. For each example, open the link to access the audio recording.
2. Listen to the example wearing headphones.
3. Rate the choir's overall tone quality for each performance.

Test your audio settings by opening this sound file (please wear headphones)

https://drive.google.com/file/d/1bFQRQjZqzrt0Z87M2BvrBkJjl6et47IP/view?usp=sharing

1

8. **1. Rate the choir's overall tone quality for this performance** *

*https://drive.google.com/file/d/1q7mc-1j6--L5vQjB4UerZM7Nz2ekmzRs/view?usp=sharing*
*Good tone quality is defined as consistent, clear, free, rich, ringing, and resonant.*

*Mark only one oval.*

- ◯ 1 - poor tone quality
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5 - good tone quality

2

9. **2. Rate the choir's overall tone quality for this performance** *

https://drive.google.com/file/d/1V5lOQYIU3oBCynHHbyY-u4MInB3aYL6_/view?usp=sharing
*Good tone quality is defined as consistent, clear, free, rich, ringing, and resonant.*

*Mark only one oval.*

- ◯ 1 - poor tone quality
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5 - good tone quality

3

10. **3. Rate the choir's overall tone quality for this performance** *

https://drive.google.com/file/d/1KLJmKx0rYdc6y140H-El86spu8Lt77JC/view?usp=sharing
*Good tone quality is defined as consistent, clear, free, rich, ringing, and resonant.*

*Mark only one oval.*

- ◯ 1 - poor tone quality
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5 - good tone quality

4

11. **4. Rate the choir's overall tone quality for this performance** *

https://drive.google.com/file/d/1RuRfZDvVRerOsbZGq4mVEXSmjmpaNZtX/view?usp=sharing
*Good tone quality is defined as consistent, clear, free, rich, ringing, and resonant.*

*Mark only one oval.*

- ◯ 1 - poor tone quality
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5 - good tone quality

5

12. **5. Rate the choir's overall tone quality for this performance** *

https://drive.google.com/file/d/1RC5_VX0whl3KzdMvoU2GCXDxzTvlOms3/view?usp=sharing
*Good tone quality is defined as consistent, clear, free, rich, ringing, and resonant.*

*Mark only one oval.*

- ◯ 1 - poor tone quality
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5 - good tone quality

6

13. **6. Rate the choir's overall tone quality for this performance** *

https://drive.google.com/file/d/1JXliKE9Mcm2aDO2RaPxXVAKW61ZYknMH/view?usp=sharing
*Good tone quality is defined as consistent, clear, free, rich, ringing, and resonant.*

*Mark only one oval.*

- ◯ 1 - poor tone quality
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5 - good tone quality

7

14. **7. Rate the choir's overall tone quality for this performance** *

https://drive.google.com/file/d/16J2atw-09fmZlyDCNp8TlcVNibgwY-SD/view?usp=sharing
*Good tone quality is defined as consistent, clear, free, rich, ringing, and resonant.*

*Mark only one oval.*

- ◯ 1 - poor tone quality
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5 - good tone quality

8

15. **8. Rate the choir's overall tone quality for this performance** *

https://drive.google.com/file/d/1GLIRuNcrNyJj81e9wmOeBi-K0judVJVL/view?usp=sharing
*Good tone quality is defined as consistent, clear, free, rich, ringing, and resonant.*

*Mark only one oval.*

- ◯ 1 - poor tone quality
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5 - good tone quality

9

16. **9. Rate the choir's overall tone quality for this performance** *

https://drive.google.com/file/d/1dXD4xkyZ4wxN8pnsuTxHAseYOrw07mQc/view?usp=sharing
*Good tone quality is defined as consistent, clear, free, rich, ringing, and resonant.*

*Mark only one oval.*

- ◯ 1 - poor tone quality
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5 - good tone quality

10

17. **10. Rate the choir's overall tone quality for this performance** *

https://drive.google.com/file/d/14LhCQa8BngestsH_NqiuprHsms4pPB3b/view?usp=sharing
*Good tone quality is defined as consistent, clear, free, rich, ringing, and resonant.*

*Mark only one oval.*

- ◯ 1 - poor tone quality
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5 - good tone quality

11

18. **11. Rate the choir's overall tone quality for this performance** *

https://drive.google.com/file/d/1SO1J90wSxW7AhqQAMKHgviRRrQtJVaj6/view?usp=sharing
*Good tone quality is defined as consistent, clear, free, rich, ringing, and resonant.*

*Mark only one oval.*

- 1 - poor tone quality
- 2
- 3
- 4
- 5 - good tone quality

12

19. **12. Rate the choir's overall tone quality for this performance** *

https://drive.google.com/file/d/13nkJ_LhOUXSY5cFZkpGa-ryf9Xo5FBD7w/view?usp=sharing
*Good tone quality is defined as consistent, clear, free, rich, ringing, and resonant.*

*Mark only one oval.*

- 1 - poor tone quality
- 2
- 3
- 4
- 5 - good tone quality

13

20. **13. Rate the choir's overall tone quality for this performance** *

https://drive.google.com/file/d/1L8dYKWkGiOxql2FsgD80yiGtdhoEYQxO/view?usp=sharing
*Good tone quality is defined as consistent, clear, free, rich, ringing, and resonant.*

*Mark only one oval.*

- 1 - poor tone quality
- 2
- 3
- 4
- 5 - good tone quality

14

21. **14. Rate the choir's overall tone quality for this performance** *

https://drive.google.com/file/d/1pm4uSbeMWLA-9iBjcR4PA_C8V1cg_MVx/view?usp=sharing
*Good tone quality is defined as consistent, clear, free, rich, ringing, and resonant.*

*Mark only one oval.*

- 1 - poor tone quality
- 2
- 3
- 4
- 5 - good tone quality

15

22. **15. Rate the choir's overall tone quality for this performance** *

https://drive.google.com/file/d/1SLDL4Bsy5asbUnVxZT3Nc-9_jrNc2J6E/view?usp=sharing
*Good tone quality is defined as consistent, clear, free, rich, ringing, and resonant.*

*Mark only one oval.*

- 1 - poor tone quality
- 2
- 3
- 4
- 5 - good tone quality

Thank you for completing this questionnaire!

# APPENDIX L

## Expert Panel Choral Tone Rating Data

| Randomized Order | Choir Three | Choir Three | Choir Three | Choir One | Choir One | Choir One | Choir Two | Choir One | Choir One | Choir Three | Choir Three | Choir Two | Choir Two | Choir Two | Choir Two |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Participant ID | Oil | Perform | Favorite | Literal | Oil | Imagine | Imagine | Favorite | Perform | Literal | Imagine | Favorite | Oil | Perform | Literal |
| 95 | 4 | 5 | 3 | 5 | 5 | 4 | 2 | 4 | 5 | 3 | 3 | 2 | 4 | 4 | 3 |
| 96 | 4 | 4 | 4 | 5 | 5 | 5 | 3 | 4 | 4 | 3 | 3 | 3 | 3 | 3 | 3 |
| 97 | 5 | 4 | 4 | 5 | 5 | 3 | 3 | 4 | 5 | 4 | 3 | 4 | 4 | 4 | 4 |
| 98 | 3 | 4 | 4 | 5 | 4 | 5 | 3 | 5 | 5 | 3 | 3 | 3 | 2 | 2 | 3 |
| 99 | 5 | 5 | 5 | 5 | 5 | 5 | 3 | 4 | 5 | 3 | 4 | 1 | 3 | 3 | 3 |
| 100 | 2 | 3 | 4 | 4 | 5 | 5 | 2 | 4 | 5 | 3 | 3 | 3 | 3 | 3 | 2 |
| 101 | 3 | 3 | 3 | 4 | 5 | 4 | 1 | 4 | 5 | 3 | 3 | 2 | 3 | 3 | 4 |
| 102 | 3 | 4 | 2 | 4 | 4 | 3 | 2 | 4 | 5 | 2 | 3 | 1 | 2 | 2 | 1 |
| 103 | 2 | 3 | 3 | 4 | 4 | 4 | 2 | 4 | 4 | 3 | 3 | 2 | 2 | 2 | 2 |
| 104 | 4 | 4 | 3 | 5 | 5 | 4 | 3 | 3 | 4 | 3 | 3 | 2 | 2 | 2 | 1 |
| 105 | 2 | 2 | 2 | 5 | 4 | 5 | 1 | 2 | 3 | 2 | 2 | 1 | 1 | 3 | 2 |
| 106 | 4 | 3 | 3 | 5 | 5 | 5 | 2 | 3 | 4 | 1 | 2 | 1 | 1 | 1 | 1 |
| 107 | 2 | 3 | 3 | 4 | 4 | 4 | 3 | 4 | 4 | 3 | 3 | 3 | 3 | 3 | 3 |
| 108 | 4 | 3 | 3 | 5 | 4 | 3 | 1 | 3 | 4 | 2 | 2 | 1 | 3 | 3 | 2 |
| 109 | 3 | 3 | 3 | 4 | 4 | 5 | 2 | 3 | 4 | 2 | 2 | 2 | 2 | 2 | 2 |
| 110 | 3 | 3 | 3 | 5 | 4 | 5 | 2 | 4 | 4 | 2 | 3 | 1 | 2 | 2 | 1 |
| 111 | 3 | 2 | 1 | 4 | 5 | 4 | 1 | 3 | 4 | 1 | 2 | 1 | 2 | 1 | 1 |
| 112 | 3 | 3 | 2 | 4 | 4 | 4 | 1 | 4 | 3 | 1 | 2 | 2 | 2 | 2 | 2 |
| 113 | 3 | 3 | 2 | 5 | 4 | 5 | 1 | 5 | 4 | 3 | 3 | 2 | 2 | 2 | 2 |
| 114 | 3 | 4 | 3 | 4 | 3 | 4 | 2 | 3 | 4 | 3 | 3 | 1 | 2 | 2 | 1 |
| 115 | 3 | 2 | 2 | 4 | 3 | 4 | 1 | 5 | 4 | 1 | 2 | 1 | 1 | 1 | 1 |
| 116 | 1 | 2 | 3 | 4 | 5 | 5 | 3 | 4 | 3 | 2 | 3 | 1 | 1 | 3 | 3 |
| 117 | 4 | 5 | 4 | 5 | 5 | 5 | 3 | 4 | 4 | 2 | 3 | 3 | 2 | 2 | 2 |
| 118 | 3 | 4 | 4 | 5 | 4 | 5 | 3 | 3 | 5 | 2 | 3 | 2 | 2 | 3 | 3 |
| 119 | 3 | 3 | 2 | 4 | 5 | 5 | 1 | 5 | 3 | 2 | 2 | 1 | 2 | 1 | 1 |
| 120 | 2 | 3 | 3 | 4 | 5 | 5 | 2 | 5 | 5 | 3 | 2 | 1 | 1 | 2 | 1 |
| 121 | 3 | 4 | 4 | 5 | 5 | 5 | 2 | 5 | 4 | 2 | 3 | 2 | 2 | 3 | 2 |
| 122 | 3 | 3 | 2 | 3 | 4 | 4 | 2 | 2 | 3 | 1 | 2 | 2 | 2 | 2 | 1 |
| 123 | 3 | 4 | 4 | 5 | 5 | 5 | 2 | 4 | 4 | 3 | 4 | 2 | 2 | 3 | 3 |
| 124 | 3 | 2 | 2 | 4 | 4 | 5 | 2 | 3 | 4 | 3 | 2 | 1 | 1 | 1 | 1 |
| 125 | 4 | 4 | 4 | 5 | 5 | 5 | 2 | 5 | 4 | 3 | 3 | 2 | 2 | 2 | 2 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 126 | 3 | 4 | 3 | 4 | 4 | 4 | 2 | 4 | 4 | 2 | 2 | 2 | 1 | 2 | 2 |
| 127 | 2 | 2 | 3 | 4 | 4 | 5 | 2 | 3 | 4 | 2 | 3 | 2 | 2 | 2 | 2 |
| 128 | 4 | 3 | 3 | 5 | 4 | 5 | 2 | 3 | 4 | 2 | 2 | 1 | 3 | 3 | 1 |
| 129 | 3 | 2 | 2 | 4 | 4 | 4 | 2 | 5 | 5 | 1 | 3 | 1 | 2 | 1 | 1 |
| 130 | 3 | 3 | 2 | 3 | 3 | 4 | 3 | 4 | 5 | 2 | 3 | 5 | 3 | 2 | 3 |
| 131 | 3 | 4 | 2 | 5 | 4 | 3 | 1 | 4 | 3 | 1 | 2 | 1 | 2 | 2 | 2 |
| 132 | 2 | 3 | 3 | 4 | 5 | 5 | 3 | 4 | 5 | 3 | 3 | 3 | 4 | 4 | 3 |
| 133 | 3 | 2 | 3 | 4 | 4 | 5 | 2 | 5 | 4 | 2 | 2 | 1 | 1 | 1 | 2 |
| 134 | 3 | 4 | 4 | 5 | 3 | 4 | 2 | 3 | 5 | 2 | 2 | 1 | 1 | 2 | 2 |
| 135 | 3 | 4 | 2 | 4 | 3 | 4 | 2 | 3 | 3 | 1 | 2 | 2 | 2 | 2 | 1 |
| 136 | 3 | 4 | 4 | 5 | 4 | 4 | 2 | 4 | 5 | 1 | 2 | 1 | 1 | 1 | 1 |
| 137 | 4 | 4 | 3 | 5 | 5 | 5 | 2 | 5 | 4 | 2 | 3 | 1 | 2 | 2 | 2 |
| 138 | 4 | 3 | 4 | 5 | 4 | 5 | 3 | 4 | 5 | 2 | 3 | 2 | 2 | 2 | 3 |
| 139 | 1 | 2 | 2 | 5 | 4 | 5 | 1 | 4 | 5 | 1 | 1 | 2 | 2 | 2 | 1 |
| 140 | 3 | 4 | 3 | 4 | 4 | 5 | 3 | 4 | 5 | 2 | 3 | 2 | 2 | 2 | 2 |
| 141 | 4 | 3 | 3 | 5 | 5 | 5 | 3 | 5 | 5 | 3 | 2 | 2 | 2 | 2 | 2 |
| 142 | 3 | 4 | 4 | 5 | 5 | 4 | 2 | 5 | 4 | 2 | 3 | 1 | 1 | 2 | 2 |
| 143 | 3 | 4 | 3 | 5 | 4 | 5 | 2 | 5 | 3 | 1 | 2 | 2 | 2 | 3 | 3 |
| 144 | 3 | 2 | 3 | 4 | 4 | 5 | 2 | 5 | 4 | 3 | 3 | 2 | 2 | 2 | 2 |
| 145 | 4 | 4 | 3 | 5 | 5 | 4 | 3 | 4 | 5 | 3 | 3 | 2 | 3 | 2 | 2 |
| 146 | 4 | 3 | 3 | 4 | 5 | 4 | 3 | 4 | 4 | 3 | 3 | 2 | 2 | 3 | 2 |
| 147 | 3 | 4 | 4 | 5 | 5 | 5 | 2 | 4 | 4 | 2 | 3 | 2 | 3 | 3 | 2 |
| 148 | 4 | 3 | 3 | 5 | 4 | 5 | 2 | 5 | 4 | 3 | 3 | 2 | 2 | 2 | 2 |
| 149 | 3 | 4 | 3 | 5 | 5 | 5 | 2 | 5 | 5 | 2 | 3 | 1 | 2 | 1 | 3 |
| 150 | 3 | 4 | 4 | 5 | 4 | 5 | 2 | 4 | 4 | 2 | 3 | 3 | 3 | 2 | 2 |
| 151 | 3 | 2 | 2 | 5 | 3 | 3 | 1 | 3 | 3 | 1 | 1 | 2 | 1 | 2 | 1 |
| 152 | 2 | 3 | 4 | 4 | 5 | 5 | 2 | 4 | 5 | 2 | 3 | 2 | 1 | 2 | 2 |
| 153 | 2 | 2 | 2 | 5 | 3 | 4 | 2 | 2 | 5 | 1 | 2 | 1 | 1 | 1 | 2 |
| 154 | 2 | 3 | 2 | 4 | 2 | 3 | 1 | 4 | 3 | 1 | 2 | 2 | 4 | 3 | 2 |
| 155 | 2 | 3 | 3 | 4 | 5 | 4 | 2 | 4 | 5 | 1 | 2 | 1 | 2 | 3 | 3 |
| 156 | 2 | 2 | 4 | 5 | 4 | 3 | 2 | 4 | 4 | 3 | 3 | 1 | 1 | 1 | 2 |
| 157 | 3 | 3 | 2 | 4 | 5 | 5 | 2 | 4 | 5 | 3 | 4 | 2 | 2 | 3 | 2 |
| 158 | 3 | 4 | 4 | 5 | 4 | 5 | 2 | 3 | 4 | 3 | 3 | 2 | 1 | 2 | 2 |
| 159 | 3 | 4 | 3 | 5 | 4 | 5 | 2 | 4 | 5 | 1 | 2 | 2 | 1 | 2 | 2 |
| 160 | 4 | 3 | 3 | 5 | 5 | 4 | 2 | 4 | 4 | 1 | 2 | 1 | 2 | 1 | 1 |

*Note.* Choral tone rating range is 1–5, with 5 being good tone quality. The data presented here is the randomized order in which the experts heard the audio recordings of the choirs.

# APPENDIX M

## Long-Term Average Spectrum (LTAS) Data

| | Choir One | | | | | Chori 2 | | | | | Choir Three | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Perform | Literal | Imagine | Favorite | Oil | Perform | Literal | Imagine | Favorite | Oil | Perform | Literal | Imagine | Favorite | Oil |
| kHz | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB |
| 0 | 19.7 | 19.65 | 20.58 | 18.6 | 17.1 | 25.64 | 26.25 | 27.67 | 26.94 | 26.36 | 39.88 | 39.1 | 38.51 | 39.61 | 36.1 |
| 86.13 | 28.79 | 28.84 | 29.19 | 27.08 | 25.68 | 34.83 | 35.72 | 36.86 | 36.14 | 35.26 | 41.06 | 39.91 | 39.84 | 39.26 | 37.97 |
| 172.27 | 36.48 | 36.42 | 36.44 | 34.63 | 32.83 | 42.06 | 43.01 | 44.18 | 43.39 | 42.69 | 42.14 | 41.42 | 41.14 | 39.45 | 39.34 |
| 258.4 | 40.08 | 39.87 | 39.76 | 38.32 | 36.42 | 45.18 | 46 | 47.36 | 46.25 | 46.02 | 44.76 | 44.3 | 43.13 | 42.1 | 42.22 |
| 344.53 | 42 | 41.29 | 41.02 | 39.95 | 38.3 | 46.25 | 46.88 | 48.27 | 47.43 | 47.03 | 45.81 | 45.2 | 43.85 | 43.3 | 43.42 |
| 430.66 | 46.28 | 45.21 | 45.1 | 43.88 | 42.72 | 48.85 | 49.38 | 50.4 | 49.88 | 49.59 | 48.52 | 47.61 | 46.38 | 46.32 | 46.2 |
| 516.8 | 49.42 | 48.27 | 48.14 | 46.8 | 45.58 | 51.28 | 52.03 | 52.85 | 52.41 | 52.13 | 51.14 | 50 | 48.83 | 49.11 | 48.71 |
| 602.93 | 47.31 | 46.14 | 45.83 | 44.4 | 43.17 | 49.38 | 50.23 | 51.05 | 50.43 | 50.18 | 48.39 | 47.35 | 46.1 | 46.48 | 46.1 |
| 689.06 | 41.85 | 40.73 | 40.22 | 38.72 | 37.64 | 44.32 | 45.23 | 46.14 | 45.49 | 45.33 | 42.32 | 41.62 | 40.23 | 40.25 | 40.11 |
| 775.2 | 36.96 | 36.21 | 35.53 | 34.07 | 32.98 | 39.79 | 40.96 | 41.91 | 41.29 | 40.61 | 38.37 | 37.4 | 35.67 | 35.5 | 35.24 |
| 861.33 | 33.18 | 32.69 | 31.93 | 30.65 | 29.2 | 35.87 | 37.34 | 38.15 | 37.56 | 36.78 | 34.59 | 33.39 | 31.41 | 31.49 | 30.8 |
| 947.46 | 34.88 | 34.63 | 33.38 | 32.49 | 30.8 | 37.14 | 38.96 | 39.15 | 38.8 | 37.43 | 34.47 | 33.28 | 32.07 | 31.64 | 30.9 |
| 1033.59 | 37.08 | 37.04 | 35.84 | 35.04 | 33.21 | 38.92 | 40.6 | 41.04 | 40.65 | 39.02 | 35.54 | 34.16 | 33.26 | 33.16 | 32.54 |
| 1119.73 | 35.5 | 35.44 | 34.54 | 33.65 | 31.8 | 37.06 | 38.52 | 39.27 | 38.97 | 37.37 | 33.31 | 31.9 | 31.13 | 31.28 | 30.69 |
| 1205.86 | 32.37 | 32.05 | 31.21 | 30.28 | 28.87 | 33.74 | 34.75 | 35.93 | 35.72 | 34.7 | 30.16 | 28.98 | 28.08 | 28.35 | 28.42 |
| 1291.99 | 29.46 | 28.58 | 28.01 | 27.07 | 25.68 | 31.35 | 32.35 | 33.2 | 32.97 | 32.12 | 28.12 | 27.31 | 26.14 | 26.09 | 26.44 |
| 1378.13 | 25.99 | 24.83 | 24.37 | 23.48 | 21.84 | 28.03 | 29.19 | 29.81 | 29.75 | 28.55 | 25.55 | 24.55 | 23.09 | 23.21 | 23.15 |
| 1464.26 | 26.18 | 25.38 | 24.89 | 23.79 | 22.08 | 28.02 | 29.32 | 29.62 | 29.79 | 28.69 | 26.14 | 25.03 | 23.71 | 24.39 | 23.61 |
| 1550.39 | 26.67 | 26 | 25.45 | 24.04 | 22.59 | 28.74 | 30.06 | 30.17 | 30.51 | 29.69 | 26.64 | 25.68 | 24.37 | 25.06 | 24.16 |
| 1636.52 | 26.36 | 25.75 | 24.9 | 23.43 | 22.21 | 28.08 | 29.47 | 29.33 | 29.64 | 28.92 | 26.08 | 24.91 | 23.85 | 24.85 | 23.81 |
| 1722.66 | 25.16 | 24.82 | 23.52 | 22.43 | 21.29 | 27.16 | 28.59 | 28.63 | 28.78 | 27.86 | 24.8 | 23.36 | 22.54 | 23.7 | 22.6 |
| 1808.79 | 23.54 | 23.08 | 22.13 | 21.15 | 19.78 | 25.76 | 27.18 | 27.45 | 27.31 | 26.17 | 22.6 | 20.87 | 20.2 | 21.53 | 20.06 |
| 1894.92 | 22.25 | 21.25 | 20.85 | 19.97 | 18.31 | 23.91 | 25.1 | 25.35 | 25.2 | 24.12 | 20.24 | 18.52 | 17.74 | 18.5 | 17.81 |
| 1981.05 | 21.58 | 20.49 | 20.43 | 19.42 | 17.63 | 23.99 | 24.81 | 25.17 | 25.28 | 24.27 | 19.95 | 18.58 | 17.89 | 18.23 | 17.82 |
| 2067.19 | 20.26 | 19.1 | 18.88 | 17.91 | 16.29 | 23.4 | 24.01 | 24.52 | 24.61 | 23.69 | 19.51 | 18.11 | 17.67 | 17.96 | 17.69 |
| 2153.32 | 19.07 | 17.97 | 17.14 | 16.07 | 14.67 | 21.26 | 22.3 | 22.54 | 22.65 | 21.75 | 18.64 | 17.29 | 16.79 | 16.89 | 16.97 |
| 2239.45 | 20.73 | 19.4 | 18.11 | 17.12 | 15.84 | 22.7 | 23.62 | 23.69 | 24.63 | 23.05 | 20.47 | 19.31 | 18.95 | 19.29 | 19.18 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2325.59 | 22.1 | 20.35 | 19 | 18.16 | 16.91 | 24.31 | 24.63 | 25.21 | 26.18 | 24.38 | 20.85 | 19.73 | 19.63 | 20.19 | 19.88 |
| 2411.72 | 21.64 | 19.66 | 18.12 | 17.59 | 16.19 | 22.93 | 23.27 | 24.37 | 24.8 | 23.27 | 18.77 | 17.12 | 17.22 | 17.74 | 17.49 |
| 2497.85 | 22.61 | 20.96 | 19.44 | 18.99 | 17.44 | 21.89 | 22.96 | 23.89 | 24.15 | 22.82 | 18.14 | 15.96 | 15.92 | 16.69 | 16.68 |
| 2583.98 | 23.74 | 22.21 | 21.18 | 20.28 | 19.17 | 22.16 | 23.48 | 24.39 | 24.68 | 22.94 | 18.42 | 16.27 | 16.05 | 17.03 | 17.24 |
| 2670.12 | 22.79 | 21.33 | 20.48 | 19.21 | 18.59 | 21.18 | 22.21 | 23.45 | 23.54 | 21.72 | 17.17 | 15.31 | 14.46 | 15.51 | 15.56 |
| 2756.25 | 21.17 | 20.01 | 18.38 | 17.35 | 16.52 | 19.76 | 20.75 | 21.84 | 21.66 | 20.11 | 16.67 | 15.09 | 13.25 | 14.23 | 14.23 |
| 2842.38 | 21.17 | 20.14 | 18.37 | 17.53 | 16.41 | 20.63 | 21.85 | 22.47 | 22.18 | 20.98 | 18.43 | 16.84 | 14.62 | 15.92 | 15.42 |
| 2928.52 | 20.97 | 20.11 | 18.39 | 17.66 | 15.86 | 20.89 | 21.94 | 22.5 | 22.38 | 21.04 | 19.4 | 17.33 | 16.09 | 17.02 | 16.16 |
| 3014.65 | 21.48 | 20.92 | 19.28 | 18.47 | 16.44 | 21.29 | 22.58 | 22.95 | 23.12 | 21.8 | 20.14 | 18.24 | 17.24 | 17.81 | 17.34 |
| 3100.78 | 21.49 | 20.98 | 19.59 | 18.33 | 16.71 | 21.45 | 23.18 | 23.31 | 23.78 | 22.12 | 19.7 | 18.22 | 16.98 | 17.57 | 17.36 |
| 3186.91 | 21.07 | 20.24 | 18.71 | 17.68 | 16.36 | 21.19 | 22.89 | 23.02 | 23.65 | 21.65 | 17.99 | 16.49 | 15.65 | 15.94 | 16.52 |
| 3273.05 | 21.12 | 19.67 | 17.72 | 17.42 | 16.43 | 21.31 | 22.87 | 22.6 | 23.51 | 20.86 | 16.68 | 15.51 | 15.29 | 14.81 | 16.32 |
| 3359.18 | 21.71 | 19.95 | 18.02 | 18.19 | 17.14 | 21.11 | 22.49 | 21.94 | 22.62 | 19.89 | 16.82 | 15.74 | 15.55 | 15.27 | 16.66 |
| 3445.31 | 21.94 | 20.23 | 18.09 | 18.48 | 17.59 | 20.4 | 21.42 | 21.73 | 21.78 | 19.22 | 17.63 | 16.05 | 16.17 | 15.9 | 16.88 |
| 3531.45 | 21.34 | 19.84 | 17.61 | 17.72 | 16.89 | 19.41 | 20.06 | 20.96 | 20.77 | 18.37 | 17.65 | 16.12 | 16.21 | 16.13 | 16.91 |
| 3617.58 | 19.45 | 18.16 | 15.98 | 15.79 | 14.76 | 17.51 | 17.99 | 19.21 | 18.85 | 16.76 | 16.51 | 15.18 | 15.09 | 15.15 | 15.68 |
| 3703.71 | 17 | 15.61 | 14.06 | 13.66 | 12.08 | 15.85 | 16.63 | 17.24 | 16.84 | 15.02 | 15.47 | 14.26 | 14.34 | 13.76 | 15.01 |
| 3789.84 | 16.39 | 14.73 | 13.61 | 12.98 | 11.27 | 16.33 | 17.12 | 17.09 | 16.89 | 15.31 | 15.36 | 14.06 | 14.1 | 13.54 | 15.81 |
| 3875.98 | 15.71 | 14.23 | 13.25 | 12.35 | 11.01 | 15.95 | 16.68 | 16.74 | 16.41 | 15.17 | 14.19 | 12.95 | 12.84 | 12.59 | 14.86 |
| 3962.11 | 14.68 | 13.46 | 12.26 | 11.63 | 10.21 | 14.21 | 15.17 | 15.18 | 14.78 | 13.5 | 12.94 | 11.77 | 11.56 | 11.7 | 13.7 |
| 4048.24 | 14.01 | 12.68 | 11.62 | 10.85 | 9.83 | 14.34 | 15.05 | 15.13 | 15.07 | 13.65 | 13.03 | 11.54 | 11.2 | 11.96 | 13.56 |
| 4134.38 | 12.27 | 11.11 | 10.2 | 9.39 | 8.42 | 14.33 | 14.96 | 15.12 | 15.34 | 14.06 | 12.19 | 10.54 | 10.13 | 11.3 | 11.94 |
| 4220.51 | 9.69 | 8.69 | 7.79 | 6.48 | 5.62 | 12.9 | 13.67 | 13.91 | 13.92 | 12.58 | 9.67 | 7.97 | 7.66 | 8.82 | 9.38 |
| 4306.64 | 7.7 | 6.87 | 5.45 | 4.29 | 3.47 | 11.36 | 12.27 | 12.62 | 12.26 | 10.97 | 7.45 | 6.1 | 5.9 | 6.37 | 7.02 |
| 4392.77 | 6.32 | 5.91 | 4.47 | 3.49 | 2.65 | 10.06 | 11.1 | 11.66 | 11.19 | 9.64 | 6.29 | 5.16 | 4.91 | 5.15 | 5.18 |
| 4478.91 | 6.6 | 5.76 | 4.52 | 3.76 | 2.83 | 9.65 | 11.05 | 11.34 | 10.7 | 9.22 | 5.84 | 4.75 | 4.44 | 4.92 | 4.77 |
| 4565.04 | 7.6 | 6.66 | 5.53 | 4.52 | 3.54 | 10.67 | 12.35 | 12.56 | 11.82 | 10.48 | 6.34 | 5.43 | 5.07 | 5.83 | 5.05 |
| 4651.17 | 6.9 | 6.02 | 5.04 | 3.74 | 2.7 | 11.07 | 12.8 | 13.28 | 12.2 | 10.7 | 5.6 | 4.95 | 4.81 | 5.24 | 4.29 |
| 4737.3 | 4.9 | 3.98 | 3.16 | 1.91 | 0.21 | 10.2 | 11.84 | 12.32 | 11.45 | 9.85 | 4.03 | 3.51 | 3.29 | 3.38 | 3.26 |
| 4823.44 | 3.41 | 2.44 | 2.08 | 0.62 | -1.45 | 9.48 | 11.5 | 11.86 | 11.27 | 9.34 | 2.89 | 2.88 | 2.22 | 2.76 | 2.96 |
| 4909.57 | 2.53 | 1.56 | 1.47 | -0.26 | -2.4 | 9.16 | 11.38 | 11.85 | 11.45 | 8.81 | 2.12 | 2.21 | 1.62 | 2.13 | 2.52 |
| 4995.7 | 2.45 | 1.56 | 1.41 | -0.31 | -2.62 | 8.78 | 10.97 | 11.62 | 11.1 | 8.75 | 1.74 | 1.95 | 0.88 | 1.27 | 1.42 |
| 5081.84 | 3.73 | 2.9 | 2.58 | 1.2 | -1.31 | 9.35 | 11.77 | 12.1 | 11.95 | 9.84 | 2.21 | 2.59 | 0.93 | 1.19 | 0.88 |
| 5167.97 | 4.69 | 3.44 | 3.27 | 1.88 | -0.52 | 10.71 | 13.04 | 13.61 | 13.37 | 11.06 | 2.32 | 2.87 | 1.08 | 1.28 | 0.75 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5254.1 | 4.46 | 2.99 | 2.55 | 1.62 | -0.87 | 10.51 | 12.86 | 14.08 | 13.64 | 11.12 | 1.89 | 2.56 | 0.6 | 0.79 | 0.2 |
| 5340.23 | 4.39 | 2.53 | 2.08 | 1.71 | -1 | 9.79 | 12.28 | 13.61 | 12.85 | 10.09 | 1.5 | 2.05 | 0.02 | 0.2 | -0.21 |
| 5426.37 | 4.6 | 2.09 | 1.86 | 1.61 | -1.16 | 9.27 | 11.77 | 12.69 | 12.4 | 9 | 1.14 | 1.84 | -0.28 | -0.13 | -0.31 |
| 5512.5 | 4.34 | 1.69 | 1.45 | 1.02 | -1.46 | 8.41 | 10.72 | 12.14 | 11.8 | 8.01 | 0.87 | 1.9 | -0.2 | -0.05 | -0.03 |
| 5598.63 | 3.91 | 1.97 | 1.36 | 0.64 | -1.56 | 8.02 | 9.91 | 11.41 | 11.05 | 7.4 | 0.94 | 2.16 | 0.12 | 0.01 | 0.54 |
| 5684.77 | 3.53 | 2.34 | 1.73 | 0.81 | -1.17 | 7.75 | 9.48 | 10.59 | 10.24 | 6.91 | 1.18 | 2.15 | -0.04 | 0.11 | 0.73 |
| 5770.9 | 3.04 | 2.33 | 1.72 | 0.89 | -0.98 | 7.38 | 9.2 | 10.25 | 9.67 | 6.67 | 1.42 | 1.86 | 0.02 | 0.22 | 0.46 |
| 5857.03 | 2.36 | 1.84 | 1.25 | 0.49 | -1.3 | 6.53 | 8.75 | 9.79 | 8.87 | 6.17 | 1.28 | 1.78 | 0.04 | 0.07 | 0.17 |
| 5943.16 | 1.54 | 1.19 | 0.45 | -0.53 | -2.42 | 5.48 | 7.85 | 8.8 | 7.82 | 5.09 | 0.93 | 1.5 | -0.09 | -0.42 | -0.05 |
| 6029.3 | 1.53 | 1.02 | 0.16 | -0.81 | -3.11 | 5.02 | 7.53 | 8.3 | 7.45 | 4.67 | 0.88 | 1.42 | 0.13 | -0.45 | 0.34 |
| 6115.43 | 2.22 | 1.44 | 0.58 | -0.28 | -3.04 | 5.6 | 7.89 | 8.58 | 7.85 | 5.04 | 1.18 | 1.91 | 0.46 | 0.08 | 0.72 |
| 6201.56 | 2.46 | 1.53 | 0.52 | -0.08 | -3.13 | 6.07 | 8.13 | 8.44 | 7.78 | 5.02 | 1.48 | 2.18 | 0.37 | 0.11 | 0.73 |
| 6287.7 | 2.76 | 1.73 | 0.61 | 0.15 | -2.99 | 6.38 | 8.23 | 8.46 | 8.01 | 4.88 | 1.66 | 2.34 | 0.46 | 0.4 | 0.95 |
| 6373.83 | 3.04 | 2.11 | 0.86 | 0.36 | -2.48 | 6.51 | 8.08 | 8.76 | 8.19 | 5.02 | 2.2 | 2.52 | 0.78 | 1.14 | 1.01 |
| 6459.96 | 2.94 | 1.93 | 0.81 | 0.31 | -2.54 | 5.76 | 7.52 | 8.12 | 7.84 | 4.4 | 2.67 | 2.58 | 0.84 | 1.65 | 0.89 |
| 6546.09 | 2.51 | 1.65 | 0.65 | 0.07 | -2.91 | 5.12 | 6.93 | 6.84 | 7.21 | 3.75 | 2.75 | 2.73 | 0.88 | 1.83 | 1.34 |
| 6632.23 | 2.34 | 1.67 | 0.69 | -0.14 | -3.12 | 5 | 6.6 | 6.19 | 6.81 | 3.39 | 3.03 | 3.09 | 1.19 | 2.09 | 1.61 |
| 6718.36 | 2.45 | 1.62 | 0.54 | -0.28 | -3.11 | 4.78 | 6.18 | 5.84 | 6.41 | 3.18 | 3.14 | 3.46 | 1.17 | 2.23 | 1.77 |
| 6804.49 | 2.72 | 1.55 | 0.35 | -0.17 | -2.85 | 4.63 | 6.19 | 5.79 | 6.16 | 3.25 | 3.22 | 4.02 | 1.36 | 2.37 | 2.14 |
| 6890.63 | 2.99 | 1.62 | 0.42 | 0.1 | -2.41 | 4.96 | 6.73 | 6.22 | 6.37 | 3.49 | 3.53 | 4.3 | 1.67 | 2.83 | 2.15 |
| 6976.76 | 2.94 | 1.63 | 0.26 | 0.05 | -2.39 | 5.21 | 6.94 | 6.48 | 6.77 | 4.05 | 3.72 | 4.46 | 1.92 | 3.01 | 2.37 |
| 7062.89 | 3.19 | 1.71 | 0.27 | 0.23 | -2.64 | 5.46 | 7.11 | 6.98 | 7.33 | 4.5 | 4.05 | 4.82 | 2.38 | 3.41 | 3.09 |
| 7149.02 | 3.5 | 1.94 | 0.5 | 0.51 | -2.29 | 6.15 | 7.65 | 7.75 | 7.89 | 4.97 | 4.39 | 4.98 | 2.88 | 3.74 | 3.73 |
| 7235.16 | 3.51 | 1.75 | 0.41 | 0.33 | -2.17 | 6.36 | 7.91 | 8.41 | 8.33 | 5.36 | 4.75 | 5.31 | 3.37 | 4.18 | 3.9 |
| 7321.29 | 3.07 | 1.43 | 0.31 | -0.07 | -2.65 | 5.96 | 7.69 | 8.3 | 8.01 | 5.31 | 4.84 | 5.51 | 3.54 | 4.31 | 4.19 |
| 7407.42 | 2.6 | 1.15 | 0.16 | -0.41 | -2.98 | 5.63 | 7.36 | 8 | 7.69 | 4.99 | 4.97 | 5.38 | 3.47 | 4.19 | 4.57 |
| 7493.55 | 2.24 | 1.12 | 0.03 | -0.77 | -3.08 | 5.43 | 7.17 | 8.1 | 7.66 | 5.03 | 5.1 | 5.35 | 3.43 | 4.01 | 4.52 |
| 7579.69 | 1.84 | 1.01 | -0.01 | -0.79 | -3.07 | 5.4 | 6.82 | 7.99 | 7.3 | 5.19 | 5.05 | 5.19 | 3.28 | 3.87 | 4.08 |
| 7665.82 | 1.43 | 0.83 | 0.22 | -0.65 | -2.8 | 5.33 | 6.67 | 7.68 | 7.16 | 5.4 | 4.78 | 4.8 | 2.81 | 3.67 | 3.86 |
| 7751.95 | 0.94 | 0.54 | -0.08 | -1.14 | -3.44 | 5.16 | 6.48 | 7.27 | 6.8 | 5.24 | 4.42 | 4.37 | 2.06 | 3.04 | 3.48 |
| 7838.09 | 0.39 | 0.21 | -0.74 | -1.74 | -4.04 | 4.47 | 6.02 | 6.79 | 6.31 | 4.57 | 3.78 | 3.93 | 1.57 | 2.48 | 2.58 |
| 7924.22 | 0.31 | 0.02 | -1 | -1.92 | -4.29 | 4.06 | 5.52 | 6.33 | 6.01 | 4.2 | 3.52 | 3.77 | 1.35 | 1.89 | 2.21 |
| 8010.35 | 0.66 | 0.04 | -0.49 | -1.39 | -3.75 | 3.82 | 5.5 | 6.21 | 5.85 | 3.83 | 3.64 | 3.35 | 1.18 | 1.66 | 1.86 |
| 8096.48 | 1.16 | 0.43 | -0.1 | -1 | -3.25 | 3.89 | 5.56 | 6.23 | 6.04 | 3.53 | 3.73 | 3.16 | 1.45 | 1.96 | 1.69 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8182.62 | 1.53 | 0.55 | 0.06 | -1.16 | -3.15 | 4.09 | 5.34 | 6.09 | 5.88 | 3.52 | 3.6 | 3.03 | 1.38 | 1.89 | 1.32 |
| 8268.75 | 1.16 | 0.26 | -0.18 | -1.42 | -3.38 | 3.99 | 5.33 | 5.81 | 5.99 | 3.32 | 3.04 | 2.4 | 1.08 | 1.28 | 0.96 |
| 8354.88 | 1.06 | 0.08 | -0.61 | -1.56 | -3.71 | 4.11 | 5.67 | 6.01 | 6.36 | 3.22 | 2.59 | 2.04 | 1.11 | 1.08 | 0.75 |
| 8441.02 | 1.09 | 0.06 | -0.87 | -1.69 | -4.16 | 4.19 | 5.79 | 6.25 | 6.4 | 3.39 | 2.48 | 2.03 | 1.06 | 0.95 | 0.8 |
| 8527.15 | 0.86 | 0.12 | -1 | -1.85 | -4.16 | 4.3 | 5.7 | 6.03 | 6.08 | 3.18 | 2.68 | 2.09 | 0.93 | 1.04 | 0.69 |
| 8613.28 | 1.02 | 0.2 | -1.03 | -1.92 | -4 | 4.48 | 5.59 | 5.93 | 5.78 | 3.1 | 2.97 | 2.3 | 1.04 | 1.32 | 0.64 |
| 8699.41 | 1.31 | 0.26 | -1 | -1.75 | -4.15 | 4.38 | 5.71 | 6.17 | 5.61 | 3.1 | 3.36 | 2.43 | 1.17 | 1.33 | 0.83 |
| 8785.55 | 1.04 | 0.35 | -0.83 | -1.82 | -4.31 | 4.22 | 5.6 | 5.9 | 5.62 | 3.08 | 3.33 | 2.22 | 0.94 | 0.94 | 0.56 |
| 8871.68 | 0.35 | 0 | -0.87 | -2.37 | "-inf" | 4.39 | 5.47 | 5.72 | 5.45 | 3 | 2.91 | 2.01 | 0.66 | 0.62 | 0.27 |
| 8957.81 | 0.15 | -0.27 | -1.13 | -2.74 | "-inf" | 4.38 | 5.45 | 5.69 | 5.51 | 2.63 | 2.64 | 1.77 | 0.47 | 0.43 | 0 |
| 9043.95 | 0.14 | -0.49 | -1.24 | -2.64 | "-inf" | 4.26 | 5.47 | 5.83 | 5.59 | 2.59 | 2.66 | 1.84 | 0.37 | 0.47 | -0.08 |
| 9130.08 | 0.45 | -0.28 | -1.07 | -2.49 | "-inf" | 4.15 | 5.45 | 6.02 | 5.45 | 2.56 | 2.82 | 2.05 | 0.28 | 0.75 | 0.01 |
| 9216.21 | 0.53 | 0.11 | -1.12 | -2.41 | "-inf" | 3.89 | 5.41 | 5.99 | 5.37 | 2.45 | 2.78 | 2.42 | 0.57 | 1.33 | 0.09 |
| 9302.34 | 0.09 | -0.37 | -1.48 | -2.59 | "-inf" | 3.57 | 5.12 | 5.75 | 5.04 | 2.64 | 2.81 | 2.7 | 0.89 | 1.74 | 0.13 |
| 9388.48 | -0.28 | -0.93 | -1.74 | -3.05 | "-inf" | 3.06 | 5.12 | 5.35 | 4.71 | 2.58 | 2.96 | 2.93 | 0.87 | 1.78 | 0.37 |
| 9474.61 | -0.39 | -1.36 | -2.12 | -3.48 | "-inf" | 2.92 | 5.25 | 4.96 | 4.77 | 2.64 | 3 | 3.14 | 1.1 | 2.21 | 0.78 |
| 9560.74 | -0.46 | -1.54 | -2.3 | -3.54 | "-inf" | 2.76 | 5.16 | 4.99 | 4.83 | 2.87 | 3.36 | 3.32 | 1.52 | 2.79 | 0.99 |
| 9646.88 | -0.54 | -1.41 | -2.09 | -3.3 | "-inf" | 2.76 | 5.16 | 4.97 | 5 | 2.9 | 3.46 | 3.46 | 1.78 | 2.99 | 1.18 |
| 9733.01 | -0.65 | -1.48 | -1.93 | -3.09 | "-inf" | 2.98 | 5.09 | 5.12 | 5.2 | 3.09 | 3.05 | 3.31 | 1.82 | 2.81 | 1.27 |
| 9819.14 | -0.79 | -1.78 | -2.12 | -3.49 | "-inf" | 2.94 | 4.89 | 4.96 | 5.18 | 3.14 | 2.51 | 3 | 1.81 | 2.58 | 0.96 |
| 9905.27 | -1.35 | -2.28 | -2.57 | -3.95 | "-inf" | 2.85 | 4.76 | 4.81 | 4.93 | 3.24 | 2.27 | 2.93 | 1.61 | 2.12 | 0.7 |
| 9991.41 | -1.85 | -2.87 | -3.1 | "-inf" | "-inf" | 2.9 | 4.51 | 4.69 | 4.71 | 3.15 | 1.98 | 2.83 | 1.43 | 1.45 | 0.49 |

*Note.* The green shading is the 2.0- to 4.0-kHz range.

# APPENDIX N

## Qualitative Coding of Singer Comments

| Participant ID | If you answered yes, how did breathing in slowly and deeply with an open throat effect your tone quality? Codes 1 positive, 2 negative, 3 neutral, 0 misc | If you answered yes, how did imagining you are inhaling the aroma of a fragrant rose effect your tone quality? Codes 1 positive, 2 negative, 3 neutral, 0 misc | If you answered yes, how did your choice effect your tone quality? Please comment: Codes 1 positive, 2 negative, 3 neutral, 0 misc | If you answered yes, how did inhaling the aroma of a fragrant rose effect your tone quality? Please comment: Codes 1 positive, 2 negative, 3 neutral, 0 misc | (from 8a 8. You imagined inhaling...did you notice diff between imagine vs. actual inhale) 8b. If you noticed difference, please comment. Codes (0=misc, pos imag 1, neut imag 2, neg image 3, pos oil 4, neut oil 5, neg oil 6, | 16. Did you notice any changes in your singing that you'd like to share? Comment. 1 preference/benefit, 2 application, 3factors, 4 misc. | 17. Is there anything else you'd like to share about the experience? Comment. 1 preference/benefit, 2 application, 3factors, 4 misc. | Category code number. Comments (aware 1, breath 2, 3 emotion, 4 breath support, 6 tone, 7 palate, 8 tension, 9 throat, 10 face, 11, expression, 12 misc, 13 onset, 16 resonator, 14 relax, 15 listening |
|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 2 | | | | | | 6 |
| 1 | | 1 | | | | | | 15 |
| 2 | 2 | 1 | | 1 | | 1 | 4 | 7 |
| 2 | 1 | 2 | 1 | 1 | 6 | 2 | | 13 |
| 3 | 1 | 1 | 1 | 0 | 0 | | | 7 |
| 3 | 1 | 1 | 1 | 0 | 0 | | | 6 |
| 4 | 2 | 1 | 1 | 1 | 0 | 1 | | |
| 4 | 2 | 1 | 1 | 1 | 0 | 4 | | 6 |
| 4 | 2 | 1 | 1 | 1 | 0 | | | |
| 5 | 1 | 2 | | | | 1 | 4 | 6 |
| 6 | 1 | 1 | 1 | 1 | 6 | 1 | 4 | 2 |
| 6 | | 2 | | | | | | |
| 6 | | 2 | | | | | | |
| 7 | | | | | 6 | 1 | 4 | |
| 7 | 1 | 1 | 1 | 2 | 4 | | 4 | 2 |
| 8 | | | | | | | | 6 |
| 8 | 1 | | | 1 | | | | 2 |
| 8 | 1 | | | 1 | | | | 9 |
| 9 | 1 | 1 | 1 | 1 | 0 | | | 2 |
| 10 | 1 | 1 | 1 | 2 | 0 | | | 3 |
| 11 | 1 | 1 | 1 | 1 | 3 | 1 | | 7 |
| 12 | 1 | 1 | 1 | 1 | 4 | 1 | | 3 |
| 12 | | | | | | | | 11 |
| 12 | | | | | | | | 12 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 13 | 1 | 1 | | | | 1 | 1 | 11 |
| 14 | 0 | 2 | 1 | 2 | 6 | 1 | 4 | 2 |
| 15 | 1 | 2 | | 1 | 4 | | 2 | 2 |
| 15 | 1 | 2 | | 1 | 4 | | | 7 |
| 16 | 1 | 2 | 1 | 1 | 1 | | | |
| 16 | 1 | 2 | 1 | 1 | 1 | | | |
| 16 | 1 | 2 | 1 | 1 | 1 | | | |
| 16 | | | | | 4 | | | 2 |
| 17 | 1 | 1 | 1 | | 0 | | | 2 |
| 17 | 1 | 1 | 1 | | 0 | | | |
| 18 | | | | | 4 | 1 | 4 | 10 |
| 18 | 1 | | 1 | 1 | 3 | | | |
| 18 | 1 | | 1 | 1 | 3 | | | |
| 19 | 1 | 0 | | 1 | 1 | 4 | | 7 |
| 19 | | | | | | | | 9 |
| 20 | 1 | 1 | 1 | | 1 | 1 | | 16 |
| 20 | | | | | | | | 7 |
| 20 | | | | | | | | 14 |
| 21 | | 1 | 1 | 1 | 3 | | | 9 |
| 21 | | 1 | 1 | 1 | 3 | | | |
| 22 | 1 | 1 | 1 | 2 | 0 | | | 6 |
| 22 | | | | | 1 | | | |
| 22 | | | | 1 | | | | |
| 23 | 1 | 2 | | | | 1 | 4 | |
| 25 | 1 | | 1 | 1 | 0 | | | |
| 25 | 1 | | 1 | 1 | 4 | | | 2 |
| 25 | 1 | | 1 | 1 | 4 | | | 8 |
| 25 | | | | | | | | 6 |
| 26 | 2 | 2 | 0 | 1 | 1 | 1 | | |
| 27 | | | | | | | | 4 |
| 27 | 1 | 1 | 1 | | | 1 | | 2 |
| 27 | 1 | 1 | 1 | | | 3 | 3 | 1 |
| 28 | 1 | 1 | 1 | | 4 | 2 | 4 | 2 |
| 29 | 0 | 1 | 1 | 1 | 5 | 1 | | 2 |
| 29 | | | | | | | | 3 |
| 30 | | | | | 3 | | | 2 |
| 30 | | 1 | 1 | | 4 | | | |
| 31 | 1 | 0 | 1 | | | 1 | 4 | |
| 31 | 1 | 0 | 1 | | | | | 6 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 32 | 1 | 2 | 1 | 2 | 0 | 1 | | 2 |
| 32 | 2 | 1 | 1 | 2 | 0 | | | |
| 33 | 1 | 2 | 1 | 2 | 4 | | 2 | |
| 33 | | | | | 6 | | 2 | |
| 33 | 1 | 2 | 1 | 2 | 4 | | | |
| 33 | 1 | 2 | 1 | 2 | 4 | | | |
| 34 | 1 | | 1 | 2 | 4 | 4 | 2 | 2 |
| 34 | | | | | | | | 3 |
| 35 | 1 | | | 1 | 4 | 1 | | 11 |
| 35 | 1 | | | 1 | 4 | | | |
| 35 | | | | | 2 | | | |
| 36 | 1 | 1 | 1 | 1 | 4 | | | 6 |
| 36 | 1 | 1 | 1 | 1 | 4 | | | 3 |
| 37 | 1 | 2 | 1 | | | | 4 | 2 |
| 38 | | 1 | 1 | 1 | 3 | | | |
| 38 | | 1 | 1 | 1 | 3 | | | 11 |
| 38 | | | | | 0 | | | 6 |
| 39 | 1 | | 1 | 1 | 4 | | 2 | 2 |
| 39 | 2 | | 1 | 2 | 0 | | 1 | |
| 40 | 1 | 0 | 1 | 1 | 4 | | | 4 |
| 40 | 1 | 0 | 1 | 1 | 4 | | | 2 |
| 41 | 1 | 2 | 1 | 0 | | 1 | 4 | 2 |
| 42 | 1 | 2 | 1 | 1 | 4 | 4 | | |
| 42 | | | 0 | | | | | 6 |
| 43 | | | 1 | 1 | 0 | 1 | | 2 |
| 44 | 1 | 1 | 1 | 1 | 5 | 1 | | |
| 44 | 1 | 1 | 1 | 1 | 3 | 2 | 4 | |
| 44 | | | | 2 | | | | |
| 44 | | | | 2 | | | | |
| 44 | 1 | 1 | 1 | 1 | 3 | | | |
| 44 | 1 | 1 | 1 | 1 | 3 | | | |
| 44 | | | | | 0 | | | |
| 45 | 1 | | 1 | | 6 | | | 2 |
| 45 | | | | | 6 | | | 2 |
| 46 | 1 | | 1 | 2 | 0 | | | |
| 47 | | 1 | 1 | | 4 | | | 12 |
| 48 | 1 | 1 | 1 | 1 | 4 | | 4 | 1 |
| 49 | | | | | 4 | 1 | 1 | |
| 49 | 1 | 1 | 1 | 2 | 1 | 1 | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 49 | | | 2 | | | | | |
| 49 | | | 2 | | | | | |
| 49 | | | | 0 | | | | 2 |
| 50 | | | 1 | 1 | 4 | | 1 | 2 |
| 50 | | | 1 | 1 | 4 | | | |
| 50 | | | 1 | 1 | 4 | | | |
| 50 | | | 1 | 1 | 4 | | | |
| 51 | | | 1 | 1 | 5 | | | |
| 51 | | | 1 | 1 | 5 | | | |
| 51 | | | | | 2 | | | 2 |
| 52 | 1 | | 2 | 1 | 3 | 1 | 4 | 2 |
| 53 | 0 | | 1 | 0 | 3 | | | 6 |
| 54 | | 0 | 1 | 2 | 4 | 1 | 4 | 16 |
| 54 | | | | | | | | 2 |
| 55 | | 1 | 0 | 1 | 4 | 1 | | 2 |
| 55 | | | | | | | | 4 |
| 56 | | 1 | 1 | 1 | 0 | 1 | 4 | 6 |
| 56 | | | | | | | | 12 |
| 57 | 0 | 1 | 1 | 1 | 6 | 1 | 4 | 6 |
| 57 | | | | | | | | 11 |
| 57 | 0 | 1 | 1 | 1 | 6 | | | 10 |
| 58 | 0 | | 1 | 1 | 4 | 1 | 4 | |
| 58 | | | | | 3 | | | 6 |
| 59 | | | | | | | | 12 |
| 59 | 1 | 0 | 1 | 1 | 4 | | | 6 |
| 60 | | | | 2 | | 1 | | |
| 60 | 1 | | 1 | 1 | 3 | | | 6 |
| 61 | 1 | 2 | 1 | 1 | 3 | | | 3 |
| 62 | | 1 | 1 | | | | | |
| 62 | | 1 | 1 | | | | | 2 |
| 63 | | | 1 | 1 | 4 | 3 | 4 | 2 |
| 63 | | | | | 3 | | | |
| 64 | 1 | 1 | 1 | 1 | 4 | 1 | | |
| 64 | 1 | 1 | 1 | 1 | 4 | | | 2 |
| 65 | 1 | | 1 | 1 | 3 | | | 1 |
| 66 | | 1 | 1 | 1 | 4 | | | 6 |
| 67 | | | 1 | 1 | 4 | | | 2 |
| 67 | | | | 2 | | | | 1 |
| 67 | | | | 2 | | | | 4 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 68 | | | 1 | 1 | 0 | 4 | 2 | |
| 68 | | | 1 | 1 | 0 | | | 10 |
| 69 | 0 | | 1 | 1 | 4 | 1 | | |
| 69 | 0 | | 1 | 1 | 4 | 3 | | |
| 69 | | | | | 1 | | 4 | 12 |
| 70 | | 2 | | | | | 4 | |
| 70 | 1 | 1 | 1 | | 4 | | | |
| 70 | 1 | 1 | 1 | | 4 | | | 3 |
| 70 | 1 | 1 | 1 | | 4 | | | 6 |
| 71 | | | | | | 3 | 4 | 1 |
| 71 | | | | | | | | 14 |
| 72 | | | | | 0 | 3 | | 2 |
| 72 | 1 | 1 | 1 | 0 | 3 | | | |
| 73 | 1 | 1 | 1 | 1 | 4 | 4 | 4 | 2 |
| 74 | 1 | | 0 | 1 | | 1 | | 2 |
| 74 | 1 | | 0 | 1 | | 3 | | |
| 75 | 1 | | 1 | 2 | 6 | | | 12 |
| 76 | 1 | 1 | | 1 | 0 | | 4 | 2 |
| 76 | | | | | | | | 4 |
| 77 | 0 | | 1 | 1 | 4 | | | 3 |
| 77 | | | | | | | | 6 |
| 78 | 1 | 2 | | 1 | 4 | 4 | 4 | 2 |
| 78 | 1 | 2 | | 1 | 4 | | | 8 |
| 78 | 1 | 2 | | 1 | 4 | | | |
| 79 | 2 | 1 | 1 | 2 | 4 | 1 | | 6 |
| 79 | | 2 | | | | | 3 | |
| 80 | | | | | 5 | 1 | | 6 |
| 80 | 1 | 1 | | 1 | 0 | | | 8 |
| 81 | 1 | 1 | 0 | 2 | 4 | | | 9 |
| 81 | 1 | 1 | 0 | 2 | 4 | | | 2 |
| 82 | 1 | | 1 | | 0 | 4 | | 2 |
| 82 | 1 | | 1 | | 0 | | | |
| 83 | 1 | 1 | 1 | 1 | | 1 | 4 | 7 |
| 83 | 1 | 1 | 1 | 1 | | | | 6 |
| 84 | 1 | 1 | 1 | 1 | 0 | | | 6 |
| 84 | | | | | | | | 11 |
| 84 | | | | | | | | 3 |
| 85 | 1 | 2 | 1 | 1 | 0 | 4 | 4 | |
| 85 | 1 | 2 | 1 | 1 | 0 | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 85 | 1 | 2 | 1 | 1 | 0 | | | 6 |
| 86 | 1 | | | 1 | 6 | | 1 | 6 |
| 87 | | 1 | 1 | 0 | 3 | 1 | | |
| 87 | | 1 | 1 | 0 | 3 | | | 2 |
| 88 | 1 | | 1 | | | 1 | | 7 |
| 89 | | 1 | 0 | 0 | | | | |
| 90 | 1 | 1 | 1 | | 6 | 4 | 4 | 2 |
| 91 | | 0 | | | | 3 | 4 | 3 |
| 91 | | | | | | | | 10 |
| 91 | 1 | 2 | 1 | 1 | 0 | | | 2 |
| 91 | | 0 | | | | | | 7 |
| 92 | 1 | | | | | | | 2 |
| 93 | 1 | | 1 | 1 | 0 | | | 2 |
| 93 | 1 | | 1 | 1 | 0 | | | 9 |
| 94 | 1 | | 1 | 1 | 4 | | 2 | 2 |
| 94 | | | | | | | | 3 |
| 94 | | | | | | | | 6 |

# APPENDIX O

## Interrater Agreement Questionnaire

### Interrater Agreement

Qualitative Comment Coding

* Indicates required question

Directions
1. Read question.
2. Read singer comment.
3. Read notes about classifying into categories
4. Classify each singer comment based on choices available.
5. Know that singers received the following definition of tone quality throughout the singer questionnaire:
*Good tone quality is*
*defined as consistent, clear, free, rich, ringing, and resonant.*
*FYI: if singers had misspellings/typos, they are in the comments*

Prompt 1

Did
the prompt "breathe in slowly and deeply with an open
throat" effect your tone
quality?

If
you answered yes, how did breathing in slowly and
deeply with an open throat
effect your tone quality? Please comment:

---

Categories:

Positive - (positives that are linked to the definition of good tone quality...*Good tone quality is defined as consistent, clear, free, rich, ringing, and resonant.)*

Negative

Miscellaneous - anything else singers say i.e. this was fun, I think music is good, :), I tried this.

1. *
(up arrow) time for muscle tension while breathing slowly

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

2. *
It gave me a more full breath

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

3. *
I was more aware to focus on my breathing in general and that helped

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

4. I was more aware of my space and vowels. I felt more supported in the phrasing. my tone was more warm and rich. *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

5. It helped me sustain longer notes, more dynamics. *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

6. My voice and throat did not feel as tense, and I had much more resonant tone quality. *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

7. My sound was richer and fuller as well as the rest of the choir *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

8. *
I had more breath support to get me through the phrase

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

9. It gave me more time to prep my sound for a better tone and onset *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

10. I felt alot more prepared and soundly grounded *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

11. *
It made me focus on my breathing more

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

12. My voice was more clarified, but I was a little breathless still *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

13. I had more breath so it was better *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

14. My tone was more full and supported, It sounded much healthier *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

15. made it more relaxed and natural *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

16. *

Fuller sound.

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

17. Dry throat right now from flu, makes sound harder to get out *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

18. *

With breathing slowly & deeply I felt it allowed taller vowels

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

19. *

It opened up my vowels and allowed me to place my sound more forward. I did yawn right after I was done as well.

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

20. My tone was noticeably deeper and more resonant. *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

21. By taking the time to be mindful about the placement of the breathe, I could maintain a more open sound *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

22. warmer/clearer/"taller" vowels *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

23. It helped me to relax the muscles in my throat and take a slow and full breath. *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

24. It made it easier to come in with a dark and open vowel which supported greater resonance and thus a better tone. *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

Prompt 2

Did
the prompt "imagine
you are inhaling the aroma of a fragrant rose." effect your tone quality?
(Yes)

If
you answered yes, how did imagining you are inhaling the aroma of a fragrant
rose effect your tone quality? Please comment:

---

Categories:

Positive - (positives that are linked to the definition of good tone quality...*Good tone quality is defined as consistent, clear, free, rich, ringing, and resonant.)*

Negative

Miscellaneous - anything else singers say i.e. this was fun, I think music is good, :), I tried this.

25. I think I got too caught up in the accuracy of my imagination and forgot to sing well. *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

26. It was largely the same as the last prompt *(FYI that singer's responses to the previous prompt was* "My tone was noticeably deeper and more resonant.") *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

27. It was hard to picture the scent in teh short time between phrases. *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

28. but the association with smelling had me breathing through my nose - not ideal, haha *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

29. It encouraged to inhale solely through my nose which gave me a more moist inhalation which opened my throat *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

30. I feel like I wanted to breathe through my nose, and that made me lose some space/resonance of tone *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

31. *

it made me breath through my nose more, which made it feel like it took longer for me to breath and get the support I needed

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

32. By imagining smelling a rose I was able to be mindful of my voice coming out brightly from my forehead. *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

33. It seems more musical, sweet, reverent this time. *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

34. but the association with smelling had me breathing through my nose - not ideal, haha *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

35. I felt more free tone wise and had a more relaxed as well as more variety in dynamics. *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

36. I was breathing through my nose and I felt it impaired how well I could open up for higher notes *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

37. however this also made me drop my soft palate a bit. *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

38. I think so - it still allowed be to thing about bigger breaths. allowing for full/supported tone. It was a bit more lovely. *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

39. *

It felt as though my soft palate immediately knew to lift, making it easier to sing

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

40. Made me breathe from my nose making my vowel onsets worse. also my throat felt less clear. *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

41. I think it made my phrases more emotional and happy like Jubilate deo is suppost to imply *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

42. It sounded more expressive *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

43. *

I think my breaths were more shallow. My tone was less supported.

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

44. it helped me relax a bit more, my muscles felt less tight. *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

45. I naturally had a deeper breath and my tone was warmer and more pleasant. *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

Prompt 3

When
asked to pick your favorite direction, or to combine the directions, what did you choose to think about? (check one)

o
___ Option 1: For every inhalation, breathe in slowly and deeply with an open throat

o
___
Option 2: For every inhalation, imagine you are inhaling the aroma of a fragrant rose.

o
___ Option 3: Combination of both
(imagery and breathe slowly/deeply with an open throat)

Did
your choice effect your tone quality? (circle one)

Yes No

If you answered yes, how did your
choice effect your tone quality? Please comment:

---

Categories:

Positive - (positives that are linked to the definition of good tone quality...*Good tone quality is defined as consistent, clear, free, rich, ringing, and resonant.)*

Negative

Miscellaneous - anything else singers say i.e. this was fun, I think music is good, :), I tried this.

46. *
Thoughtful breath, better/confident start.

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

47. *
Again softer and gentler, but not as much as the previous.

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

48. *
I had more breath support and the tone felt freer

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

49. *
Keeping the focus on resonating through the top of my head/forehead works best for my singing

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

50. *
I think the slow and deep breaths really helped clear some congustion

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

51. *
Significantly less tension in my jaw/chords!

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

52. *
I don't really know

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

53. *
When I had the choice I thought more about both

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

54. *
Smelling the "Rose" made me want to breathe in more deeply to imagine getting more scent

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

55. *
I am more relaxed

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

56. *
The imagery helped me imagine the tone

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

57. Placement locked in - freer & warmer sound. *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

58. The decision elicited a response of relaxation throughout my body, ultimately improving my tone. *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

59. I feel like I could take smaller more efficient breaths. *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

60. fuller and more resonant tone *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

61. fuller and more resonant tone *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

62. Prompt helped to breathe properly keep mouth dome space open *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

63. I'm feeling I have more space to breathe in *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

64. Prepping with an open throat breath instantly prepped me for good tone *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

65. Emphasis on technique but also an emotional and sensory quality to apply *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

66. Smoother transitions between notes, inhaling openly helped onset and imagining the rose kept tone better throughout *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

67. Taller vowels *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

68. I felt I was able to get taller vowels *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

69. Like earlier, it allowed for more open notes *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

70. but it was a lot to think about. *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

Prompt 4

Did
the prompt "inhale the aroma of a fragrant rose" effect your tone quality?
(circle one)

Yes No

If you answered yes, how did
inhaling the aroma of a fragrant rose effect your tone quality? Please comment:

---

Categories:

Positive - (positives that are linked to the definition of good tone quality...*Good tone quality is defined as consistent, clear, free, rich, ringing, and resonant.)*

Negative

Miscellaneous - anything else singers say i.e. this was fun, I think music is good, :), I tried this.

71. I enjoyed breathing in more because of the good smell *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

72. Because I was focused on smelling the rose fragrance, I was able to take a really deep breath that supported my tone quality *[illegible any?]* more. *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

73. I think it may have a little bit because it was new stimulation and created a pleasant feeling in my mind which may have translated to my tone. *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

74. Like earlier, it allowed for more open notes *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

75. I felt way more open than before and a slight bit more energy *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

76. I liked the upward space *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

77. Something about the beautiful and strong scent opened my nasal passage and made that space feel readily and easily accessible in a pinch (during a quick inhale). *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

78. It made me more relax *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

79. It made it more clean and open. *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

80. I think being able to actually smell the aroma makes it easier to picture singing even smoother *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

81. A bit too much for trying to facilitate good tone. *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

82. It was interesting, inhaling the actual rose fragrance seemed to affect the breath I took in, making it full and giving me more breath support. *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

83. Having to resist a sniff when thinking about taking the appropriate breath for tone production. Also I'm kind of sensitive to strong smells so having it fill the room was kind of distracting to singing? *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

84. Very pleasant to smell but did not have noticeable effect on my tone quality. *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

85. I can't really say for sure. The scent was pleasant, and relaxed my breathing. *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

86. I felt like it was easier for me to keep a more open tone. *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

87. I was more focused on the scent and was tuned into my breathing too much *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

88. It helped me achieve better space and more ring in my sound. Focusing on the smell helped get an inhale w/less tension *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

89. I felt like the action of inhaling the rose made my focus split between singing and inhaling, making me feel distracted regardless of the actual aroma *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

90. I felt but then it felt shallow at times. I also felt a little light headed. *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

91. Sometimes I think too much about my vocal production and over-control it, and I think the smell sort of distracted me and freed up my sound. *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

92. More clear *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

93. It smelled lovely, *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

94. I was able to add a bit of warmth to the high notes *

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

95. *

Sounded much more supported

*Mark only one oval.*

- Positive
- Negative
- Miscellaneous

Prompt 5

You imaged inhaling the aroma of
a fragrant rose, then you were asked to actually inhale the aroma of a rose.
Did you notice any differences in your inhalation and tone quality between the imaginary aroma versus the actual aroma? (check one)

o
___ I noticed a big difference

o
___
I noticed a small difference

o
___ I didn't notice a difference

o
___ Not sure

If you noticed a difference, please
explain what you noticed about your inhalation, your body, or your tone quality. Please comment:

---

Categories:

IMAGINE: Positive referring to imagine rose prompt

IMAGINE: Neutral comment referring to imagine rose prompt

IMAGINE: Negative referring to imagine rose prompt

OIL: Positive referring to inhaling rose oil aroma

OIL: Neutral comment referring to rose oil aroma

OIL: Negative referring to inhaling rose oil aroma

Miscellaneous (use misc. if singer doesn't specify if they are talking about imagine or oil)

96. *

I think the imaginary rose was productive to my tone production,

*Mark only one oval.*

- IMAGINE: Positive referring to imagine rose prompt
- IMAGINE: Neutral comment referring to imagine rose prompt
- IMAGINE: Negative referring to imagine rose prompt
- OIL: Positive referring to inhaling rose oil aroma
- OIL: Neutral comment referring to rose oil aroma
- OIL: Negative referring to inhaling rose oil aroma
- Miscellaneous

97. *

I found it hard to imagine the scent while actively singing

*Mark only one oval.*

- IMAGINE: Positive referring to imagine rose prompt
- IMAGINE: Neutral comment referring to imagine rose prompt
- IMAGINE: Negative referring to imagine rose prompt
- OIL: Positive referring to inhaling rose oil aroma
- OIL: Neutral comment referring to rose oil aroma
- OIL: Negative referring to inhaling rose oil aroma
- Miscellaneous

98. *

I found it hard to imagine the scent while actively singing

*Mark only one oval.*

- IMAGINE: Positive referring to imagine rose prompt
- IMAGINE: Neutral comment referring to imagine rose prompt
- IMAGINE: Negative referring to imagine rose prompt
- OIL: Positive referring to inhaling rose oil aroma
- OIL: Neutral comment referring to rose oil aroma
- OIL: Negative referring to inhaling rose oil aroma
- Miscellaneous

99. *

I became overly aware of my breathing and it distracted me.

*Mark only one oval.*

- IMAGINE: Positive referring to imagine rose prompt
- IMAGINE: Neutral comment referring to imagine rose prompt
- IMAGINE: Negative referring to imagine rose prompt
- OIL: Positive referring to inhaling rose oil aroma
- OIL: Neutral comment referring to rose oil aroma
- OIL: Negative referring to inhaling rose oil aroma
- Miscellaneous

100. I just found it hard to imagine w/o an actual thing in front of me. *

*Mark only one oval.*

- IMAGINE: Positive referring to imagine rose prompt
- IMAGINE: Neutral comment referring to imagine rose prompt
- IMAGINE: Negative referring to imagine rose prompt
- OIL: Positive referring to inhaling rose oil aroma
- OIL: Neutral comment referring to rose oil aroma
- OIL: Negative referring to inhaling rose oil aroma
- Miscellaneous

101. but I thought it would be a harsher scent then the cottonball was. *

*Mark only one oval.*

- IMAGINE: Positive referring to imagine rose prompt
- IMAGINE: Neutral comment referring to imagine rose prompt
- IMAGINE: Negative referring to imagine rose prompt
- OIL: Positive referring to inhaling rose oil aroma
- OIL: Neutral comment referring to rose oil aroma
- OIL: Negative referring to inhaling rose oil aroma
- Miscellaneous

102. Actually inhaling the scent opened my nasal passage and encouraged it to stay open verses imagining the scent. *

*Mark only one oval.*

- IMAGINE: Positive referring to imagine rose prompt
- IMAGINE: Neutral comment referring to imagine rose prompt
- IMAGINE: Negative referring to imagine rose prompt
- OIL: Positive referring to inhaling rose oil aroma
- OIL: Neutral comment referring to rose oil aroma
- OIL: Negative referring to inhaling rose oil aroma
- Miscellaneous

103. It's not the tone. I'll have different period long of time to breathe in. *

*Mark only one oval.*

- IMAGINE: Positive referring to imagine rose prompt
- IMAGINE: Neutral comment referring to imagine rose prompt
- IMAGINE: Negative referring to imagine rose prompt
- OIL: Positive referring to inhaling rose oil aroma
- OIL: Neutral comment referring to rose oil aroma
- OIL: Negative referring to inhaling rose oil aroma
- Miscellaneous

104. For imagining a rose, I heard more warmth *

*Mark only one oval.*

- IMAGINE: Positive referring to imagine rose prompt
- IMAGINE: Neutral comment referring to imagine rose prompt
- IMAGINE: Negative referring to imagine rose prompt
- OIL: Positive referring to inhaling rose oil aroma
- OIL: Neutral comment referring to rose oil aroma
- OIL: Negative referring to inhaling rose oil aroma
- Miscellaneous

105. I couldn't really imagine the scent so I was just breathing through my nose *

*Mark only one oval.*

- IMAGINE: Positive referring to imagine rose prompt
- IMAGINE: Neutral comment referring to imagine rose prompt
- IMAGINE: Negative referring to imagine rose prompt
- OIL: Positive referring to inhaling rose oil aroma
- OIL: Neutral comment referring to rose oil aroma
- OIL: Negative referring to inhaling rose oil aroma
- Miscellaneous

106. whereas the actual smell was kind of an impediment. *

*Mark only one oval.*

- IMAGINE: Positive referring to imagine rose prompt
- IMAGINE: Neutral comment referring to imagine rose prompt
- IMAGINE: Negative referring to imagine rose prompt
- OIL: Positive referring to inhaling rose oil aroma
- OIL: Neutral comment referring to rose oil aroma
- OIL: Negative referring to inhaling rose oil aroma
- Miscellaneous

107. When actually inhaling it felt like all the pressure I had in my body went away *

*Mark only one oval.*

- IMAGINE: Positive referring to imagine rose prompt
- IMAGINE: Neutral comment referring to imagine rose prompt
- IMAGINE: Negative referring to imagine rose prompt
- OIL: Positive referring to inhaling rose oil aroma
- OIL: Neutral comment referring to rose oil aroma
- OIL: Negative referring to inhaling rose oil aroma
- Miscellaneous

108. My tone quality was bouncy and tall when I could actually smell the aroma *

*Mark only one oval.*

- IMAGINE: Positive referring to imagine rose prompt
- IMAGINE: Neutral comment referring to imagine rose prompt
- IMAGINE: Negative referring to imagine rose prompt
- OIL: Positive referring to inhaling rose oil aroma
- OIL: Neutral comment referring to rose oil aroma
- OIL: Negative referring to inhaling rose oil aroma
- Miscellaneous

109. buy my nostrils felt dilated during the rose one. *

*Mark only one oval.*

- IMAGINE: Positive referring to imagine rose prompt
- IMAGINE: Neutral comment referring to imagine rose prompt
- IMAGINE: Negative referring to imagine rose prompt
- OIL: Positive referring to inhaling rose oil aroma
- OIL: Neutral comment referring to rose oil aroma
- OIL: Negative referring to inhaling rose oil aroma
- Miscellaneous

110. The aroma of the rose energized my body and feelings thus energizing my tone *

*Mark only one oval.*

- IMAGINE: Positive referring to imagine rose prompt
- IMAGINE: Neutral comment referring to imagine rose prompt
- IMAGINE: Negative referring to imagine rose prompt
- OIL: Positive referring to inhaling rose oil aroma
- OIL: Neutral comment referring to rose oil aroma
- OIL: Negative referring to inhaling rose oil aroma
- Miscellaneous

111. Trying to imagine the scent distracted me and was difficult. *

*Mark only one oval.*

- IMAGINE: Positive referring to imagine rose prompt
- IMAGINE: Neutral comment referring to imagine rose prompt
- IMAGINE: Negative referring to imagine rose prompt
- OIL: Positive referring to inhaling rose oil aroma
- OIL: Neutral comment referring to rose oil aroma
- OIL: Negative referring to inhaling rose oil aroma
- Miscellaneous

112. It wasn't the aroma that changed, it was the action of trying to smell the aroma *

*Mark only one oval.*

- IMAGINE: Positive referring to imagine rose prompt
- IMAGINE: Neutral comment referring to imagine rose prompt
- IMAGINE: Negative referring to imagine rose prompt
- OIL: Positive referring to inhaling rose oil aroma
- OIL: Neutral comment referring to rose oil aroma
- OIL: Negative referring to inhaling rose oil aroma
- Miscellaneous

113. I had less tension in my body and breath when inhaling the smell of the rose. It made my voice ring, and singing felt easier. *

*Mark only one oval.*

- IMAGINE: Positive referring to imagine rose prompt
- IMAGINE: Neutral comment referring to imagine rose prompt
- IMAGINE: Negative referring to imagine rose prompt
- OIL: Positive referring to inhaling rose oil aroma
- OIL: Neutral comment referring to rose oil aroma
- OIL: Negative referring to inhaling rose oil aroma
- Miscellaneous

114. while it was pleasant it didn't evoke the same response/mental imagery that just imagining it did. *

*Mark only one oval.*

- IMAGINE: Positive referring to imagine rose prompt
- IMAGINE: Neutral comment referring to imagine rose prompt
- IMAGINE: Negative referring to imagine rose prompt
- OIL: Positive referring to inhaling rose oil aroma
- OIL: Neutral comment referring to rose oil aroma
- OIL: Negative referring to inhaling rose oil aroma
- Miscellaneous

115. Actually smelling improved the tone. *

*Mark only one oval.*

- IMAGINE: Positive referring to imagine rose prompt
- IMAGINE: Neutral comment referring to imagine rose prompt
- IMAGINE: Negative referring to imagine rose prompt
- OIL: Positive referring to inhaling rose oil aroma
- OIL: Neutral comment referring to rose oil aroma
- OIL: Negative referring to inhaling rose oil aroma
- Miscellaneous

116. When actually inhaling the aroma, I automatically breathed deeper than when imagining it *

*Mark only one oval.*

- IMAGINE: Positive referring to imagine rose prompt
- IMAGINE: Neutral comment referring to imagine rose prompt
- IMAGINE: Negative referring to imagine rose prompt
- OIL: Positive referring to inhaling rose oil aroma
- OIL: Neutral comment referring to rose oil aroma
- OIL: Negative referring to inhaling rose oil aroma
- Miscellaneous

117. but the rose scent cleared it up. *

*Mark only one oval.*

- IMAGINE: Positive referring to imagine rose prompt
- IMAGINE: Neutral comment referring to imagine rose prompt
- IMAGINE: Negative referring to imagine rose prompt
- OIL: Positive referring to inhaling rose oil aroma
- OIL: Neutral comment referring to rose oil aroma
- OIL: Negative referring to inhaling rose oil aroma
- Miscellaneous

118. I took more time & focused on my breathing and posture more *

*Mark only one oval.*

- IMAGINE: Positive referring to imagine rose prompt
- IMAGINE: Neutral comment referring to imagine rose prompt
- IMAGINE: Negative referring to imagine rose prompt
- OIL: Positive referring to inhaling rose oil aroma
- OIL: Neutral comment referring to rose oil aroma
- OIL: Negative referring to inhaling rose oil aroma
- Miscellaneous

119. When I imagined the rose I didn't breathe as deeply as when I had to put in more physical effort to smell it. *

*Mark only one oval.*

- IMAGINE: Positive referring to imagine rose prompt
- IMAGINE: Neutral comment referring to imagine rose prompt
- IMAGINE: Negative referring to imagine rose prompt
- OIL: Positive referring to inhaling rose oil aroma
- OIL: Neutral comment referring to rose oil aroma
- OIL: Negative referring to inhaling rose oil aroma
- Miscellaneous

120. The physical experience was more affecting. It had a more tangible effect on my senses and body *

*Mark only one oval.*

- IMAGINE: Positive referring to imagine rose prompt
- IMAGINE: Neutral comment referring to imagine rose prompt
- IMAGINE: Negative referring to imagine rose prompt
- OIL: Positive referring to inhaling rose oil aroma
- OIL: Neutral comment referring to rose oil aroma
- OIL: Negative referring to inhaling rose oil aroma
- Miscellaneous

121. I noticed that imagining the smell of rose worked better for me because I got distracted by the actual smell of rose. *

*Mark only one oval.*

- IMAGINE: Positive referring to imagine rose prompt
- IMAGINE: Neutral comment referring to imagine rose prompt
- IMAGINE: Negative referring to imagine rose prompt
- OIL: Positive referring to inhaling rose oil aroma
- OIL: Neutral comment referring to rose oil aroma
- OIL: Negative referring to inhaling rose oil aroma
- Miscellaneous

122. I was more relaxed and focused with the imaginary. *

*Mark only one oval.*

- IMAGINE: Positive referring to imagine rose prompt
- IMAGINE: Neutral comment referring to imagine rose prompt
- IMAGINE: Negative referring to imagine rose prompt
- OIL: Positive referring to inhaling rose oil aroma
- OIL: Neutral comment referring to rose oil aroma
- OIL: Negative referring to inhaling rose oil aroma
- Miscellaneous

123. I wasn't able to imagine the scent of a rose, so it didn't change anything until I actually smelled it *

*Mark only one oval.*

- IMAGINE: Positive referring to imagine rose prompt
- IMAGINE: Neutral comment referring to imagine rose prompt
- IMAGINE: Negative referring to imagine rose prompt
- OIL: Positive referring to inhaling rose oil aroma
- OIL: Neutral comment referring to rose oil aroma
- OIL: Negative referring to inhaling rose oil aroma
- Miscellaneous

124. *

The actual aroma gave me an incentive to breathe deeper and relax, which helped my tone.

*Mark only one oval.*

- IMAGINE: Positive referring to imagine rose prompt
- IMAGINE: Neutral comment referring to imagine rose prompt
- IMAGINE: Negative referring to imagine rose prompt
- OIL: Positive referring to inhaling rose oil aroma
- OIL: Neutral comment referring to rose oil aroma
- OIL: Negative referring to inhaling rose oil aroma
- Miscellaneous

Untitled Section

Prompt 6

10. What do you think
conductor/music teacher wants you to change when they ask you to imagine you are inhaling the aroma of a fragrant rose?

Please comment:

---

For this prompt - choose the keyword that best suits the comments. Often the singer will use one of the words below in their comment. The possible keywords are:

For questions with multiple possible answers, there is a checklist so you can select more than one (2-3).

aware

breath

breath support

emotion

expression

face

listening

miscellaneous

onset

relax

palate

resonator (referring to shape within the vocal tract...open mouth, throat)

tension

throat

tone

125. *

I think that the conductor wants me to change the quality of my breathing

*Mark only one oval.*

- aware
- breath
- breath support
- emotion
- expression
- face
- listening
- miscellaneous
- onset
- relax
- palate
- resonator (referring to shape within the vocal tract...mouth, throat)
- tension
- throat
- tone

126. *

They likely want you to inhale deeply.

*Mark only one oval.*

- aware
- breath
- breath support
- emotion
- expression
- face
- listening
- miscellaneous
- onset
- relax
- palate
- resonator (referring to shape within the vocal tract...mouth, throat)
- tension
- throat
- tone

127. *

Slow breaths, more mindful breath a singing

*Check all that apply.*

- [ ] aware
- [ ] breath
- [ ] breath support
- [ ] emotion
- [ ] expression
- [ ] face
- [ ] listening
- [ ] miscellaneous
- [ ] onset
- [ ] relax
- [ ] palate
- [ ] resonator (referring to shape within the vocal tract...mouth, throat)
- [ ] tension
- [ ] throat
- [ ] tone

128. *

Inhale easily and slowly

*Mark only one oval.*

- ◯ aware
- ◯ breath
- ◯ breath support
- ◯ emotion
- ◯ expression
- ◯ face
- ◯ listening
- ◯ miscellaneous
- ◯ onset
- ◯ relax
- ◯ palate
- ◯ resonator (referring to shape within the vocal tract...mouth, throat)
- ◯ tension
- ◯ throat
- ◯ tone

129. *

Inhale easily and slowly

*Mark only one oval.*

- ◯ aware
- ◯ breath
- ◯ breath support
- ◯ emotion
- ◯ expression
- ◯ face
- ◯ listening
- ◯ miscellaneous
- ◯ onset
- ◯ relax
- ◯ palate
- ◯ resonator (referring to shape within the vocal tract...mouth, throat)
- ◯ tension
- ◯ throat
- ◯ tone

130. *

inhale with mindfulness

*Check all that apply.*

- [ ] aware
- [ ] breath
- [ ] breath support
- [ ] emotion
- [ ] expression
- [ ] face
- [ ] listening
- [ ] miscellaneous
- [ ] onset
- [ ] relax
- [ ] palate
- [ ] resonator (referring to shape within the vocal tract...mouth, throat)
- [ ] tension
- [ ] throat
- [ ] tone

131. Take deeper, more full breaths *

*Mark only one oval.*

- aware
- breath
- breath support
- emotion
- expression
- face
- listening
- miscellaneous
- onset
- relax
- palate
- resonator (referring to shape within the vocal tract...mouth, throat)
- tension
- throat
- tone

132. have a sweeter sound *

*Mark only one oval.*

- aware
- breath
- breath support
- emotion
- expression
- face
- listening
- miscellaneous
- onset
- relax
- palate
- resonator (referring to shape within the vocal tract...mouth, throat)
- tension
- throat
- tone

133. Emotion and feeling *

*Mark only one oval.*

- aware
- breath
- breath support
- emotion
- expression
- face
- listening
- miscellaneous
- onset
- relax
- palate
- resonator (referring to shape within the vocal tract...mouth, throat)
- tension
- throat
- tone

134. The conductor wants the sound to math the smell of the aroma. *

*Mark only one oval.*

- aware
- breath
- breath support
- emotion
- expression
- face
- listening
- miscellaneous
- onset
- relax
- palate
- resonator (referring to shape within the vocal tract...mouth, throat)
- tension
- throat
- tone

135. *

release tension in your body and voice

*Check all that apply.*

- [ ] aware
- [ ] breath
- [ ] breath support
- [ ] emotion
- [ ] expression
- [ ] face
- [ ] listening
- [ ] miscellaneous
- [ ] onset
- [ ] relax
- [ ] palate
- [ ] resonator (referring to shape within the vocal tract...mouth, throat)
- [ ] tension
- [ ] throat
- [ ] tone

136. *

I would think that the conductor wants us to feel what it's really like to take a deep enough breath.

*Mark only one oval.*

- ◯ aware
- ◯ breath
- ◯ breath support
- ◯ emotion
- ◯ expression
- ◯ face
- ◯ listening
- ◯ miscellaneous
- ◯ onset
- ◯ relax
- ◯ palate
- ◯ resonator (referring to shape within the vocal tract...mouth, throat)
- ◯ tension
- ◯ throat
- ◯ tone

137. *

To take larger breaths that extend from your nose to the bottom of your stomach.

*Mark only one oval.*

- ◯ aware
- ◯ breath
- ◯ breath support
- ◯ emotion
- ◯ expression
- ◯ face
- ◯ listening
- ◯ miscellaneous
- ◯ onset
- ◯ relax
- ◯ palate
- ◯ resonator (referring to shape within the vocal tract...mouth, throat)
- ◯ tension
- ◯ throat
- ◯ tone

138. *

Perhaps placement of soft palate

*Mark only one oval.*

- ◯ aware
- ◯ breath
- ◯ breath support
- ◯ emotion
- ◯ expression
- ◯ face
- ◯ listening
- ◯ miscellaneous
- ◯ onset
- ◯ relax
- ◯ palate
- ◯ resonator (referring to shape within the vocal tract...mouth, throat)
- ◯ tension
- ◯ throat
- ◯ tone

139. Taking a deep, full breath and sing more open/with less tension. *

*Check all that apply.*

- [ ] aware
- [ ] breath
- [ ] breath support
- [ ] emotion
- [ ] expression
- [ ] face
- [ ] listening
- [ ] miscellaneous
- [ ] onset
- [ ] relax
- [ ] palate
- [ ] resonator (referring to shape within the vocal tract...mouth, throat)
- [ ] tension
- [ ] throat
- [ ] tone

140. Richer tone quality and "prettier" dynamics *

*Mark only one oval.*

- ◯ aware
- ◯ breath
- ◯ breath support
- ◯ emotion
- ◯ expression
- ◯ face
- ◯ listening
- ◯ miscellaneous
- ◯ onset
- ◯ relax
- ◯ palate
- ◯ resonator (referring to shape within the vocal tract...mouth, throat)
- ◯ tension
- ◯ throat
- ◯ tone

141. Perhaps changing the way you're breathing *

*Mark only one oval.*

- ◯ aware
- ◯ breath
- ◯ breath support
- ◯ emotion
- ◯ expression
- ◯ face
- ◯ listening
- ◯ miscellaneous
- ◯ onset
- ◯ relax
- ◯ palate
- ◯ resonator (referring to shape within the vocal tract...mouth, throat)
- ◯ tension
- ◯ throat
- ◯ tone

142. It forces you to take quality breaths *

*Mark only one oval.*

- ◯ aware
- ◯ breath
- ◯ breath support
- ◯ emotion
- ◯ expression
- ◯ face
- ◯ listening
- ◯ miscellaneous
- ◯ onset
- ◯ relax
- ◯ palate
- ◯ resonator (referring to shape within the vocal tract...mouth, throat)
- ◯ tension
- ◯ throat
- ◯ tone

143. *

Phrasing/musicality

*Mark only one oval.*

- aware
- breath
- breath support
- emotion
- expression
- face
- listening
- miscellaneous
- onset
- relax
- palate
- resonator (referring to shape within the vocal tract...mouth, throat)
- tension
- throat
- tone

144. *

To breath more, open the back of our mouth, and sing with warmer tone.

*Check all that apply.*

- aware
- breath
- breath support
- emotion
- expression
- face
- listening
- miscellaneous
- onset
- relax
- palate
- resonator (referring to shape within the vocal tract...mouth, throat)
- tension
- throat
- tone

145. *

I tried this experiment!

*Mark only one oval.*

- aware
- breath
- breath support
- emotion
- expression
- face
- listening
- miscellaneous
- onset
- relax
- palate
- resonator (referring to shape within the vocal tract...mouth, throat)
- tension
- throat
- tone

146. *

Our tone/facial expressions

*Check all that apply.*

- aware
- breath
- breath support
- emotion
- expression
- face
- listening
- miscellaneous
- onset
- relax
- palate
- resonator (referring to shape within the vocal tract...mouth, throat)
- tension
- throat
- tone

147. *

The way I inhale

*Mark only one oval.*

- aware
- breath
- breath support
- emotion
- expression
- face
- listening
- miscellaneous
- onset
- relax
- palate
- resonator (referring to shape within the vocal tract...mouth, throat)
- tension
- throat
- tone

148. *

Deeper breaths and pleasant imagery

*Check all that apply.*

- aware
- breath
- breath support
- emotion
- expression
- face
- listening
- miscellaneous
- onset
- relax
- palate
- resonator (referring to shape within the vocal tract...mouth, throat)
- tension
- throat
- tone

149. *

smoothness of voice (?)

*Mark only one oval.*

- aware
- breath
- breath support
- emotion
- expression
- face
- listening
- miscellaneous
- onset
- relax
- palate
- resonator (referring to shape within the vocal tract...mouth, throat)
- tension
- throat
- tone

150. *

your breathing

*Mark only one oval.*

- aware
- breath
- breath support
- emotion
- expression
- face
- listening
- miscellaneous
- onset
- relax
- palate
- resonator (referring to shape within the vocal tract...mouth, throat)
- tension
- throat
- tone

151. *

I think they want us to open our mouths and keep our breath more steady.

*Check all that apply.*

- [ ] aware
- [ ] breath
- [ ] breath support
- [ ] emotion
- [ ] expression
- [ ] face
- [ ] listening
- [ ] miscellaneous
- [ ] onset
- [ ] relax
- [ ] palate
- [ ] resonator (referring to shape within the vocal tract...mouth, throat)
- [ ] tension
- [ ] throat
- [ ] tone

152. *

Tone quality and overall mood of the sound

*Mark only one oval.*

- ◯ aware
- ◯ breath
- ◯ breath support
- ◯ emotion
- ◯ expression
- ◯ face
- ◯ listening
- ◯ miscellaneous
- ◯ onset
- ◯ relax
- ◯ palate
- ◯ resonator (referring to shape within the vocal tract...mouth, throat)
- ◯ tension
- ◯ throat
- ◯ tone

Prompt 7

Did you notice any changes in your singing that you'd like to share?

Please
comment:

---

Categories:

PREFERENCE: Singer indicates a preference or benefit to one of the conditions (imagine, oil, favorite, etc.)

APPLICATION: Singer indicates that they will apply something from this experiment to future practice or performing

FACTORS: Singer indicates other factors that are responsible for changes in tone (i.e. singing the example multiple times, or now they are more warmed up)

MISCELLANEOUS - everything else (most comments are misc. here)

***note, checkboxes when more than one option is appropriate (2)

153. *

Imagery of rose effects phrasing/shaping while singing, not just what occurs during inhale

*Mark only one oval.*

- ◯ PREFERENCE: Singer indicates a preference or benefit to one of the conditions (imagine, oil, favorite, etc.)
- ◯ APPLICATION: Singer indicates that they will apply something from this experiment to future practice or performing
- ◯ FACTORS: Singer indicates other factors that are responsible for changes in tone (i.e. singing the example multiple times, or now they are more warmed up)
- ◯ MISCELLANEOUS - everything else (most comments are misc. here)

154. *

During the singing w/ an open throat, I liked that I could physically feel myself following the prompt.

*Mark only one oval.*

- ◯ PREFERENCE: Singer indicates a preference or benefit to one of the conditions (imagine, oil, favorite, etc.)
- ◯ APPLICATION: Singer indicates that they will apply something from this experiment to future practice or performing
- ◯ FACTORS: Singer indicates other factors that are responsible for changes in tone (i.e. singing the example multiple times, or now they are more warmed up)
- ◯ MISCELLANEOUS - everything else (most comments are misc. here)

155. *

n/a

*Mark only one oval.*

- ◯ PREFERENCE: Singer indicates a preference or benefit to one of the conditions (imagine, oil, favorite, etc.)
- ◯ APPLICATION: Singer indicates that they will apply something from this experiment to future practice or performing
- ◯ FACTORS: Singer indicates other factors that are responsible for changes in tone (i.e. singing the example multiple times, or now they are more warmed up)
- ◯ MISCELLANEOUS - everything else (most comments are misc. here)

156. *

In a previous version of this study I did last year, the metaphorical rose-smelling helped me more when I wasn't thinking about trying not to sneeze.

*Mark only one oval.*

- PREFERENCE: Singer indicates a preference or benefit to one of the conditions (imagine, oil, favorite, etc.)
- APPLICATION: Singer indicates that they will apply something from this experiment to future practice or performing
- FACTORS: Singer indicates other factors that are responsible for changes in tone (i.e. singing the example multiple times, or now they are more warmed up)
- MISCELLANEOUS - everything else (most comments are misc. here)

157. *

I felt like I was more confident that I could sing freely and in tune while I smelled the essential oil16

*Mark only one oval.*

- PREFERENCE: Singer indicates a preference or benefit to one of the conditions (imagine, oil, favorite, etc.)
- APPLICATION: Singer indicates that they will apply something from this experiment to future practice or performing
- FACTORS: Singer indicates other factors that are responsible for changes in tone (i.e. singing the example multiple times, or now they are more warmed up)
- MISCELLANEOUS - everything else (most comments are misc. here)

158. *

My singing began to get easier with each new prompt

*Mark only one oval.*

- PREFERENCE: Singer indicates a preference or benefit to one of the conditions (imagine, oil, favorite, etc.)
- APPLICATION: Singer indicates that they will apply something from this experiment to future practice or performing
- FACTORS: Singer indicates other factors that are responsible for changes in tone (i.e. singing the example multiple times, or now they are more warmed up)
- MISCELLANEOUS - everything else (most comments are misc. here)

159. *

Every time I sang the excerpt it was a little more open and grounded.

*Mark only one oval.*

- PREFERENCE: Singer indicates a preference or benefit to one of the conditions (imagine, oil, favorite, etc.)
- APPLICATION: Singer indicates that they will apply something from this experiment to future practice or performing
- FACTORS: Singer indicates other factors that are responsible for changes in tone (i.e. singing the example multiple times, or now they are more warmed up)
- MISCELLANEOUS - everything else (most comments are misc. here)

160. *

My tonal quality enhanced w/ the literal smell not imaginary

*Mark only one oval.*

- PREFERENCE: Singer indicates a preference or benefit to one of the conditions (imagine, oil, favorite, etc.)
- APPLICATION: Singer indicates that they will apply something from this experiment to future practice or performing
- FACTORS: Singer indicates other factors that are responsible for changes in tone (i.e. singing the example multiple times, or now they are more warmed up)
- MISCELLANEOUS - everything else (most comments are misc. here)

161. *

The prompts helped me be more mindful of m throat and breath while singing.

*Mark only one oval.*

- PREFERENCE: Singer indicates a preference or benefit to one of the conditions (imagine, oil, favorite, etc.)
- APPLICATION: Singer indicates that they will apply something from this experiment to future practice or performing
- FACTORS: Singer indicates other factors that are responsible for changes in tone (i.e. singing the example multiple times, or now they are more warmed up)
- MISCELLANEOUS - everything else (most comments are misc. here)

162. *

Singing with an open throat made me more aware about the space in my mouth vs. breathing in the fragrance which made me aware of how much I was breathing.

*Mark only one oval.*

- PREFERENCE: Singer indicates a preference or benefit to one of the conditions (imagine, oil, favorite, etc.)
- APPLICATION: Singer indicates that they will apply something from this experiment to future practice or performing
- FACTORS: Singer indicates other factors that are responsible for changes in tone (i.e. singing the example multiple times, or now they are more warmed up)
- MISCELLANEOUS - everything else (most comments are misc. here)

163. *

I just react this as a mimic of how to breath. I'll guess it with my own habits.

*Mark only one oval.*

- PREFERENCE: Singer indicates a preference or benefit to one of the conditions (imagine, oil, favorite, etc.)
- APPLICATION: Singer indicates that they will apply something from this experiment to future practice or performing
- FACTORS: Singer indicates other factors that are responsible for changes in tone (i.e. singing the example multiple times, or now they are more warmed up)
- MISCELLANEOUS - everything else (most comments are misc. here)

164. Once more, literally taking in a scent helps my voice become more velvety *

*Mark only one oval.*

- PREFERENCE: Singer indicates a preference or benefit to one of the conditions (imagine, oil, favorite, etc.)
- APPLICATION: Singer indicates that they will apply something from this experiment to future practice or performing
- FACTORS: Singer indicates other factors that are responsible for changes in tone (i.e. singing the example multiple times, or now they are more warmed up)
- MISCELLANEOUS - everything else (most comments are misc. here)

165. I feel like the prompts helped, but so did the repetition *

*Check all that apply.*

- [ ] PREFERENCE: Singer indicates a preference or benefit to one of the conditions (imagine, oil, favorite, etc.)
- [ ] APPLICATION: Singer indicates that they will apply something from this experiment to future practice or performing
- [ ] FACTORS: Singer indicates other factors that are responsible for changes in tone (i.e. singing the example multiple times, or now they are more warmed up)
- [ ] MISCELLANEOUS - everything else (most comments are misc. here)

166. I think that I felt more relaxed when singing and it was cool to see the change in sound. *

*Mark only one oval.*

- PREFERENCE: Singer indicates a preference or benefit to one of the conditions (imagine, oil, favorite, etc.)
- APPLICATION: Singer indicates that they will apply something from this experiment to future practice or performing
- FACTORS: Singer indicates other factors that are responsible for changes in tone (i.e. singing the example multiple times, or now they are more warmed up)
- MISCELLANEOUS - everything else (most comments are misc. here)

167. Being aware of both breathing and how I was projecting, I had a warmer tone. *

*Mark only one oval.*

- PREFERENCE: Singer indicates a preference or benefit to one of the conditions (imagine, oil, favorite, etc.)
- APPLICATION: Singer indicates that they will apply something from this experiment to future practice or performing
- FACTORS: Singer indicates other factors that are responsible for changes in tone (i.e. singing the example multiple times, or now they are more warmed up)
- MISCELLANEOUS - everything else (most comments are misc. here)

168. Higher notes came much easier to hit both when smelling the rose and singing with an open throat. *

*Mark only one oval.*

- PREFERENCE: Singer indicates a preference or benefit to one of the conditions (imagine, oil, favorite, etc.)
- APPLICATION: Singer indicates that they will apply something from this experiment to future practice or performing
- FACTORS: Singer indicates other factors that are responsible for changes in tone (i.e. singing the example multiple times, or now they are more warmed up)
- MISCELLANEOUS - everything else (most comments are misc. here)

169. Imagery effecting the tone behind a piece *

*Mark only one oval.*

- PREFERENCE: Singer indicates a preference or benefit to one of the conditions (imagine, oil, favorite, etc.)
- APPLICATION: Singer indicates that they will apply something from this experiment to future practice or performing
- FACTORS: Singer indicates other factors that are responsible for changes in tone (i.e. singing the example multiple times, or now they are more warmed up)
- MISCELLANEOUS - everything else (most comments are misc. here)

Last Prompt - Prompt 9

18. Is there anything else you'd like to share about the experience?

Please comment:

---

Categories:

PREFERENCE: Singer indicates a preference or benefit to one of the conditions (imagine, oil, favorite, etc.)

APPLICATION: Singer indicates that they will apply something from this experiment to future practice or performing

FACTORS: Singer indicates other factors that are responsible for changes in tone (i.e. singing the example multiple times, or now they are more warmed up)

MISCELLANEOUS - everything else (most comments are misc. here)

170. This was fun :) *

*Mark only one oval.*

- PREFERENCE: Singer indicates a preference or benefit to one of the conditions (imagine, oil, favorite, etc.)
- APPLICATION: Singer indicates that they will apply something from this experiment to future practice or performing
- FACTORS: Singer indicates other factors that are responsible for changes in tone (i.e. singing the example multiple times, or now they are more warmed up)
- MISCELLANEOUS - everything else (most comments are misc. here)

171. *

It was fun

*Mark only one oval.*

- PREFERENCE: Singer indicates a preference or benefit to one of the conditions (imagine, oil, favorite, etc.)
- APPLICATION: Singer indicates that they will apply something from this experiment to future practice or performing
- FACTORS: Singer indicates other factors that are responsible for changes in tone (i.e. singing the example multiple times, or now they are more warmed up)
- MISCELLANEOUS - everything else (most comments are misc. here)

172. *

I don't know how much simply getting more comfortable with the piece/being taken out of a comfort zone by being asked to switch between modes at a rapid pace made or the performance of the choir. It effected mine immensely.

*Mark only one oval.*

- PREFERENCE: Singer indicates a preference or benefit to one of the conditions (imagine, oil, favorite, etc.)
- APPLICATION: Singer indicates that they will apply something from this experiment to future practice or performing
- FACTORS: Singer indicates other factors that are responsible for changes in tone (i.e. singing the example multiple times, or now they are more warmed up)
- MISCELLANEOUS - everything else (most comments are misc. here)

173. *

Nothing special. Thank you!

*Mark only one oval.*

- PREFERENCE: Singer indicates a preference or benefit to one of the conditions (imagine, oil, favorite, etc.)
- APPLICATION: Singer indicates that they will apply something from this experiment to future practice or performing
- FACTORS: Singer indicates other factors that are responsible for changes in tone (i.e. singing the example multiple times, or now they are more warmed up)
- MISCELLANEOUS - everything else (most comments are misc. here)

174. *

n/a

*Mark only one oval.*

- PREFERENCE: Singer indicates a preference or benefit to one of the conditions (imagine, oil, favorite, etc.)
- APPLICATION: Singer indicates that they will apply something from this experiment to future practice or performing
- FACTORS: Singer indicates other factors that are responsible for changes in tone (i.e. singing the example multiple times, or now they are more warmed up)
- MISCELLANEOUS - everything else (most comments are misc. here)

175. *

the rose aroma helped

*Mark only one oval.*

- PREFERENCE: Singer indicates a preference or benefit to one of the conditions (imagine, oil, favorite, etc.)
- APPLICATION: Singer indicates that they will apply something from this experiment to future practice or performing
- FACTORS: Singer indicates other factors that are responsible for changes in tone (i.e. singing the example multiple times, or now they are more warmed up)
- MISCELLANEOUS - everything else (most comments are misc. here)

176. *

I like "tangible" things, or structural things to anchor on while singing.

*Mark only one oval.*

- PREFERENCE: Singer indicates a preference or benefit to one of the conditions (imagine, oil, favorite, etc.)
- APPLICATION: Singer indicates that they will apply something from this experiment to future practice or performing
- FACTORS: Singer indicates other factors that are responsible for changes in tone (i.e. singing the example multiple times, or now they are more warmed up)
- MISCELLANEOUS - everything else (most comments are misc. here)

177. *

n/a

*Mark only one oval.*

- PREFERENCE: Singer indicates a preference or benefit to one of the conditions (imagine, oil, favorite, etc.)
- APPLICATION: Singer indicates that they will apply something from this experiment to future practice or performing
- FACTORS: Singer indicates other factors that are responsible for changes in tone (i.e. singing the example multiple times, or now they are more warmed up)
- MISCELLANEOUS - everything else (most comments are misc. here)

178. *

This was so fun and sweet!

*Mark only one oval.*

- PREFERENCE: Singer indicates a preference or benefit to one of the conditions (imagine, oil, favorite, etc.)
- APPLICATION: Singer indicates that they will apply something from this experiment to future practice or performing
- FACTORS: Singer indicates other factors that are responsible for changes in tone (i.e. singing the example multiple times, or now they are more warmed up)
- MISCELLANEOUS - everything else (most comments are misc. here)

179. *

I have discovered that I prefer to be given the metaphorical and literal instruction.

*Mark only one oval.*

- PREFERENCE: Singer indicates a preference or benefit to one of the conditions (imagine, oil, favorite, etc.)
- APPLICATION: Singer indicates that they will apply something from this experiment to future practice or performing
- FACTORS: Singer indicates other factors that are responsible for changes in tone (i.e. singing the example multiple times, or now they are more warmed up)
- MISCELLANEOUS - everything else (most comments are misc. here)

180. *

:)

*Mark only one oval.*

- PREFERENCE: Singer indicates a preference or benefit to one of the conditions (imagine, oil, favorite, etc.)
- APPLICATION: Singer indicates that they will apply something from this experiment to future practice or performing
- FACTORS: Singer indicates other factors that are responsible for changes in tone (i.e. singing the example multiple times, or now they are more warmed up)
- MISCELLANEOUS - everything else (most comments are misc. here)

181. *

I think our tone got better as we went on because we knew the song better

*Mark only one oval.*

- PREFERENCE: Singer indicates a preference or benefit to one of the conditions (imagine, oil, favorite, etc.)
- APPLICATION: Singer indicates that they will apply something from this experiment to future practice or performing
- FACTORS: Singer indicates other factors that are responsible for changes in tone (i.e. singing the example multiple times, or now they are more warmed up)
- MISCELLANEOUS - everything else (most comments are misc. here)

THANK YOU !!!!!!!

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