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Understanding Singing Voice Timbre Through Perceptual Assessment

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Portfolio Introduction

A previous module asked how timbre is quantitatively defined in different styles of singing for the purpose of understanding with more nuance the styles I often hear in my voice studio. The literature review uncovered objective and measurable aspects of different singing styles useful to singing voice practitioners. Despite some researchers arriving at varied conclusions, research was clear that differences in timbre could be quantified (Aaen *et al.*, 2024). However, the practicality of these measures remains uncertain when voice teachers are providing immediate feedback during a lesson. Without the use of technological tools like VoceVista, Praat, or an MRI machine, voice teachers must rely on clear and concise language to help a student achieve the desired timbral outcome, which can be rooted in acoustic, somatosensory, semiotic, or mimetic experience (Heidemann, 2016; Spreadborough, 2022; Bruder, Poeppel, and Larrouy-Maestri, 2024; Aaen and Sadolin, 2024). However, such a broad scope of terminology can lead to mixed results, confusion, and frustration for both teachers and singers (Titze, 1989). Research discussing objective measures of singing voice timbre are abundant, but research discussing subjective measures are few (Yarnall, 2017). Therefore, this literature review aims to answer the question: How is timbre perceptually assessed in different styles of singing?

Purpose and Justification

Aims

The aim of this literature is to identify frameworks, processes, and other useful tools which aid in the distillation of and clarification of language used to describe singing voice timbre. Singers and their teachers should strive to have a common language, but just as important is the commonality of said definitions and applications among voice teachers, particularly in different styles of singing (AATS, 2014). Titze (1989) warned teachers that language with an unclear basis could create models that were lacking at best and misleading at worst. Therefore I also aim to further develop my own content knowledge of commonly-used terminology so that I can confidently guide a singer in the acceptable timbral direction. For example, I have experienced in my own studio situations where the words “bright” or “dark” elicit different interpretations from singers and therefore require negotiation on both our parts to come to a conclusion about how we perceive sound. This is particularly challenging when I am working

with a student who is not familiar with the differences between bright pop sounds and bright classical sounds. This literature review will ideally provide adequate theory to create best practices for expressing timbral outcomes to singers.

Objectives

I have purposefully formatted my objectives (O) as questions as a concrete way of ensuring the research and analysis stays in line with the research question:

1. Does the data provide a coherent answer to my research question?
2. Can I present a case for the practicality of this data in the voice studio?
3. Does this research apply to multiple styles of singing, and/or does it address styles of singing not commonly addressed in literature?

Because my research is likely to overlap with many other disciplines, O1 will ground me to my research question so that I do not follow trails of tangential but irrelevant material. O2 will keep the research aligned with professional practice because, while this literature review is more inclined to discuss theoretical knowledge, practical application will bridge the gap between the researcher and singer. O3 will address a critical piece of the larger question and ensure that the research I include in the review does not fall into one particular cultural lens, possibly furthering hegemonic assumptions about the singing voice (Brookfield, 2017).

Expected Learning Outcomes

Upon completion of this literature review, I will be able to:

1. Identify and synthesize the various indexes used to analyze auditory-perceptual aspects of voice quality,
2. Explain the intersectionality between perception and description of the singing voice, and
3. Identify and explain methodological challenges in conducting perceptual research on singing voice timbre.

Learning Outcome (LO) 1 is practical in that I should be able to read auditory-perceptual research and understand exactly how researchers came to their conclusions and therefore contributed to the field of voice pedagogy (Wallmark, 2021). LO2 takes this a step further; an initial look into the data show that there is a link between perception and description that few studies entertain (Bruder, Poeppel, and Larrouy-Maestri, 2024; Aaen and Sadolin, 2024). LO3 aims to clarify and contextualize the challenges researchers face when designing positivist research questions that may overlap with interpretivist conclusions.

Timeline

The timeline for this literature review was broken into three separate stages:

- Stage 1: initial data collection,
- Stage 2: refined collection and coding, and
- Stage 3: analysis and write-up.

This particular strategy was used in the previous module and kept the process organized and timely; it is largely based on Boell and Cecez-Kecmanovic's (2014) hermeneutic approach. Stage 1, the initial data collection, is designed to gather material related to my evolving research question and to aid in the design of inclusion and exclusion criteria. Stage 2 would use the refined criteria and research question to adequately code and organize information. After adequate synthesis of the research material, stage 3 would consist of the literature review design and write-up to present the data and analysis. Though not included, day-to-day tasks were created in alignment with the stages and detailed timeline for the sake of organization. The detailed timeline is available in Appendix 1.

Methodology

The Narrative Literature Review

While new studies are appropriate tools in collecting answers to researchers' questions, many agree that literature reviews of existing research are paramount in the discovery process (Grant and Booth, 2009; Boell and Cecez-Kecmanovic, 2014; Snyder, 2019). The narrative literature review is especially useful, as it can cover a wide variety of interdisciplinary subjects and be completed in a shorter amount of time (Grant and Booth, 2009; Snyder, 2019). I have chosen the narrative literature review to uncover themes and trends within existing research for this reason, that the research question inquires about perceptual and linguistic aspects of singing voice timbre.

The short timeline for this project may suggest the use of a rapid review (Grant and Booth, 2009), but it is unlikely that the interdisciplinary nature would provide enough data in one area which the research question discusses. If it were the case that enough auditory-perceptual data was available, such a review may have offered immediate practical relevance (Grant and Booth). However, the sheer amount of academic discussion surrounding singing voice timbre and its overlap with other areas of study require more nuance than what the rapid review can offer.

Data collection

The initial research was collected via University of Wales Trinity Saint David Ex Libris search engine. Further research was collected through algorithmically selected papers from Academia.edu. All research was assessed to ensure it met inclusion and exclusion criteria as seen in figure 1.

Inclusion	Exclusion
- Quantitative, qualitative, or mixed methods studies relating to singing voice timbre - Included auditory-perceptual judgements - Published after 2010 - Peer-reviewed - Used expert listeners in their methods - All participants above age 18	- Only qualitative methods used* - Published before 2010 (with the exception of historical sources) - Relating to dysphonic or rehabilitating singing voices - Relating to children's singing voices
*This criterion was removed after analysis of the quantitative-inclusive literature was scant.	

Figure 1: Inclusion and exclusion criteria

Boolean strings are included in Appendix 2. Most studies were gathered through snowballing and pearl growing, as this path was most fruitful in providing relevant literature (Boell and Cecez-Kecmanovic, 2014). There are two possible reasons for this, the first of which is that the broadest of boolean searches were too overwhelming to parse through, while narrowed searches provided very little. The second reason is that the research question invited a wide spectrum of methodological approaches to assessing timbre, making *cited by* or *works cited* far more applicable to the refined discussion (Boell and Cecez-Kecmanovic, 2014).

Though initial priority was given to quantitative and mixed-methods studies, it became increasingly clear that the former types of studies were few and far between; therefore qualitative research was added to inclusion criteria. Such a choice allowed for prioritization of white literature. Some studies published before 2010 were included as context for discussion but not specifically analyzed. As many studies as were relevant were included so as to avoid confirmation bias and therefore a manufactured conclusion, a common issue within narrative literature reviews (Baumeister and Leary, 1997; Snyder, 2019).

Positionality and Bias

My role as a voice teacher is to help a singer meet their voice goals and to be flexible to their needs. This includes using objective measures as well as metaphors, imagery, and other perceptual aspects of timbre, as both sides are equally valid for helping singers understand their voice (Yarnall, 2017; Bozeman, 2022; Hausknecht *et al.*, 2024). With this in mind, I consider an ontological position of relativism wherein each of my singers will experience their own voice in different ways (Scotland, 2012). I must also acknowledge that I will be both an insider and outsider to the research (Yip, 2024). As an insider, I may identify with the researched styles of Western music and the experience of female singers. However, when I am an outsider to the research, particularly that which discusses non-Western music styles, I will ensure that I am not dismissive of potential learning and practical application.

An integral part of the researcher's job during a literature review is to continually assess for bias (Baumeister and Leary, 1997; Hysaj, Khan, and Freeman, 2025). Throughout the writing process, I will continually be aware of confirmation bias in my literature selection and analysis, rely on inclusion and exclusion criteria, and ensure that I find common ground between studies to develop a nuanced picture of assessment of voice timbre (Baumeister and Leary, 1997).

Literature Review

Introduction

The term *timbre* is fraught, and many disagree with the officially recognized definition. The Acoustical Society of America Standards (ASAS) describes timbre as such:

That multidimensional attribute of auditory sensation which enables a listener to judge that two non-identical sounds, similarly presented and having the same loudness, pitch, spatial location, and duration, are dissimilar. Timbre is related to sound quality, often specified by qualitative adjectives (e.g., bright or dull). (ASAS, no date)

A common criticism is that the above definition describes more what timbre is *not* without describing what it *is* (McAdams and Giordano, 2016; Seidenberg and McAdams, 2017; Howell, 2025). For instance, timbre is covariable with pitch and loudness, rather than completely separate from the two (Howell, 2016; Howell, 2025). Yet where the ASAS definition is not controversial is that timbre is a perceptual experience interpreted through language (Titze, 1989; Heidemann, 2016; Yarnall, 2017; Wallmark, 2021). Such a distinction places timbral identification in the hands of those experiencing the sound rather than relying on objective measures as seen by the use of spectrographic software, magnetic resonance imaging (MRI),

and electroglottography (Echternach *et al.*, 2010; Latartara, 2012; Mainka *et al.*, 2015; McGlashan, Thuesen, and Sadolin, 2017; Capobianco *et al.*, 2023).

Computerized measurements of timbre may objectify sound, but the words used to describe those sounds rely on linguistic clarity and interdisciplinary agreement (American Academy of Teachers of Singing, 2014; Wallmark, 2021). Despite objective evidence to their nature, terms like “belt,” “loft,” and “twang,” can be oversimplified, causing confusion and misguidance (Titze, 1989; Heidemann, 2016; Yarnall, 2017; McCoy, 2019). Furthering the issue is the use of pedagogic terminology with timbral connotations borrowed from other languages; examples include *chiaroscuro*, *falsestto*, or *voce di petto*, which carry with them an historic and cultural context along with their sonic quality (Yarnall, 2017; McCoy, 2019). At the core of this conundrum is not timbre itself, but the language used to express timbral outcomes. The American Academy of Teachers of Singing (AATS) aimed to dispel some of these misunderstandings by recommending voice teachers stray from sensation-based terminology, yet acknowledge that singing is an art based in “imagination, function, musicality, phrasing, and...emotion” (AATS, 2014, p. 14). While AATS does not explicitly mention descriptions of timbre, there remains a disconnect between descriptions that are fact-based, and descriptions that are advantageous to a singer. For voice teachers, it is important to remember that these are not mutually exclusive, but worth investigating. This literature review aims to bridge the gap and uncover how timbre is perceptually assessed in various singing styles.

Auditory-Perceptual Ratings

Auditory-perceptual ratings are commonly used tools which allow study participants to assign labels to sound, and are considered superior for voice assessment in both normophonic and dysphonic voices (Iwarsson and Reinholt Petersen, 2012; Aaen and Sadolin, 2024; Walstrom *et al.*, 2024; Battyany, Latoszek, and Maryn, 2024; Raveendran and Krishna, 2025). These indexes often include parameters for listeners to assess the singing voice, including *Ring* (the perceived brightness of a sound), *Vibrato Onset Delay* (the amount of time from onset of sound to appearance of vibrato), or *Breathiness* (the perceptual amount of noise coming from non-resonant air) (Kempster, *et al.*, 2009; Aaen and Sadolin, 2024; Shields *et al.*, 2025). Such tools and markers can be useful for gaining insight on generally agreed upon aspects of many singing styles.

Shields *et al.* used auditory-perceptual ratings to identify markers of *kapa haka* performances, a style of indigenous music from New Zealand/Aotearoa (2025). The authors recognize that *kapa haka* has been viewed through Western models of ethnomusicology which

run the risk of overlooking important cultural aspects of the tradition, especially as it relates to labeling sound quality (Shields *et al.*, 2025). Expert listeners with experience in various music genres (including *kapa haka*) were prompted to rate Breathiness, Vibrato Onset Delay, Loudness, Consonant Strength, and Ring from three different styles of indigenous Maori music (*waiata*, *mōteatea*, and *haka*), as well as speech. Not only were listeners able to distinguish the selected perceptual attributes, but they scored the presence of said attributes with high inter-rater agreement (Shields *et al.*, 2025). In addition, the auditory-perceptual scores were reflected in acoustic measures, further validating the listeners' perceptual awareness and ability to pair a sound with a descriptor (Shields *et al.*, 2025). As others hypothesize, agreement may suggest that, with appropriate training, descriptors of vocal timbre are clear enough to translate between and among voice pedagogues with accuracy (Iwarsson and Reinholy Petersen, 2012; Aaen and Sadolin, 2024; Walstrom *et al.*, 2024).

It should be noted, specifically in the case of determining Vibrato Onset Delay, that research has shown that the presence of any vibrato can be an indicator of timbral source, but not necessarily that source's timbre (McAdams and Giordano, 2016). Vibrato Onset Delay may be a key stylistic feature of *haka*, and teaching it as such would allow young singers to perform in the culturally agreed upon style, but other attributes of *haka* may contribute more to its timbral identity, namely Loudness and Ring. These two would likely be seen on spectrographic imaging to have defining spectral features which are known to be associated with timbral contributions (Howell, 2016; Bozeman, 2017).

Auditory-perceptual assessments have also been used to determine resonant qualities of the singing voice (Raveendran and Krishna, 2025). While *resonance* is not a direct synonym for *timbre*, it can be used to describe a specific timbre. In the case of the following study, a resonant voice is defined as having an increased spectral energy in the second and third formants which the authors consider desirable (Vurma and Ross, 2002; Raveendran and Krishna, 2025). Through auditory-perceptual analysis, Raveendran and Krishna studied the impact of resonant voice therapy (RVT) on Indian Carnatic classical singers (2023). Nine judges were used and divided into three categories:

1. Group A: three trained, professional Carnatic singers
2. Group B: three speech-language pathologists (SLPs) with a background in Carnatic singing, and
3. Group C: three SLPs with no background in Carnatic singing.

Each group assessed aspects of resonant voice quality in six professionally trained Carnatic singers, of which three received RVT while the other three did not. These aspects included

Loudness, Pitch Stability, and Pleasant Quality. Results showed that groups A and B perceived a significant difference in pre- and post-training recordings for singers who had undergone RVT, and were found to be in agreement across the three aspects after inter-rater reliability testing (Raveendran and Krishna, 2025). Group C did not perceive a statistically significant difference between pre-and post-training recordings, and therefore were not considered in agreement with Group A (Raveendran and Krishna, 2025). Based on these findings, the authors conclude that expert listeners with voice training are more likely to perceive subtle changes to the singing voice simply due to experience and exposure. This validates the conclusions from Iwarsson and Reinholt Petersen (2012) as well as Aaen and Sadolin (2024) that consensus models, prompted anchors from shared education, and experience are trustworthy enough to be used for determining timbral quality.

In an earlier study, LeBorgne *et al.* researched whether expert listeners were able to identify elite and average student belters based on perceptual parameters (2010). The parameters given were Loudness, Vibrato, Timbre (or brightness), Ring, Focus, and Nasality. Curiously, while listeners agreed on whether the student belters were elite or average, they did not agree on the perceptual qualities which defined them as such. Listeners 1 and 2 were generally in agreement on ratings of Intensity, Vibrato, and Ring; listener 3 only aligned on their rating of Vibrato (LeBorgne *et al.*, 2010). Where listeners and singers agreed was that belting requires a bright sound, as indicated in this study through the category of Timbre. With credit to LeBorgne *et al.* (2010), this study is the oldest and therefore shows signs of being outdated, particularly as it relates to the terminology. The inclusion of Timbre as an auditory-perceptual aspect of singing implies its independence from other aspects. Newer research suggests that timbre, whether specifically discussing darkness or brightness, is not separate, but changes with the presence or absence of other qualities (Siedenburg and McAdams, 2017; Howell, 2025). In addition, the use of the word “Timbre” for “Brightness” creates a dichotomy between the perceptual categories of timbre and ring, which based on the authors’ definitions, may likely present similarly if they were to be assessed using acoustic measures. After all, timbre can be *dark* or *warm* as well (Howell, 2025).

Methods like Complete Vocal Technique™ aim to address the lack of consensus by training voice teachers to align pedagogical vocabulary to objective measures (Complete Vocal Institute, no date). Their research proposed new categories of the belt quality by separating it into *overdrive* and *edge* (McGlashan, Thuesen, and Sadolin, 2017). Both subcategories showcase belt’s signature boosted second harmonic, yet are defined by other qualities seen in LTAS and EGG readings (McGlashan, Thuesen and Sadolin, 2017). Without the use of

auditory-perceptual feedback from expert listeners, these authors describe *overdrive* as “shout-like” and *edge* as “scream-like” (2017, p. 14). It is unclear if such descriptions are based on one person’s perceptual differentiation of shouting and screaming, or if a large panel of expert listeners came to an agreement. For voice teachers using other methodologies, who have different linguistic models, or are simply new to the jargon, metaphorical terms used without broad professional consent may sow confusion. Terms like *breathiness* have explicit meaning and an obvious perceptual quality; *overdrive* and *edge* do not yet.

Methodological Concerns

Describing singing voice timbre is clearly an integral part of the auditory experience, whether that is because a listener is determining preference, categorizing, or looking to understand that which differentiates dissimilar sounds (LeBorgne *et al.*, 2010; McGlashan, Thuesen, and Sadolin, 2017; Seidenberg and McAdams, 2017; Knight, Sares, and Deroche, 2023; Raveendran and Krishna, 2025; Shields *et al.*, 2025). For voice teachers, the primary listeners in a voice lesson, the auditory experience allows them to assess singers. The above literature may be useful in providing strategies and language for voice teachers, but caution should be taken before directly applying theory to practice.

Though auditory-perceptual ratings are commonly used and considered legitimate (Raveendran and Krishna, 2025; Aaen and Sadolin, 2024; Batthyany, Latoszek, and Maryn; 2024), the reliance on expert listeners brings in a new variable: varied experience. In the case of LeBorgne *et al.*, one judge did not agree on perceived levels of five out of the six possible categories (2010). This judge, though having trained in belting and with a similar resume to the other two judges, still carried a perceptual framework that differed from their peers. In an effort to address concerns like this, Aaen and Sadolin devised a study wherein expert listeners used an intuition-based model for perceptual evaluation in one group, and trained listeners used assessment anchors based on the Complete Vocal Technique model for voice teachers in another group (2024). Expert listeners using the intuition-based model scored lower in accuracy than trained listeners and had generally lower levels of agreement. Such is also reflected in Iwarsson and Reinholt Petersen (2012), and indicates that institutions which train novice and expert voice teachers should spend adequate time listening, reflecting, analyzing the literature, and designing models for functional listening.

Despite Shields *et al.* (2025) and Raveendran and Krishna (2025) showing agreement in ratings while using an intuition-based model (they received no training on assessment criteria from researchers), there is no evidence in these studies that prior professional experience is

what allowed agreement. It can be simultaneously true that studies using expert listeners find consensus in auditory-perceptual ratings (LeBorgne *et al.*, 2010; Stone and Erickson, 2025; Raveendran, and Krishna, 2025; Aaen and Sadolin, 2024; Shields *et al.*, 2025), and that these expert listeners carry with them varying definitions and mental models of the prompted auditory-perceptual aspects. This issue is taken even further when higher institutions do not have a systematic approach to assessing singing voice, resulting in a lack of consensus across English-speaking voice programs (Hausknecht *et al.*, 2024). Hausknecht *et al.* attribute to this phenomenon the basic notion that singing voice assessment is inherently subjective (2024).

If assuming best intent, one can surmise that the voice researchers using auditory-perceptual measures desire to objectively describe singing voice timbre. The positivist approach results in numbers and values to be neatly arranged in tables and charts. Scotland acknowledges that in this position, language is merely a verbal representation of a phenomenon, but that positivists “self-delude themselves into thinking that their research is value free” (2012, p. 11). As much is true when value-laden language is dispersed throughout auditory-perceptual research:

We used high quality, enjoyable naturalistic singing performances...Additionally, we made the decision not to (attempt to) record amateur or untrained singers due to the challenges associated with satisfactorily performing these melodies a cappella.” (Bruder, Poeppel, and Larrouy-Maestri, 2024, p. 7)

The auditory perceptual skills of the SLPs should be accurate enough to identify and measure the auditory perceptual features like vocal resonance, regarded as the benchmark of vocal excellence.” (Raveendran and Krishna, 2025, p. 1)

When peer reviewed research includes subjective language like “high quality, enjoyable, naturalistic” and “vocal excellence” to justify their choices, researchers add yet another new variable to the research: their own personal preferences. Thus researchers predetermine what is worthy of being studied. Not every study included in this literature review used value-based language to justify methods, but when it is encountered, voice pedagogues must remain critical, questioning whether or not objective results can occur when the variables were determined based on researcher preference. Positivist research cannot be based on what the researcher deems preferable.

Value-laden language carries with it two other issues. The first of which is that it determines which voices are considered good or bad, worthy or unworthy of study. For example, the phrase “high quality, enjoyable naturalistic singing...” (Bruder, Poeppel, and Larrouy-Maestri, 2024, p. 7) implies that the researchers decided some voices were not of high enough quality to

include in their research. This is egregiously ironic, considering this particular study investigated singing voice preference and its connection to perceptual features. Bruder, Poeppel, and Larrouy-Maestri ultimately found there was little inter-rater reliability (2024). This could have been hypothesized, given that listeners were generally laypeople with a wide variety of singing voice preferences, and who may have come to different conclusions about what they considered high-quality and enjoyable. In addition, preference was more linked to perceptual features rather than acoustic (Bruder, Poeppel, and Larrouy-Maestri, 2024), likely because acoustic measures require hardware and software to analyze, and perceptual measures (assuming no use of hearing aids) do not. The researchers admit that timbre was the most metaphorical perceptual feature, and therefore required lay listeners to make *a posteriori* determinations regarding what they heard. To note, this author would argue that timbre is not metaphorical (though it can be described with metaphors); after all, timbral differences can be quantified and voice teachers can be trained to listen specifically for timbral attributes (Echternach *et al.*, 2010; Latartara, 2012; Mainka *et al.*, 2015; McGlashan, Thuesen, and Sadolin, 2017; Capobianco *et al.*, 2023). Regardless, there remains a dissonance between asking questions rooted in positivism and relating the variables and content to interpretivism.

The second notable issue arising from value-laden language is that it is often embedded within a cultural context. In the case of Raveendran and Krishna (2025), they regard resonance as a desirable quality, and therefore asked listeners to judge based on the agreed upon aspects of Carnatic singing: Loudness, Pitch Stability, and Pleasantness (Arunachalam, Boominathan, and Mahalingam, 2014). It is unfortunate that such language as “excellence” and “pleasantness” are attributed to a specific style of singing when such words can be used to describe any kind of singing which follows the societally and culturally acceptable timbral landscape. Shields *et al.* manage to accomplish such research without assuming that the perceptual features heard in *kapa haka* are desirable in all styles (2025). On the contrary, it is made clear that the nasalized timbre of *waiata* is inherent to its sound and singability, but is not typically favored in Western Classical singing (Shields *et al.*, 2025). Shields *et al.* avoid making the claim that a nasalized sound is inherently better than non-nasalized, but instead address the preference that a “Western musical ear” would not appreciate it the same way (2025, p. 8). This language matters for voice teachers who work with students singing in multiple styles. Neutrality is key to helping students not only realize the potential sounds their voice can make, but does so without elevating one style of music over another based on the way the voice is used.

Other methodological concerns linger, namely that a lack of racial, generational, gender, and sex diversity make results difficult to scale (Marchand Knight, Sares, and Deroche, 2023;

Hausknecht *et al.*, 2024; Shields *et al.*, 2025). In addition, some studies used professional recordings (Aaen and Sadolin, 2024) which have been put through the equalization process, making it difficult to truly parse the nuance of individual singing voices. Furthermore, much discussion of voice perception and timbral analysis exists outside the realm of quantitative analysis.

Mimesis, Modeling, and Metaphors

The above studies answer this review's research question insofar as they discuss a common assessment for researchers to explore perceptual aspects of singing voice timbre. What they fail to address are the reasons why researchers choose the given parameters for studying various voice qualities. Heidemann neatly succinctly sums up a solution to this conundrum:

A satisfying method for description and analysis of pop vocal timbre should...afford detailed descriptions of the sound of vocal timbre, support intersubjective comparison of listening experiences while minimizing miscommunication and confusion, and recognize and reflect the visceral nature of music listening. (2016, p.2)

She is not against objective listening experience, but also addresses the elephant in the room; listening to music extends beyond logic and reasoning, and can be therefore based in phenomenological inquiry. Hausknecht *et al.* relate this to singing voice assessment criteria, which are based not only on objective measures like auditory-perceptual ratings, but exist within shared cultural experiences (2024). These shared cultural experiences shape a voice teacher's pedagogical framework which thus gets passed along to students, molding their own understanding of the singing voice.

Heidemann (2016) offers a model of inquiry for voice perception based on a phenomenological underpinning that singers can create meaning based on what they physically feel while singing:

1. How do the vocal folds seem to be vibrating?
2. What is the apparent position of the vocal tract?
3. Where do sympathetic vibrations occur in the body?
4. What is the apparent degree of breath support and muscle anchoring?

Singers and voice teachers alike may relate to using an approach like this, considering these questions are often formatted as different pillars of vocal production: registration, resonance, and respiration, respectively (Dimon, 2018; McCoy, 2019; Ragan, 2020). Heidemann, rather than prioritizing objective measures and technical jargon, uses anatomically-based models to, in

essence, body-scan while vocalizing; in turn, they claim to have an understanding of how sound is made through embodied experimentation (2016). They state

When listening to a singer, through a combination of muscle memory and mimesis, or complex imitation, I can get a sense of the likely degree of tension in their vocal folds, a rough estimation of glottal opening, the physical condition of the folds, and whether those folds are vibrating efficiently (2016, p. 5).

Heidemann continues to express that, while anatomical terminology is useful, it is not necessary (2016). Heidemann then explores various vocal tract shaping to create “baby” and “sobbing” sounds (2016, p. 7), tracks sympathetic vibrations in the head during “head voice” (2016, p. 8) and chest for “chest voice” (2016, p.9), and experiments with the ways in which changes in air pressure and airflow affect sound. The technique Heidemann (2016) is suggesting is often referred to as bodymapping in voice pedagogy literature, and is based on the intuitive notion that singing requires an awareness of one’s body in space (Malde, Alden, and Kurt-Zeller, 2020; Stapleton, 2024; LeBorgne and Rosenberg, 2025). Though young as a researched pedagogic model, it has been reported that a cohort of undergraduate students did report some improvement to their singing voice after participating in bodymapping coaching (Stapleton, 2024). It remains uncertain how directly bodymapping can be related to improvements in intended timbral outcome. Future research on implementing bodymapping concepts in singing lessons may add more validity to Heidemann’s work.

While this approach may work for some, teachers should take caution. Heidemann’s (2016) mimetic approach to analyzing vocal timbre is based on their own body, and cannot be translated across a population (AATS, 2014). Consider this within the relationship between registration and sensation. The notion that singing in chest voice results in sympathetic vibrations in the thorax *could be* true, but is not always the case, as various cues can be given to a singer to help them discover their own sympathetic vibrations (McCoy, 2019; Ragan, 2020). Therefore a voice teacher might avoid telling singers what they should feel, but what they might feel. In addition, vibrotactile sensation and auditory outcomes are not inherently related, and therefore a singer cannot assume that a feeling is associated with a given sound (McCoy, 2019; AATS, 2014). For example, if a perceptual timbral shift has occurred in the *secondo passaggio* for bass voices, it may feel as though a change has occurred at a laryngeal level, but that is not the case (McCoy, 2019;). McCoy suggests that singers should avoid large physiological changes while navigating the *secondo passaggio*, and instead focus on maintaining laryngeal stability, well-managed airflow, subtle vowel modification, and free articulation (2019). For the Western Classical singer, this will keep the first formant from elevating (which would result in a yell-like

timbre) and help the singer maintain the expected amount of vocal warmth (Echternach *et al.*, 2010; McCoy, 2019; Bozeman, 2022).

Bodymapping and embodied singing is not inherently problematic; an accurate mental model of the body and the interplay among its systems is invaluable (Yarnall, 2017). Teachers should aim to instill in their students an accurate and reliable bodymap, as it is critical in shaping “healthy, efficient, stylistically correct, and artistic performances” (AATS, 2014, p. 10). As with any pedagogical strategy, a voice teacher should be able to gauge when a new approach needs to be used with a student. One such strategy is voice modeling.

Voice teachers often direct students to listen to other professional singers to gain a sense of style, musicality, and timbre (Manternach, 2026). In doing so, young singers would develop a perceptual and physical idea of the potential sounds they can make, want to make, and do not want to make. Similarly, a teacher’s vocal modeling can be useful, particularly for those who are still building mental models of potential voice use and do not yet have the ability to make a sound based on their teacher’s description (LeBorgne and Rosenberg, 2025). An anecdotally common trope is that of a choir director modeling “tall vowels” for young choristers. Simply telling a group of 8 year-old singers to not sing with a horizontal mouth is not likely to yield positive results without the director’s visual and vocal help. In this particular case, the tall vowels in question might contribute to the director’s desire for a warm sound, but such timbre has been accomplished with the alternative pedagogical means of modeling.

Modeling may also be a starting point for novice teachers who are still building a methodological toolbox (Angell, 2019). The case can be made for the validity of this practice based on the premise that this is how singing training has occurred for the larger part of human history (Angell, 2019; Manternach, 2026). The key factor is that vocal modeling (or encouraging a student to mimic) often encourages a *specific* sound, and not necessarily a *unique* sound (Yarnall, 2017). Uniqueness has been considered a desirable trait when considering a singer’s timbre (LeBorgne *et al.*, 2010; Latartara, 2012; Yarnall, 2017; Manternach, 2026), and strict vocal modeling alone will not be the most efficient path to achieving it. LeBorgne and Rosenberg suggest that modeling is useful during the skill acquisition phase of a singer’s journey, but there will come a point when the singer should trust their internal timbral memory to achieve the sound they desire (2025). Voice teachers should encourage this transition by pausing their own modeling over time and provide space in a lesson for singers to safely experiment on their own with various sounds.

Science-based terminology is often used to describe singing voice timbre, but it is rarely the only option (Titze, 1989; Siedenburg and McAdams, 2017; Yarnall, 2017; Hausknecht *et al.*,

2024; Shields *et al.*, 2025). Particularly when paired with colorful poetry and the singer's creative impulse, metaphor can be an effective way to communicate timbral necessitations for a given style (AATS, 2014). Though not as common of a term as it once was, referring to the operatic voice as a *pear* with robust warmth resulting from a dominant fundamental and a top with the ring from high frequency energy has had some pedagogical use (Edwin, 2011). Additionally, Wallmark notes, "Would your friend be excited to go check out that new song in G major with a 32-bar AABA form? Not likely. How about that song with a dusky, warm, atmospheric sound? Much more so" (2021, p. 2). Technical language is good to have because it connects voice teachers with other voice teachers. In translating theory to practice however, metaphor is likely better suited to connect voice teachers with their singers.

Yarnall's research into listener perception found that metaphors for the singing voice could be divided into five categories: Effort, Comfort, Technical, Musical, and Personal (2017, p. 569). Similar categories are mirrored in earlier literature (Arnheim 1974; Titze, 1989; Thurman and Welch, 2000). Within these categories, singers and listeners alike were able to explore a wide variety of linguistic terms to explain not only what they heard, but what they felt while singing. The key in phenomenological research such as this is that there is no wrong answer, but perspectives that broaden object reality (Holmes and Holmes, 2012; Yarnall, 2017; Wallmark, 2021). While auditory-perceptual ratings provide methodological comfort that experts can agree on descriptive aspects of sound, it is just that: comforting. Any description of a sound results from an ontological and epistemological choice that researchers, teachers, and singers make to transmit their own meaning. Voice teachers are the bridge between researcher and singer, and therefore carry the mental load of translating, critically applying meaning, and regularly checking in with the singer for understanding and the need for clarification.

On Hearing

The above literature exists not only in two methodological realms, but two physical ones as well; the voice system causes a natural phenomenon to occur, and then it is perceived by the ear. Much of singing voice and timbre literature fails to consider the ear's complex contribution to timbral perception and identification despite its obvious significance in the process. New literature in voice pedagogy is changing the trajectory and acknowledging the critical role of hearing in pedagogic decisions (Howell, 2025).

The human voice creates a complex pressure wave: it is not a perfect sine wave, but a messy and complicated one caused by variations in airflow, muscle engagement, and the interaction between the vocal folds and vocal tract (McCoy, 2019; Howell, 2025). Acoustic

measures of these waves aim to synthesize them and distill the most notable aspects, but this is not how the ear operates. Simply put, the ear contains three major parts: the outer, middle, and inner ear (McCoy, 2019; Howell, 2025). The outer and middle ear sense and transmit vibrations from the complex pressure wave resulting from human voice production, and the inner ear translates those vibrations to electrical impulses for the brain (Howell, 2025).

The process wherein “the ears and brain monitor the resulting sounds to check for accuracy” and adaptations are “quickly and subconsciously corrected” is called the auditory feedback loop (McCoy, 2019, p. 271). For singers, no amount of bodymapping and vibrotactile awareness will override this powerful process, and teachers would do well to honor a student’s perceptual experience. Anecdotally speaking, it is not uncommon for a young singer to try a new vocal tract shape, only to be surprised by what they heard, thinking it sounds wrong or bad. A voice teacher should know a student will hear their own voice differently because of the ear’s proximity (McCoy, 2019), but that cultural context and a student’s past experiences will inform the way they describe what they perceive. The voice teacher’s role then is to meet the student at their developmental level, mindset, and cultural context to guide their own listening and perceptual model.

While research on the ear and singing is scant in voice pedagogy literature, research on hearing loss in voice teachers is even less. This is despite the fact that incidents of hearing loss in voice teachers is higher than in the general population (Isaac *et al.*, 2017). Voice teachers are often exposed to prolonged levels of high frequency sound known to cause sensorineural hearing loss (Isaac *et al.*, 2017; McCoy, 2019). Others may experience pathological issues within the inner ear, or cochlea (also considered sensorineural hearing loss), or conductive hearing loss as a result of damage to the outer and/or middle ear (Isaac *et al.*, 2017; McCoy, 2019). Hearing loss of any kind can cause timbres to muddy (Younan *et al.*, 2025), altering the affected voice teacher’s perceptive conclusions. Cochlear implant users are likely to experience far more challenges in spectral tuning due to the limited amount of technology able to fit in the implants (Younan *et al.*, 2025). Quantitative studies on the prevalence and effects of hearing loss exist, but are limited. To this author’s knowledge, there is currently no phenomenological literature addressing voice teachers with hearing loss; this highlights an area of future research.

Conclusion

A literature review into the domains of perceptual assessment of singing voice timbre showed two major themes: auditory-perceptual ratings, and mimetic and metaphoric assessment. Both forms of assessment relied on using language to describe what listeners and

teachers were hearing in the singing voice, yet the methodologies were paradigmatically different. Auditory-perceptual ratings may be useful in identifying timbres of various styles of singing, though inter-rater reliability of said assessments is mixed (LeBorgne *et al.*, 2010; Raveendran and Krishna, 2025; Bruder, Poeppel, and Larrouy-Maestri, 2024). Anchor-based models of assessment may help improve inter-rater reliability, but these ultimately require cohesive training (Iwarsson and Reinholt Petersen, 2012; Aaen and Sadolin, 2024), likely from methodologies of voice pedagogy like Complete Vocal Technique™ or Estill Voice Training™. Phenomenological studies seem to be in an entirely separate realm from others, discussing the ways in which singers experience timbre both internally (Heidemann, 2016), externally (Angell, 2019; Manternach, 2026), and linguistically (Yarnall, 2017; Wallmark, 2021).

The push toward facts-based, evidence-based, or science-based voice pedagogy is a positive one, but cannot become so dogmatic as to neglect legitimate qualitative research that provides useful, if not incomplete, models for teaching singing. For this purpose, the field of voice pedagogy would benefit from more of *both* methodologies, allowing teachers to design holistic models and bring new best practices into their studios. Further quantitative studies of singing timbre from expert listeners would continue to assign labels to sounds; ideally these studies contain high numbers of judges to improve scalability. Additionally, more phenomenological studies of singing timbre would bridge theory and practice, as well as build empathy with singers. A critically important addition to the field of singing voice timbre research would be that of hearing. Voice teachers should understand and engage in metacognition about functional hearing. Additionally, an understanding of timbral domains provides a baseline for how voice teachers with hearing loss are impacted in their work; further inquiry is missing and would greatly benefit the field. At the end of the day, a voice teacher's job is to listen: listen to a singer's voice, their needs, and what they have to say about the world they occupy.

Critical Reflection

The research question at hand, understanding the singing voice through perceptual assessment, was designed to ask the other side of an earlier literature review discussing quantitative assessment. Given that the latter could be neatly arranged for analysis and did not have glaring methodological incongruences, I considered that perhaps there was a bias in voice pedagogy research. This bias can be viewed through Brookfield's criteria for hegemonic assumptions:

1. They are considered "commonsense truth" and are therefore best practice,

2. They support teachers' "best interests," and
3. They quietly perpetuate harmful systems and prevent teachers from meaningful success (2017, p. 40).

Thus, the hegemonic assumption would be as follows: some aspects of singing voice timbre are numerical, tangible and facts-based, and are therefore positive; others are philosophical or emotional, and therefore not tangible and possibly harmful. I believe that voice teachers wish to do no harm, but this assumption furthers the master-apprentice model that quietly silences a singer's intuition and artistic voice. Hence, Brookfield's model of critical reflection for teaching has allowed me to engage with the content as a voice teacher who aims to teach her students as holistically as possible.

Kolb's experiential learning cycle (1984) seemed promising given the in-the-moment experiential act of teaching. Formative assessment is a critical part of a voice lesson and requires immediate decisions based on the teacher's knowledge (Rollings Bigler *et al.*, 2021). Because theory was a far more relevant topic of discussion than practice, the experiential learning cycle became less relevant. This is not to say it was entirely disregarded, as it will be addressed when applicable.

Student's Eyes

In lessons I make decisions based on what I hear and *do not* hear. Auditory-perceptual ratings as seen in Shields *et al.* (2025) and Raveendran and Krishna *et al.* (2025) can help me confirm that what I am hearing is agreed upon by experts; phenomenological approaches from Heidemann (2016) and Yarnall (2017) help me name the outcomes I am looking for. Key, however, is the singer I work with. Brookfield's suggestion is that our teaching is reflected by what we know of our students and investigating their inclinations to make adjustments to our teaching (2017). This literature review has given me permission to be creative for a singer's sake. Whether I choose to use a term rooted in positivism or interpretivism, it should be used because it works for that singer.

Colleagues' Perspectives

I have neither the privilege of working across the hallway from other professionals, nor do I have the ability to regularly discuss and reflect with them as Brookfield would suggest (2017). However, past conversations with colleagues have led me to believe that many fall somewhere in the middle on the spectrum of "objective reality only" to "subjective reality only."

Ideally, this literature review helps me place myself somewhere in the middle of the spectrum, and to be empathetic and flexible to where my students may fall. I realize this positions me to eschew the advice of voice teachers with more experience than I, but I find that critically assessing my teaching and explaining my conclusions to colleagues will be more beneficial to both me and my students in the long run. My identity as a teacher is shaped by my experience as a young singer who was taught with metaphor and modeling. Now as a teacher still taking her own lessons, the emphasis has shifted to anatomical and perceptual truisms. Because I have seen the value of both pedagogical sides, I aim to add them in other voice lessons when appropriate. This literature review has only emboldened me to codify such a philosophy.

Personal Experience

I am struck by Brookfield's opinion that "adult learning opportunities provide us with an experiential analog of the terrors and anxieties that our own students are facing as they approach new learning" (2017, p. 154). It was often during this module that I was frustrated by the lack of consistency in the literature and its disagreement within itself. I was plagued by writer's block, and found very few threads holding the literature together. Boolean string searches were initially helpful, but researching qualitative domains proved noisy and scattered, and laughed in the face of my inclusion and exclusion criteria, which needed to be made flexible over time. However, I overcame the initial confusion and found that, in doing so, I met all three of my learning outcomes addressing the wide array of methods and methodologies which came about. Brookfield (2017) considers this experience useful, if not demoralizing at first; such was abundantly true as I navigated a complex paper with an overfull teaching schedule, a toddler, and the quickly impending arrival of another baby.

Theory

The silver lining within this module is that perceptual models for singing are more easily translated into practice than objective ones. As Brookfield states, "Interpreting, predicting, explaining, and making meaning are acts we engage in..." (2017, p. 172). I was comforted by this after being faced with the task of explaining to a singer the timbre they use to "What Was I Made For?" by Billie Eilish should not be the same timbre they use to sing "Bel piacere" by Handel. The literature touched only theoretically on such a conundrum, but it was immediately applicable with a young singer. Whether I used the words "breathy" and "tired" for the first song or "resonant" and "pingy" for the second, the student could use what was effective for them. Not

only in this instance did I apply theory to practice, but I can consider a student's perspective and use a term that works best for them.

Conclusion

Upon reflection, the most important professional and educational takeaway from this literature review is that, despite its confusion, engaging with it allows me to build my pedagogical toolbox, critically engage with other professionals, and explore my own strengths and weaknesses as a practitioner-researcher. Brookfield's model of reflection is useful because my goal is to apply everything I have learned to benefit the singers I get to teach. Kolb provides a meaningful pathway to explore learning by doing, but I do not see this literature review as ending with me. It starts with me and is passed along to my students.

The ultimate goal of this module and the previous module was to set up a groundwork of theoretical knowledge before doing phenomenological research on voice teachers with hearing loss. Without a baseline understanding of timbre and its relevance to various styles of singing, one cannot begin to understand how hearing loss impacts those who work with singers of all kinds.

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Appendix 1

Timeline

January

- ☐ Determine project

February 1-14

- ☐ Design outline
- ☐ Set up delve for coding
- ☐ Begin cursory research in timbre percept studies
 - ☐ Identify prominent voices in singing percept studies
- ☐ Determine inclusion/exclusion criteria

February 15-28

- ☐ Identify early sources of timbral language
- ☐ Code at least 5 papers

March 1-15

- ☐ Code at least 15 papers (goal: average 1 per day)
- ☐ Write planned program of study (goal: average 100 words per day)

March 16-31

- ☐ Code at least 15 papers (goal: 1 per day)
- ☐ Write methodology (goal: average 100 words per day)

April 1-15

- ☐ Reread Brookfield for reflection
- ☐ Reevaluate and reread coded works
- ☐ Determine Axial Codes
- ☐ Determine key topics
- ☐ Outline

April 15-30

- ☐ Fill outline with appropriate citations
- ☐ Begin formulating (goal: literature review roughly completed)

May

- ☐ May 1 goal: rough draft complete
- ☐ May 8 goal: first draft submitted
- ☐ May 13 goal: final tutorial and questions
- ☐ May 18 goal: submit final draft

Appendix 2

Boolean Strings

Search	Database	Date
singing voice timbre percept*	UWTSD Library	3/5/2026
Describing vocal timbre	UWTSD Library	4/7/2026
"Teaching singing"	UWTSD Library	4/7/2026
Singing timbre metaphor	UWTSD Library	4/8/2026
Singing "hearing loss"	UWTSD Library	5/2/2026
Singing "auditory feedback loop"	UWTSD Library	5/2/2026