

What are the different acoustic projection strategies used in High-Belting and are they voice-type and gender dependent?

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Project Proposal

The Context

Belting is a vocal sound heard within Contemporary Commercial Music (CCM) in many styles including gospel, soul, rock and pop (LoVetri et al., 2021). Research to understand to acoustics of belt has been conducted but there is not a huge amount of research on *high-belt* defined as producing belt above C5. Some research has been conducted in the acoustics of *high-belt*, however it has focused on female research subjects (Flynn, Trudeau, and Johnson, 2018). Some practitioners have claimed sopranos are the only voice-type that can produce *high-belt* (Roll, 2016) and this project wishes to investigate this claim.

The Justification

Professional CCM singers likely will need to have access to belt-like qualities in the *high-belt* range (LoVetri et al., 2021). By using acoustic analysis to investigate *high-belt* across different voice types and genders, more can be learned about this voice quality. This may potentially counter the claim that it is only possible by sopranos, or could identify areas for further research in acoustic differences between voice types that may not be as perceptible by ear alone. The project will only investigate acoustic components of belting, however other studies have also solely looked at acoustics without investigating physiological conditions (Flynn, Trudeau, and Johnson, 2018). This research could also help gain useful insights relevant for working with the gender diverse population.

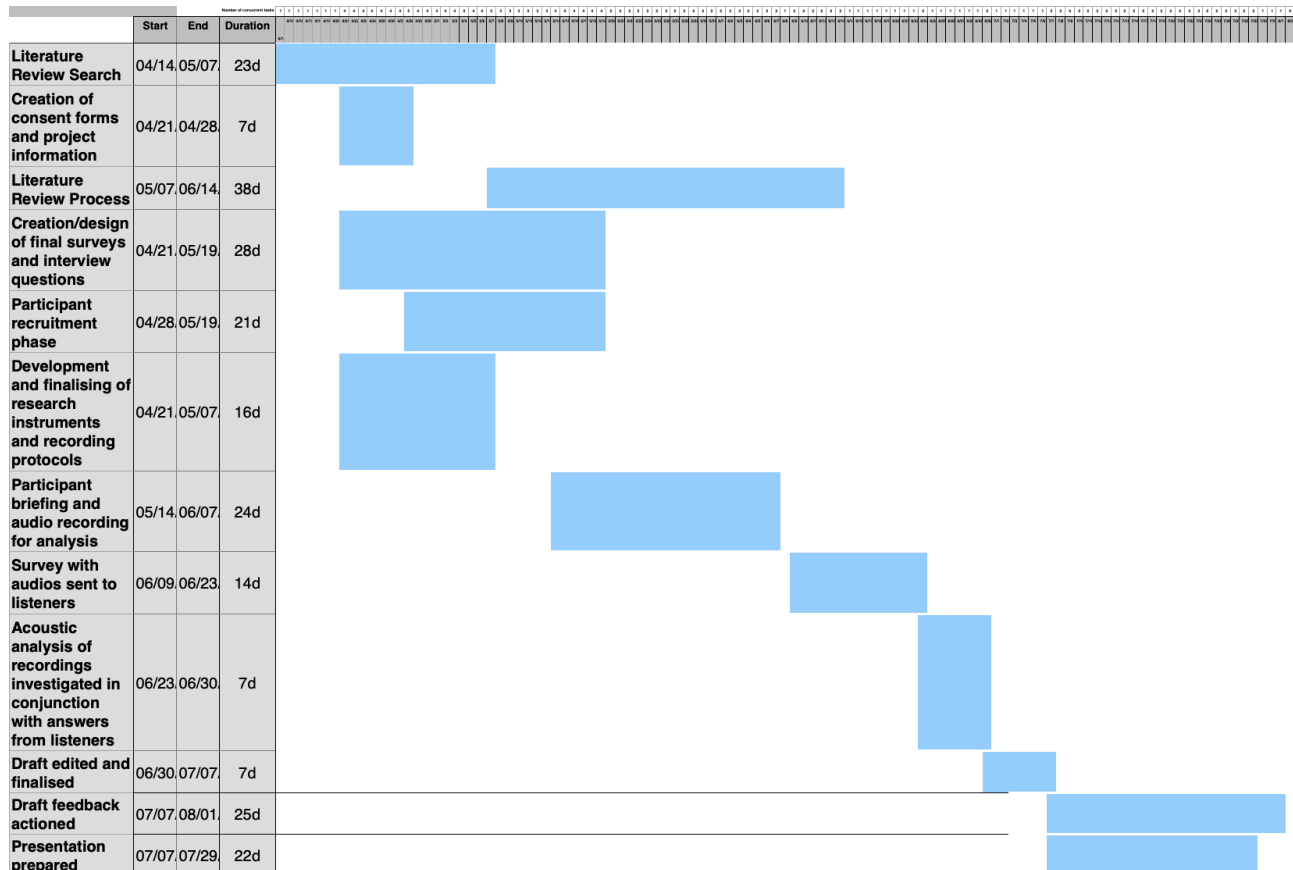
Intended Impact

If acoustic analysis gives similar readings across the different singers, this could begin to answer whether or not only sopranos are able to produce *high-belt*. Conversely, if quite different readings are returned, it allows for an exploration of other areas that contribute to the belt sound. The results could also be used to develop and update pedagogical strategies for singers of all voice types to find *high-belt*. In a wider context, it may open up exploration into how relevant gender, sex and voice type is within CCM pedagogy.

Outlined Intention

This project will involve acoustic analysis of adult singers producing belt on a given vowel and pitch above C5. An intervention will be implemented coaching to singers prior to recording to help ensure the same type of belt sound is being analysed. A group of

independent listeners will be sent a survey with the recordings, and no information about the singers, and asked if each recording is an example of belting. These same audio samples will be analysed using Estill Voiceprint software, as this software is easily readable for viewing the intensity of harmonics up to 5kHz and has a feature to show resonances which could then infer formant tuning. The singers will also take part in a one question interview to collect data on any conscious tactics they employ.



Ethics and Insider Research

Working with live subjects using a high-effort vocal sound, there will be some risk of vocal injury; for this reason, the project will only include singers with no history of vocal injury who can already produce belt in the *high-belt* range. No data that could identify participants will be shared in the final report, and participants will know they can withdraw consent and leave the research project at any time.

As the project will be led by an insider researcher, particular attention must be drawn to rigour and existing biases. Involving independent listeners to confirm that the recordings are examples of belt, will assist with promoting rigour.

Personal Learning Outcomes

This project will give me the opportunity to improve my time management and logistical skills as I will have to manage appointments, data collection and communication with a number of people, while following a timeline to complete the project. It will also involve completing background research about standard practice/recording protocols for acoustic analysis and a literature review to deepen my understanding of the topic.

Introduction

Term	Definition
Voice register	A <i>mode</i> or type of phonation that has categorisable physiological and/or acoustic characteristics.
Chest Voice	The lower of the main two voice registers, heard as heavier, louder, thicker, or more <i>speech-like</i> . This term relates to auditory and proprioceptive perception of the sound.
Head Voice/ Falsetto	The higher of the main two voice registers, heard as lighter, softer, thinner, <i>sometimes</i> breathier. This term relates to auditory and proprioceptive perception of the sound. To some practitioners head voice and falsetto are distinct, with falsetto representing a much lighter, flute-like quality; whereas to others it simply means male head-voice. It is important to note that not all practitioners agree that falsetto has a breathier sound.
M1	A mode of vocal fold vibration that involves more vocal fold mass, often with a longer closed phase. This term refers to the laryngeal mechanism responsible (Mechanism 1).
M2	A mode of vocal fold vibration that involves less vocal fold mass. This term relates to the laryngeal mechanism responsible (Mechanism 2).
Mixed-voice	A registration categorised as the middle point between chest voice and head voice. Roubeau, Henrich and Castellengo, (2009) claim this is produced by a change in acoustics while remaining in the same mechanism.
Twang	A bright voice quality with notable energy above the 4kHz range. Produced by a narrowing of the vocal tract and a high larynx.
Singers Formant	A boosted resonance between 2kHz and 4kHz. Produced by a narrowing of the vocal tract, although a high larynx may not be necessary.

Figure 1. A glossary of terms relevant to this paper.

Belt is a voice quality heard in musical theatre, gospel, rock, pop, and musical traditions around the world, often described as loud, brassy, bright and yell-like, carrying emotional intensity in the upper range (Lebowitz and Baken, 2011; Sundberg, Thalén and Popeil, 2012; Salidas et al., 2019). Regarding voice registration, *belt* has been defined as taking the chest-register or modal register to higher pitches; however, definitions of the term can vary across practitioners and there is currently no concrete scientific or aesthetic consensus on how *belt* is defined (Echternach et al., 2014). Within musical theatre, the belt range, traditionally, would extend only to C5 (Flynn, Trudeau and Johnson, 2018); however, as musical theatre further developed, roles were written requiring singers to produce a belt quality above this pitch and well into the 5th octave (Flynn, Trudeau and Johnson, 2018). In this paper *high-belting* refers to this practice.

As a working voice-teacher specialising in Contemporary Commercial Music (CCM) singing, this voice quality is of particular interest to me. It is quite common for clients working with me to want to work on developing more power, projection and strength in

their upper ranges; exploring belt quality is often a useful tool for this. With more experienced belters, the goal is often developing efficient strategies to take this voice quality higher in the range. At time of writing, there is very little research into high-belting and all research that exists has primarily studied the female voice. To more accurately represent the more diverse reality observed in my own voice studio in relation to voice types and genders exploring belting and high-belting, this research aims to explore and analyse the acoustics of high-belting across a more varied population. It is primarily interested in exploring similarities and differences across samples and investigating possible relationships to voice type. This research project specifically wishes to investigate the sometimes given claim that high-belting is only possible when executed by soprano voices (Roll, 2016).

Ethics and Insider Research

The study received ethical approval ahead of participant recruitment and all data was processed in accordance to GDPR. Participants gave informed consent and were aware they could withdraw from the study at any time without negative repercussions. Participants were also provided with an information sheet (see appendix A), and given an opportunity to ask questions before signing the consent form. Participants were also offered debriefing and member checking sessions if they desired. Interviews were audio recorded and transcribed, and deleted upon transcription.

To prioritise vocal health, at the start of each session participants were asked their current feelings of vocal comfort and function in relation to their ability to participate and were reminded that they could stop at any time if they experienced any pain or discomfort. As an experienced voice teacher in coaching *belt*, the researcher monitored vocal function and was prepared to end the experiment if they believed productions were becoming phonotraumatic.

As the project will be led by an insider researcher, particular attention must be drawn to rigour and existing biases in addition to interpersonal dynamics that may exist with study population where subjects may be known to the researcher.

Literature Review

To form this literature review, literature was identified by searching the key-words: belt, high belt, acoustic strategy, projection strategy, mixed-voice and resonance strategy. Any articles not containing the word singing or voice were removed as were any pieces of literature published before 2005. The decision to have a twenty year cut-off point compared to the conventional 10 years was made due to there being limited research in this area. Additionally, around twenty years ago was when *high-belt* began to appear more popularly within musical theatre (Flynn, Trudeau and Johnson, 2018), which is the area in which the majority of research into the *belt* voice has been. This search resulted in the collection of 77 articles. Of these 77, any literature which made no reference to CCM singing, musical theatre singing, belt, or loud singing, were removed. Due to this study's focus on acoustic analysis, no grey literature was included.

Common Definitions

	Perceptual Correlates	Acoustic Characteristics	Physiological/ Aerodynamic Theory of Production	Miscellaneous
Lebowitz and Baken, 2011	Brassy, loud, yell-like	A high amount of energy in the upper-partials.		High emotional intensity.
Sundberg, Thalén and Popeil, 2012;	Speech-like, yell-like, shouting. Has sub-styles: <i>ringy</i> , <i>brassy</i> , <i>nasal</i> , <i>speech-like</i> , <i>heavy</i> .	Significant energy around 4kHz <i>the belters formant</i> .	Vocal tract narrowing	High emotional intensity. Heard in CCM, pop, rock, R&B, jazz, country, world music and musical theatre.
Echternach et al., 2014	Loud singing style, different to classical singing. <i>Ringy</i> , <i>brassy</i> , <i>nasal</i> , <i>speech-like</i> , <i>heavy</i>	No key formant frequency differences, but belting styles consistently had a higher F1 compared to <i>classical</i> singing.	No scientific consensus. Differences in vocal tract shape, mouth opening, larynx height, tongue height compared to <i>neutral</i> singing.	No pedagogical consensus in definition. Belt is not solely using <i>modal register</i> above the lower passaggio.
Sundberg and Thalén, 2015	A sound often used in <i>non-classical</i> genres.	Less dominant voice source fundamental. F1 closer to a harmonic compared to <i>neutral</i> singing.	Higher subglottic pressure, firmer adduction. Higher maximum flow declination rate, longer closed phase.	Appears to use the same breathing strategy as <i>neutral</i> singing. Belt is said to be produced in the <i>chest register</i> .
Flynn, Trudeau and Johnson, 2018		A relatively weak fundamental. H1 cannot be the most intense harmonic. H2 or sometimes H3 is the most intense harmonic.		Complex and individually variable. Connected to the speaking voice. Distinguishable from <i>mix</i> .
Roll, 2019	Speech-like.		Longer closed phase Vocal tract narrowing.	General assumption, that high-belt is only possible by sopranos. Becomes more of a <i>mix</i> in the higher range.
Salidas et al., 2019	Brassy, loud, yell-like			High emotional intensity.

Figure 2. A table showing descriptions and definitions of *Belt* in various literature.

To some, *belt* simply means a loud sound higher in the range that doesn't sound classical (see Figure 2); whereas to others, including myself, *belt* may carry a more specific definition. Different practitioners and different voice models, have different ideas of what constitutes belting (see Figure 2.)

It may be useful to take a pragmatic approach in defining belt by shifting to focus from what it *is* to what it is *not*. No literature describes the sound as quiet, none of the literature describes the sound as minimally engaged, gentle or muted.

Summary of Literature Review

All primary research studies found within the literature search, which investigated *high-belting* only included female research subjects. This highlights a gap in the literature.

There were varying ideas on what constitutes *belting* and what happens when *belt* is taken higher in the range. Flynn, Trudeau and Johnson (2018) claimed that *high-belt* is distinguishable from *mix*, however, other researchers disagreed (Lebowitz and Baken, 2011). A common claim is that *belt* can only be heard as *belt* if the first harmonic (H1) is not the loudest harmonic (Flynn, Trudeau and Johnson, 2018). Lebowitz and Baken (2011) however, contest this claim with examples of *belt* where H1 was the most intense. An additional claim is that this boosting of intensity at H2 is achieved by aligning the first voice formant (F1) to H2 (Flynn, Trudeau and Johnson, 2018) although it has been said that this is only the case for open vowels (Sundberg, Thalén and Popeil, 2012).

The difference in agreement over some of these quantifiable claims, may be related to differences in what sounds constitute as *belt* as discussed previously.

Some practitioners believe only sopranos can achieve high belt (Roll, 2016). Research by Lee et al. (2021) may contest this, with observations of both male and female voices being able to produce a *mixed voice* registration up to a G5, whereas the highest note in *chest* voice recorded by any female subject (regardless of voice type), was only one tone higher than the highest *chest* note recorded by any male subject, C5 and D5 respectively. If belt is defined as producing higher notes in chest voice, there seems to be no reason that any voice type would be capable of producing high-belt. Therefore, it is likely that a change of strategy may be necessary to produce belt in the high-belt range (Roll, 2016; Flynn, Trudeau and Johnson, 2018). This aligns with research by Roubeau, Henrich and

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Castellengo, (2009) which found that singers transitioning from *chest voice* to a *mixed-voice*, resulted in no change of EGG measurements while acoustic data did change. It could be reasoned that this is due to change in acoustic projection strategy, or a change in muscular effort within the same mechanism.

Research suggests that there are likely a number of projection strategies which singers employ in order to successfully produce a *high-belt* (Lebowitz and Baken, 2011; Flynn, Trudeau and Johnson, 2018), but at time of writing, there do not seem to be any accurate predictors of differing strategies. In terms of acoustics, one theory is that singers in the traditional belt range employ the tactic of aligning F1 to H2 (or sometimes H3) and when moving into the high-belt range align F2 to H2 (or H3) and either tune F1 to H1 or somewhere between H1 and H2. The movement of formants is achieved by making adjustments in the vocal tract, for example, raising the larynx or lowering the body of the tongue results in raising the value of F1 and the value of F2 is related to the size of the space between the back of the tongue and the back of the throat. It is theorised that the values of the higher formants are relational to the positioning and size of the space inside the mouth (adjusted by altering the position of the tongue dorsum, blade and tip) and the size of the mouth opening.

Research suggests that singers often do change projection strategy moving from *low-belt*, typically to C5, into *high-belt* (Roll, 2016; Flynn, Trudeau and Johnson, 2018). It could be considered that the change in strategy is not the result of physiological necessity, and may be related to artistic and stylistic choices. Flynn, Trudeau and Johnson (2018) found one incidence of a singer using the same resonance strategy of peaking H2 for both *low-belt* tasks and *high-belt* tasks, which shows this must be possible in some cases. However, as it was only observed in one subject, this implies that for some singers a change of strategy may be a necessity. This could potentially be due to limits of the maximum value f1 can be tuned to, due to individual physiology. Lebowitz and Baken, (2011) also found that H1/H2 ratio values varied between singers trained by the same voice studio, which could imply that factors outside of training play a role regarding strategy decisions. The acoustic analysis performed by Flynn, Trudeau and Johnson (2018) did use sung excerpts from existing songs, meaning *belt* and *high-belt* examples were not all produced on the same vowel. It cannot be dismissed that the changes in observed strategies may be the result of varying choices in vowel tuning or modification. Another limitation of this study, is that it did not collect any physiological

data, meaning that although one subject did use the same acoustic resonance strategy, they may have used a different laryngeal registration strategy.

Guzman et al. (2014) reported similar findings when investigating reinforced falsetto in male amateur rock singers. Being the only study found that looked at acoustic analysis and resonance strategies in male CCM vocalists singing in the 5th octave, it reported three observed acoustic strategies: bringing F1 and F2 closer together to boost the intensity of H2, using F2 to boost H2 while F1 is above H1 but not near enough to boost it, and using F1 to boost H1. A limitation of this study however, is that it did not control for pitch among the different singers, but this still gives some insight into CCM singing in the 5th octave by male voices. Despite not naming this sound *belt*, the majority of samples reported a boosting of H2 and a relatively weak H1. A later study also observed significantly higher values of subglottal pressure and glottal resistance in reinforced falsetto when compared to “naive falsetto” (Guzman et al., 2019, pg. 1) and it was also noted that reinforced falsetto had more harmonic energy in the 2-5kHz region, an area often noted for carrying increased energy in both belt, classical singing and twang production. Shortening of the vocal tract, very open mouth configuration, wider jaw opening, narrower pharynx, spread lips and high larynx position were also noted during production for reinforced falsetto notes; these observations are also often noted as being present in high-belting. It could be valuable to explore if these sounds could be perceived as belt, when taken outside of the context of rock and metal male vocalists. If it is accepted that there must be a change in either laryngeal mechanism or acoustic strategy when belting above the traditional belt range and into the high-belt range, could it be considered that the only difference between *high belt* and reinforced falsetto may be gender in some circumstances?

Conclusion of Literature Review

As there is still a relatively small amount of literature available it is difficult to pinpoint exactly what *high belt* is. There is disagreement between whether or not it is distinguishable from *mix* and there is no research which includes lower voices or male subjects; although it is possible that some CCM research into male voices singing in *reinforced falsetto* may have been using a sound we would name *high belt* in female singers. This final point is also perhaps relevant to the idea that historically men are usually *mixing* in M1 whereas women are usually *mixing* in M2 (Roubeau, Henrich and Castellengo, 2009).

Methodology

As a pragmatist, I approached this research in a way to bring together both quantitative and qualitative data with a post-positivist approach to the qualitative data. Interview responses were analysed using frequency coding.

Recruitment

A participant group of 8 singers aged 23-43 who were self-described successful high belters were recruited via social media voice interest groups, the researcher's immediate network of singers and the local Manchester area. Participants had to be already capable of producing belt in the high-belt range, be at least 18 years old, and have no history of voice pathology or injury to be included. The demographic information of participants is shown below (see Figure 3).

<u>Singer</u>	<u>Voice type</u>	<u>Age</u>	<u>Gender</u>	<u>Years singing</u>	<u>Experience Level</u>
Subject 1	Mezzo-soprano	23	Cis-female	17	Amateur
Subject 2	Counter-tenor	31	Cis-male	15	Professional
Subject 3	Tenor	26	Cis-male	10	Amateur
Subject 4	Baritone	38	Non-binary (AMAB)	30	Professional
Subject 5	Mezzo-soprano	28	Cis-female	25	Semi-professional
Subject 6	Soprano	32	Cis-female	28	Professional
Subject 7	Tenor	32	Cis-male	20	Semi-professional
Subject 8	Soprano	43	Cis-female	25	Professional

Figure 3. Table showing the demographic information of the singer participant group.

Location

Recordings and interviews were taken in the researcher's home studio in Manchester.

Procedure

Each participant was recorded producing a D5 on an /æ/ vowel in a *belt* voice quality which was then analysed using Estill Voiceprint. Minimal coaching was included as an intervention to promote uniformity in the type of belt sound recorded. The participants also took part in a short semi-structured interview which was audio recorded and then transcribed. Each session took between 30 and 45 minutes in total for coaching, recording and interview.

Recording Protocol

Recordings were taken using a RODE NT1-A Condenser microphone, through a Focusrite ScarlettSolo Interface via a standard XLR cable which was then connected to an iMac via USB cable. Audio samples were recorded directly into the Estill Voiceprint program, rather than saved and then uploaded to minimise the risk of file corruption or compressing. A condenser microphone was chosen, as these are more sensitive than dynamic microphones. However, they can pick up more ambient room sound, so a sound test was done before each recording to find any ambient noise visible on the voice print and any acoustic information below a D5 was disregarded. This was because all participants would be singing this pitch and this study was not investigating subharmonics, therefore no information below this value would be necessary for analysis.

The distance between each participant and microphone was set at 75cm, with a contingency plan to increase the distance in 25cm increments if a recording caused the signal to peak. This was not necessary to do in any of the recordings. The decision of having a longer distance compared to usual guidelines was made to allow the gain settings on both the Focusrite interface and the internal gain setting on Voiceprint to be able to remain the same for each participant. It is noted that a further distance from the microphone will result in more ambient room sound being included in the recording, however, based on the equipment available this approach was pragmatically decided on to produce the most uniform conditions. Additionally, this study is primarily concerned with comparing *belt* samples, rather than defining the acoustics of *belt* itself. With this goal in mind, an accurate replication of the environment and recording protocol from

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participant to participant, is more important than a highly sensitive set-up which would give more precise data for individual samples, but could result in a number of samples becoming unusable.

Coaching Protocol

Each participant was asked how they would usually warm-up to make these types of sounds. The researcher then guided the participant through their warm-up, rather than prescribing warm-up techniques and exercises, to mitigate the risk of influencing their answers later in interview.

For voice safety, and to ensure the participant was starting at a pitch that was comfortable in their range, participants were asked to call out on a vowel of their choice in *belt* quality. This pitch was then identified and used as the starting pitch to begin ascending to the D5. They were then asked to sing an /æ/ vowel in *belt*, either on a pitch-glide over the interval of a 5th, or by hitting and sustaining their starting note, raising semitone by semitone until the required pitch of D5 was reached and the researcher could take a usable recording. An /æ/ vowel was chosen, to promote uniformity and due to the vowel's first formant being close to the H2 of a D5, would make an interesting investigation into the coupling of f1 to H1 or H2 choice.

If the sound needed reshaping, physiological and anatomical descriptions of the co-ordinations desired were not used, so that answers of question 4 (see Appendix B) were not influenced by the coaching. Instead, instructions such as “make the sound brighter”, “make the sound more direct” or “make it more like a yell” were employed.

Interview

The singing participants also took part in a short semi-structured interview which was audio recorded and then transcribed. Demographic questions such as age and gender were included along with industry specific questions such as years of singing experience, self-described voice type and professional level. Questions were pre-written, however the researcher invited participants to expand on answers or clarify points if necessary. (See Appendix B)

Data from the interview answers were processed using a mixed-methods approach, apart from immediately quantifiable data such as age or years' singing. The process for

analysing the qualitative data of Question 4, was to search for common themes which were then coded into quantitative data to investigate potential trends between voice-type and approach. Analysis process was from a post-positivist approach, and used frequency coding to use qualitative data to relate and form theory of any identifiable trends or outliers.

Acoustic Analysis

Using Estill Voiceprint, a spectral analysis software (ESTILL VOICE INTERNATIONAL LLC, 2026) the following data points were gathered.

Formant 1 (f1) tracking

Resonance Peaks

Most intense frequency/harmonic shown on power spectrum

SPL Estimation dB reading

Praat Software was used to estimate the Centre of Gravity as this data point is not available within Estill Voiceprint.

Acoustic Analysis Method

Acoustical analysis was extracted from each sample, using Estill Voiceprint for all tasks other than finding the Centre of Gravity which was completed using Praat Software. The Centre of Gravity was deemed important to look into, as this gives information of where energy is concentrated across the frequency spectrum and is often used as a measure of brightness. The intensity peak nearest to each expected harmonic was recorded. While most research into belting has concerned primarily with the first three harmonics, this study investigated the levels of the first eight harmonics. These were separated into *lower partials* (H1 to H3) and *upper partials* (H4 to H8).

Results

Interview Results and Analysis

Participants' insights on their own approach to high-belting in the experiment were quite varied but there were also many commonalities (see Figure 4).

Approach Answers

Singer	Torso/Body	Mouth/Throat Space	Breath	Vocal fold/larynx specific/register	Mindset	Effort/Engagement	Sound Quality	Miscellaneous
Subject 1	Whole body tensing. Diaphragm engaged.	Open back of throat. High soft palate	Very little breath			Engagement. Quite high effort		
Subject 2	"Tighten the corset". Soft tummy. Anchoring the torso. Shoulder blades down.	Small space at the back of the mouth. Into the back of the head and front of the mouth at the same time. Like a 120 degree angle.		High larynx.	Let the voice lock into place, then keep everything almost still to allow it to stay there.		Let it be yelly and don't worry about it sounding pretty or nice.	Feels like raising the ears.
Subject 3	Engage a lot of abdominal support.		Less airflow despite more pressure.	Quite thin folds. Larynx rising pretty high. Using vocal folds as resistors more so than at a lower pitch.			Masky sort of sound. Twang helps.	
Subject 4	Felt like nothing was coming from the diaphragm (when unsuccessful)	Manipulating the mouth and tongue in different ways to sort of <i>trap</i> the note in belt.			The less in my head I was the more successfully I was. My brain knows it <i>can</i> do it.	Felt like was forcing it out too much. Felt like was forcing it out too much. Pushing. (When unsuccessful)	Hearing the belt and feeling the belt quality at that note.	Sliding up with more freedom helped.
Subject 5	Anchoring	Creating it in the head and neck. Be aware of the velum (keep it high) Wide and up/down.			Don't think about it too much. Trust that it will just do it based on what I've learned and worked on.	Anchoring/Head and neck Anchoring	Start thinking about shouting it out and add from there. Couldn't tell if it was getting a bit nasally.	Singing to the back wall behind.
Subject 6	Stand straight up, legs apart. It's flexible. But for me my relaxed is standing upright but apart.	Opened mouth more to make it sound nicer. It would sound strained if I didn't open the mouth more. Elongating your mouth.		Naturally I'd use my head voice (referring to when not doing this specific more chesty belt sound)			The vowel didn't want to sound nice. Make it strong and powerful.	Climbing on top of the note, especially if sliding.
Subject 7	Sustained by the chest.	Try not to close the throat too much. Middle ground between the classical sound and a more natural sound. Avoid closing or opening too much, and then keep that balance. Keeping the space big enough that it remains controlled, but not so big it no longer has a natural tone.	Try to "push more air out". Having enough air to go through.	Full voice up there feels like a balloon hiss, falsetto feels bigger space/yawny - try to find a middle ground between the two. Feels like chest voice if I get it right.	Try not to worry. If I worry the throat closes up.		Taking full voice higher. Try to not make it sound too stretched or just doing a head voice that sounds like a bell.	Easier to go up slower rather than jumping straight up.
Subject 8	Right from the core.		Put a good breath behind it. A deep breath. Belly air. It looks like "gestures to belly expanding".		Clear my mind in a split second and just go for it with a good breath behind.			

Figure 4. A table of categorised interview responses of each Subject's specific approach to *high-belting*

Seven of the eight subjects made references to alignment and engagement in the torso.

"Anchoring" was mentioned by two subjects, and being "upright with legs apart" was referred to by Subject 6, a professional soprano. The diaphragm was mentioned by two

subjects, abdominals were mentioned by three, one referring specifically to “abdominal support”, another subject referred to “tightening the corset” and another speaking of the importance of “the core”. Six subjects made references to the space in the mouth and throat with varying explanations. Subject 1, an amateur mezzo-soprano, spoke about the sensation of “opening in the back of the throat”; whereas Subject 2, a professional countertenor, referenced the feeling of a “small space at the back of the mouth”. Subject 7, a semi-professional tenor, mentioned finding a “middle ground” between “opening or closing too much” in the throat. A high soft-palate/velum was mentioned by Subjects 1 and 5. It may be possible that the seemingly contradictory reports are related to each singers’ *neutral* state of singing. If it can be assumed that adjustments in the space at the back of the mouth are necessary to tune voice formants, a singer who more categorically uses a higher velum position may not need to adjust the velum greatly, experiencing the change as creating a smaller space. Conversely, a singer who perhaps does not use as high a velum for most of their singing, may feel a larger space being made, as levator palatini and tensor palatini engage to raise and tense the allowing the tongue to pull back slightly via the palatoglossus muscle.

Only four subjects made references to breath strategies, with little consistency in their responses. Subject 8, a professional soprano, mentioned a “deep belly breath” whereas Subject 1 stated they use “very little breath”. An interesting insight from Subject 3, an amateur tenor, was the feeling of “less airflow despite feeling more pressure”, whereas Subject 7, a semi-professional tenor, stated they “try to push more air out”, these contrasting insights may be related the differing tactics of boosting source energy. Perhaps Subject 3 had a tactic of increasing resistance at vocal fold level by adducting the vocal folds with more effort, and Subject 7 employed a tactic of increasing subglottic pressure by engaging abdominal effort.

A high larynx was referenced by two subjects Subject 2 & Subject 3, both lower-voices, likely related to raising F1, as both subjects aligned F1 to H2 and registration/vocal fold mass was referenced by three subjects. One stated that their folds are quite thin, and are used more as resistors to the airflow than would be at lower pitches. Subject 6 mentioned that usually they would use their “head voice” but to achieve this more robust belt they had to “open their mouth more” to remain in “chest voice” without “straining”, this may be related to raising F1. Another stated that high belting “feels like chest voice if I get it

right”, and stated that “full voice up there feels like a balloon hiss, falsetto feels yawny” and they had to find the right balance for it to feel like chest voice.

There was more agreement between subjects on the importance of mindset. Five of the eight subjects made comments relating to mindset and psychology, all referring to the importance of allowing the sound to happen; with responses including “clear my mind in a split second and just go for it”, “don’t think about it too much and just do it”, “if I worry, the throat closes up” and “let the voice lock into place, then keep everything still”.

Six subjects made references to the sound quality with statements relating more to speech like productions, such as “let it be yelly”, Subject 5, a semi-professional mezzo-soprano said they “think about shouting it and add from there”; Subject 3, to referenced brightness and resonance with comments such as “masky sort of sound. Twang helps”, Subject 7 mentioned “doing a head voice that sounds like a bell” which could be related to switching from M1 to M2 but adjusting the acoustic projection strategy.

Figurative imagery was reported by four subjects, Subject 2 mentioned the feeling of “singing into the back of the head and the front of the mouth at the same time. Like a 120 degree angle”, Subject 5 spoke of “singing to the back wall behind” them, while Subject 6 said the idea of “climbing on top of the note” was important.

Comparing responses to demographic data and variables, there did not appear to be any strongly identifiable relationship. Both subjects who mentioned a high larynx were lower-voices, however neither of the other two lower-voices reported being aware of a high larynx. Additionally, the two subjects who referred to a high-velum were higher-voices.

Analysis of Acoustic Results

None of the eight samples had H1 being the most intense harmonic. This finding was to be expected and matches findings in other experiments (Flynn, Trudeau and Johnson, 2018). The intensity values for each harmonic subject to subject varied, but some trends were identified (see Figure 5).

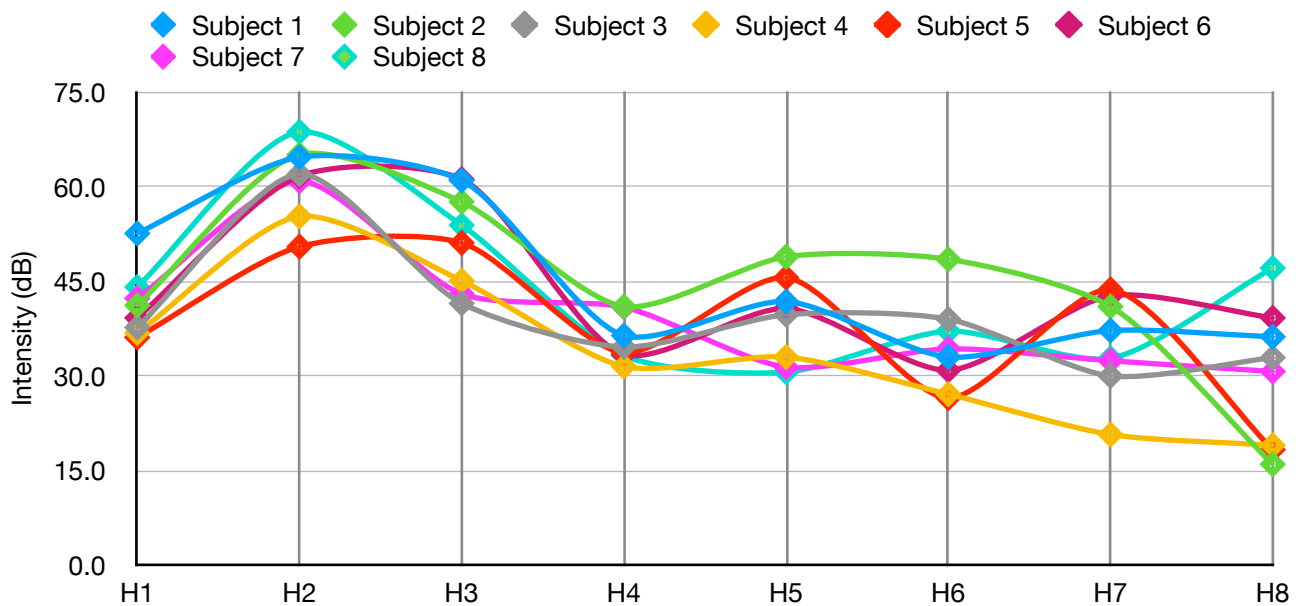


Figure 5

All singers appeared to boost intensity at both H2 and H3, and have a drop in intensity at H4. All singers also appeared to then boost at least one other harmonic in the *upper partials* area of the spectrogram. Some singers showed a more *flat* profile in the *upper partials* whereas others appeared to boost specific harmonics and allow others to sharply drop.

Five of the eight samples showed an alignment of f1 to H2, the other three aligned f1 to H1. There was no clear relationship between gender and choice of f1 tuning (see Figures 6, 7, 8 & 9), however there appeared to be a relationship when controlling for voice type (see Figure 10 & 11).

The Centre of Gravity of each sample was recorded, as well as Estimate SPL, however these measures did not seem significant in this experiment and thus were disregarded.

f1/H1 Alignment

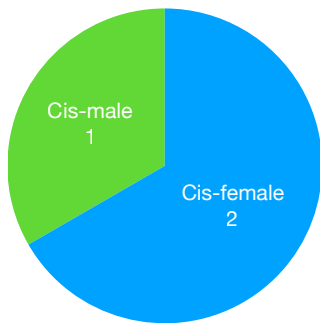


Figure 6. Pie Chart showing f1/H1 alignment by gender

f1/H2 Alignment

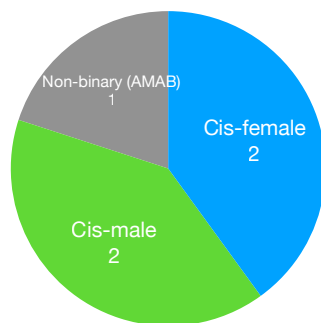


Figure 7 Pie Chart showing f1/H2 alignment by gender

f1/H1 Alignment

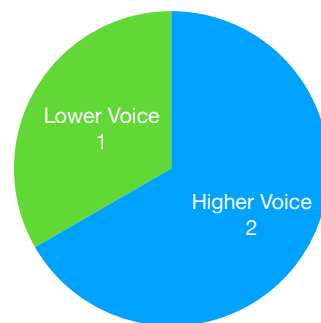


Figure 8 Pie Chart showing f1/H1 alignment by Lower or Higher Voice

f1/H2 Alignment

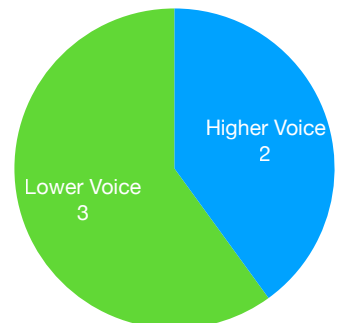


Figure 9 Pie Chart showing f1/H2 alignment by Lower or Higher Voice

f1/H1 Alignment Group by voice type

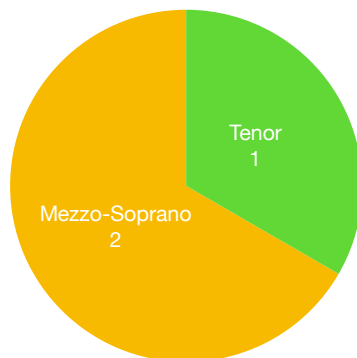


Figure 10

f1/H2 Alignment Group by voice type

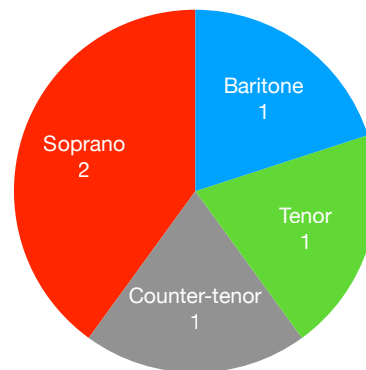


Figure 11

All sopranos tuned their f1 value to H2 whereas all mezzo-sopranos tuned f1 to H2. Due to the small sample size of this study, further research is needed with a larger population to draw conclusions, however, this is interesting when exploring the claim of whether or not high-belting is only possible by sopranos. If the claim that f1 must be aligned to H2 is accepted, and it is taken into account that all research into high-belting has been on female voices, this data supports the claim that only sopranos are capable of high-belting (within the context of higher-voices).

While there were differences in the formant tuning strategy, all samples had H2/H1 ratios >1, with a mean of 1.49 and range of 1.23-1.64. H3/H1 ratios were also >1 in every sample, with a mean 1.25 and range of 1.02-1.56 (see Figure 12).

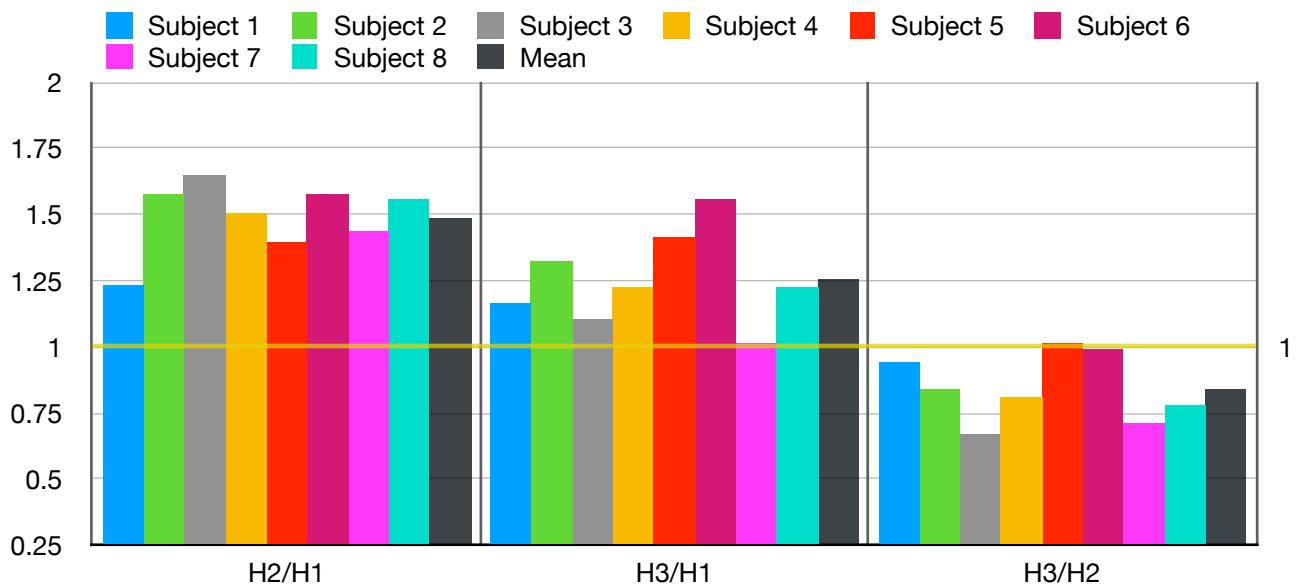


Figure 12. Ratios of H2/H1, H3/H1 and H3/H2 of each singer's sample, including mean for each pairing.

Investigating resonant strategies higher in the spectrum revealed interesting areas of note. While all eight subjects employed resonance strategies to boost H2 and H3, with some also boosting H1, a variety of resonant strategies were observed in the upper-partials, defined by the researcher as H4 to H8. The derived resonance strategies are shown in the table below (see Figure 13).

	H1	H2	H3	H4	H5	H6	H7	H8
Subject 1	Green	Green	Green	Dark Grey	Green	Dark Grey	Green	Green
Subject 2	Dark Grey	Green	Green	Dark Grey	Green	Green	Green	Dark Grey
Subject 3	Dark Grey	Green	Green	Dark Grey	Green	Green	Dark Grey	Green
Subject 4	Dark Grey	Green	Green	Dark Grey	Green	Dark Grey	Dark Grey	Dark Grey
Subject 5	Green	Green	Green	Dark Grey	Green	Dark Grey	Green	Dark Grey
Subject 6	Dark Grey	Green	Green	Dark Grey	Green	Dark Grey	Green	Green
Subject 7	Green	Green	Green	Green	Green	Green	Dark Grey	Green
Subject 8	Dark Grey	Green	Green	Dark Grey	Dark Grey	Green	Dark Grey	Green

Figure 13. Table showing the resonance strategies of each subject.

Green filled cell = Boosted harmonic

Dark grey filled cell = Harmonic not boosted

The effect that these derived strategies had on the intensity of harmonics is shown below (see Figures 14-18). Focusing solely on the upper partials, seven of the eight subjects boosted H5, which would have been around 3kHz, a frequency in the centre of the often mentioned singers' formant (Ma. Ángeles Triana-Pascual, García-López and Gavilán-Bouzas, 2023). Four out of the eight subjects boosted H6 (around 3.5kHz), four out of eight subjects boosted H7 (around 4kHz) and five of the eight subjects boosted H8 (around 4.6kHz). Two subjects did not boost any consecutive harmonics in the upper partials, instead opting for what could be described as a *one on, one off*, strategy (Subject 5 and Subject 8); however they chose to boost different harmonics. H5, H7 and H6, H8 respectively. Other subjects appeared to boost consecutive harmonics, including one subject who seemed to group resonances and boost three consecutive harmonics - H5, H6 and H7 (Subject 2). The observation of such varying results, supports the literature that there are likely a number of strategies that make high-belted possible.

Subject 5
Strategy 1

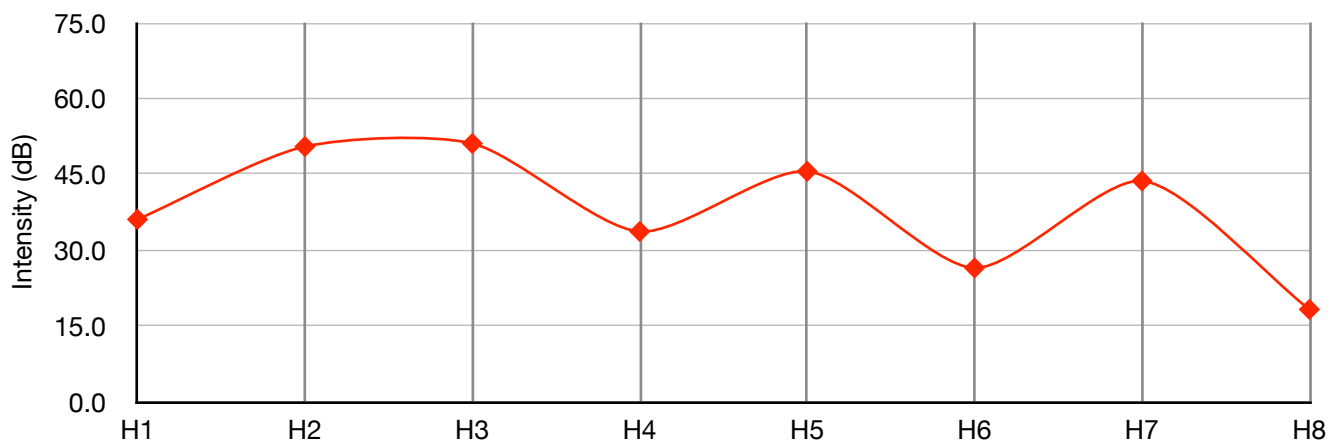


Figure 14

Subject 1 Subject 6
Strategy 2

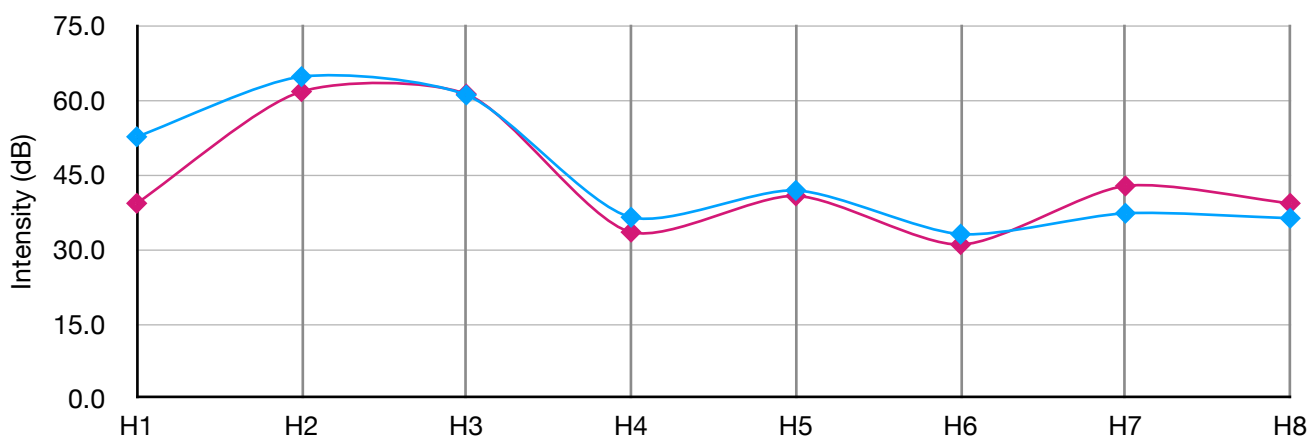


Figure 15

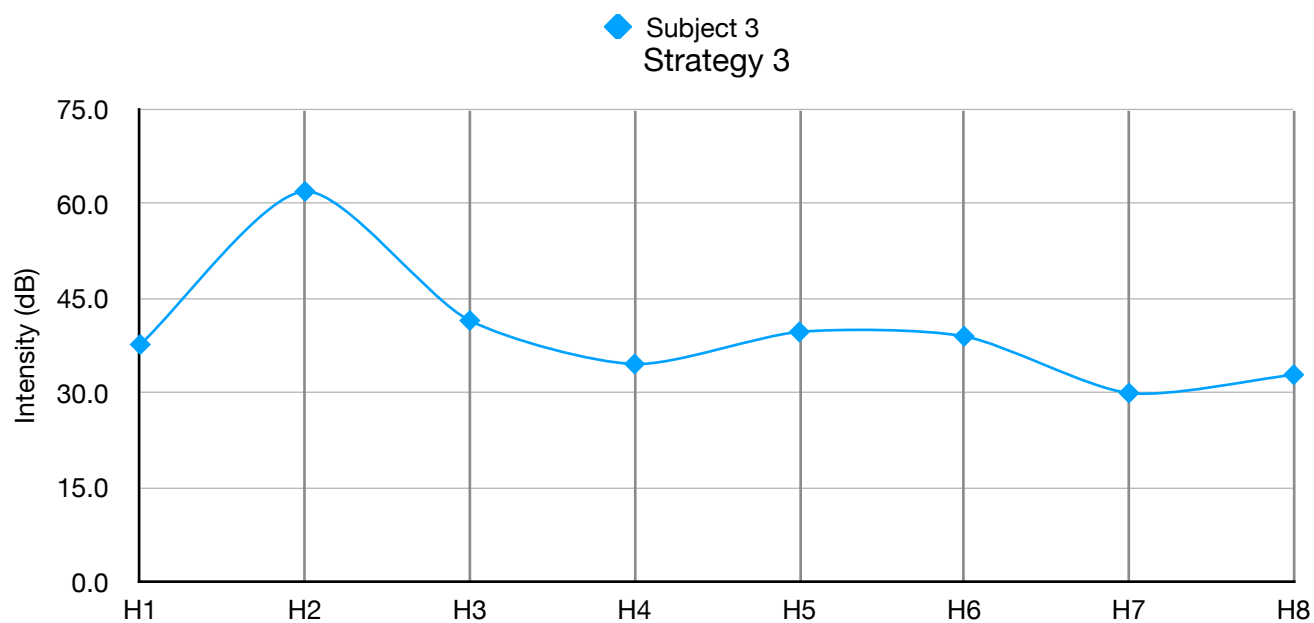


Figure 16

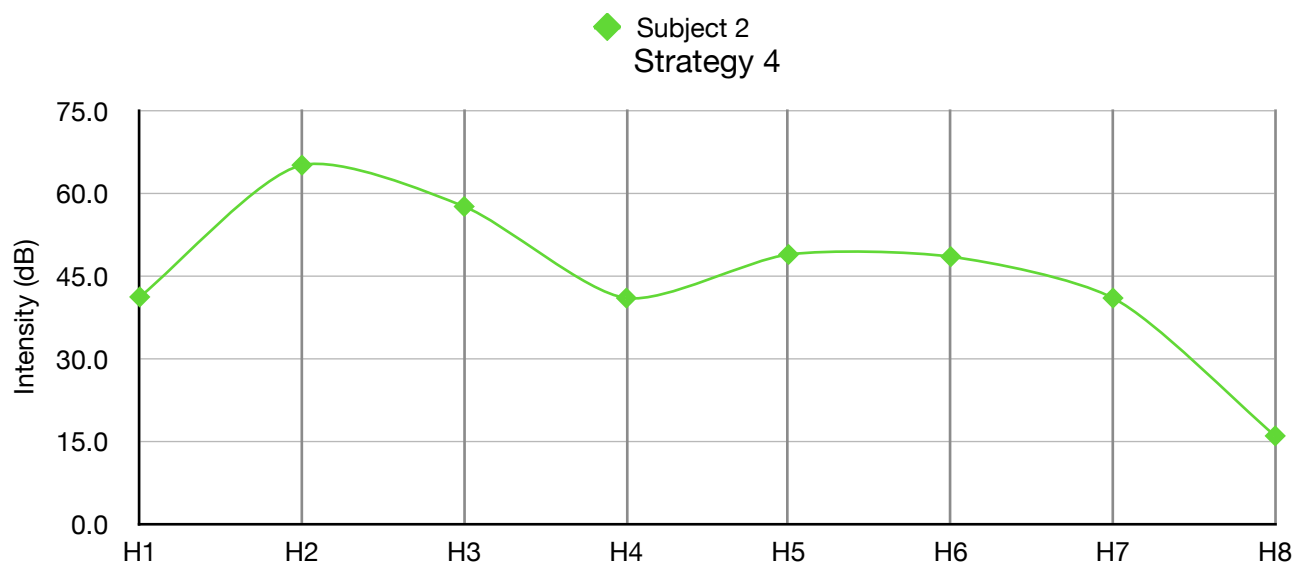


Figure 17

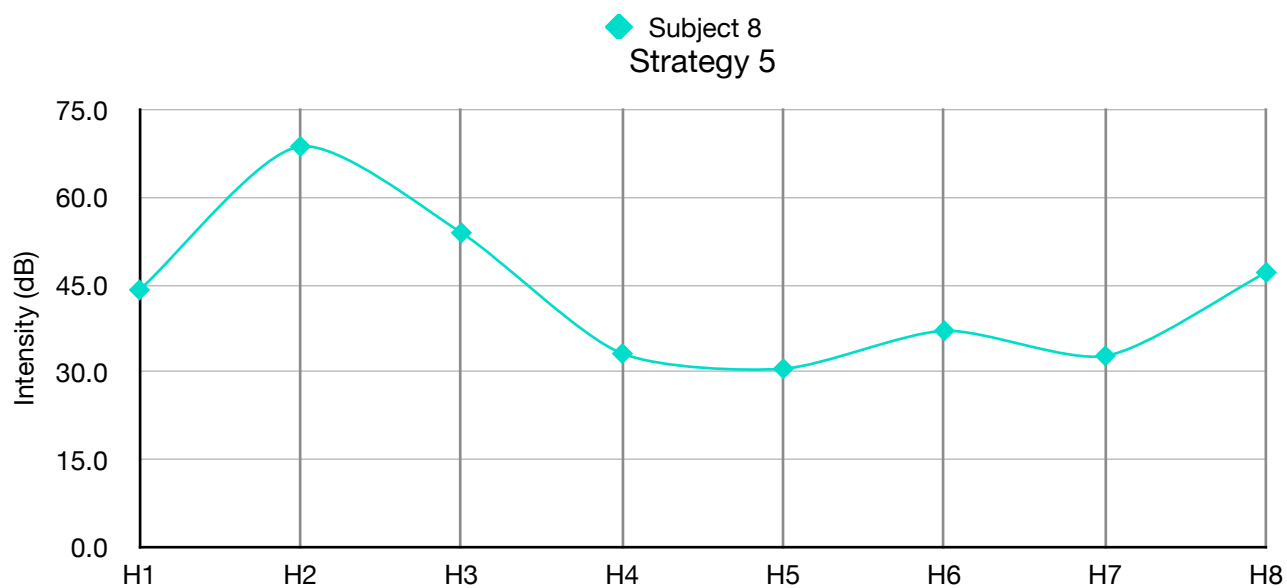


Figure 18

Of the subjects who boosted consecutive harmonics in the upper partials, Subjects 2, 3 and 7 coupled H5 and H6; Subjects 1, and 6 coupled H7 and H8. Subjects who coupled H5 and H6 were all lower-voices, compared to who coupled H7 to H8, who were higher-voices. This insight warrants further investigation with a larger sample size to see if the trend appears outside of this experiment, but it may suggest that the choice of which harmonics to couple may be influenced by voice type. It may also be worth noting that Subject 2, who was the only subject to boost H5, H6 and H7 was a countertenor, however it is important to not drawing conclusions relating to voice type not only due to the small sample size but also due to voice type being self-reported with no measurable metric in this experiment.

Subject 7 appeared to boost all harmonics except H7, despite not seemingly having a large amount of intensity in the upper partials. It is possible this result was caused by an issue in recording or acoustic analysis process, as this would imply the singer had the ability to manipulate their vocal tract in such a way that they had created 7 distinct areas of resonance (six of which being consecutive harmonics). While perhaps not impossible, upon closer inspection, and speculation, it seemed more likely that the singer was very quickly alternating between boosting H4 and H5. Subject 7 did in interview, however, mention a number of times the importance of finding the “middle ground”, perhaps this moving resonance alignment was a manifestation of that idea.

One subject (Subject 4) did not appear to employ an efficient resonance strategy in the upper partials, only causing a slight boost around H5, but did have a clear strategy of boosting H2 and H3 (see Figure 19).

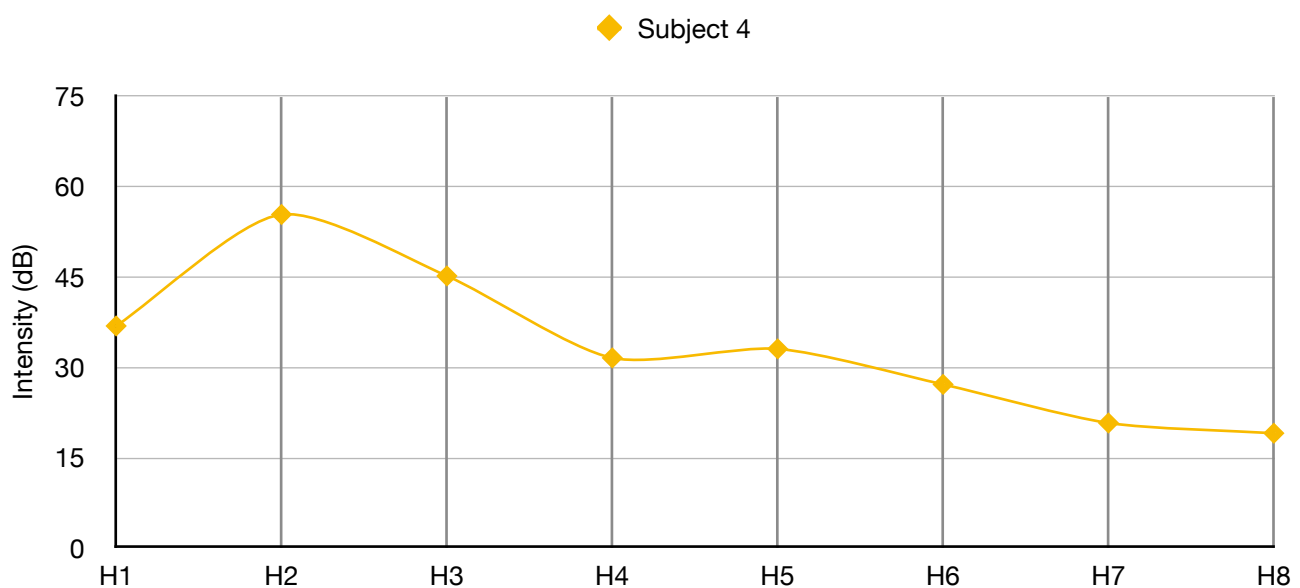


Figure 19

This singer was the only baritone in the group which may be significant, however due to the limited sample size further research is required to reach such a conclusion.

Discussion

The results of this small study appear to support the literature in the claim that there are indeed a variety of strategies that make high-belt possible, and I believe this small sample has shown that it is not only sopranos that can access effective strategies for producing high-belt. The results of this experiment, cannot really answer the question of whether acoustic strategies are voice-type or gender dependent, but it has revealed certain strategies that appear to not be gender dependent. For example, the strategy of aligning f_1 to H_2 was observed in cis-women, cis-men and non-binary subjects - relating this to voice type, the same strategy was observed in higher and lower voices. This is interesting as it is likely assumed that lower voices would tune f_1 to H_1 at these higher pitches, however in this experiment more lower-voices than higher-voices opted to align f_1 to H_2 . If we use this definition of belt, then the debate seems settled that it is not only sopranos who can produce belt in the high-belt range.

If this is true, then a case could be made that all voices can learn to high-belt. This could be incredibly valuable for voice training, especially as the vocal demands of the gigging CCM vocalist or contemporary musical theatre singer/actor are evolving. It also brings to light the possibilities that may be available for each individual singer, allowing a change in perspective rather than coaching a singer based on the sounds we imagine them capable of due to how their voice type is perceived.

It is possible that this shows the need for further research into the area which includes a wider-range of voice types. This research could further knowledge into whether differences in acoustic strategy are indeed voice type dependent or whether they are the result of training, however in order the question that we would need to question whether voice type is the result of training.

Limitations

It cannot be understated that the room was not soundproofed or acoustically treated, meaning results from this experiment may have been affected by ambient sound and resonant frequencies of the room itself. Whether or not a sound was deemed *belt* was purely the decision of the participant and the researcher. Initially there was intent to

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complete a blind listening test with a number of voice teachers experienced in teaching belt, however, due to time constraints, this task could not be completed.

Conclusion

A number of strategies are possible to produce high belt. While limited by a small sample size, this study indicates that formant tuning strategy of f1 to either H1 or H2 may not be voice type dependent as both configurations were seen in higher and lower voices. This research highlights several areas for further investigation, particularly the degree of which these varying strategies are perceptible by a listener. As mentioned, this experiment initially planned to collect listener data, and this would have been an invaluable additional set of data. One potential future experiment could be providing expert listeners with a variety of *belt* examples and have them order them from most *belt-like* to least *belt-like* to see if there are any predictable correlations between spectrographic information and perceived *beltiness*.

Further research is needed exploring high belting across different genders and voice types, due to the nature of this small study, a limitation is the small number of participants and population to further explore the ideas of this research project.

A follow-up experiment, with a larger population focusing solely on higher-level singers may be useful, in understanding whether the theorised projection strategies are influenced by voice-type or gender may be useful. Flynn, Trudeau and Johnson (2018), make similar recommendations in the importance of using elite-level singers for research exploring *high-belt*.

In terms of my own personal and professional development, this project was an opportunity to sharpen skills required to work at a higher level of professional practice. I believe I have improved my skills in literature review, specifically in comparing and contrasting existing literature and relating conclusions from existing literature to the context and axioms in which the research was conducted in. I believe I was successful in following standard practice - to the best of my ability based on the equipment and space available to me - in recording audio for acoustic analysis; while highlighting areas that would have made this experiment more rigorous if improved. While later interview were more rigorous than earlier interviews, this perhaps shows that I was learning and adapting through the process in how to position myself as a more thorough interviewer. This

process alongside the process of managing participants gave an opportunity to further develop my professional communication skills. One key area to develop in relation to conducting high quality interview research is to have questions very well defined. For example my question of “How long have you been singing?” often had to be clarified to research participants as it was unclear whether I meant when did they start practicing as singers compared to when they began working professionally or when did they become *serious* about their singing.

From the outset, I foresaw time management as being a potential challenge, and there were indeed challenges related to time management. As a disabled and neurodivergent person, this is an area necessary for further development in order to have realistic expectations in what is possible to do in a given amount of time.

Reference List

Echternach, M., Popeil, L., Traser, L., Wienhausen, S. and Richter, B. (2014). Vocal Tract Shapes in Different Singing Functions Used in Musical Theater Singing—A Pilot Study. *Journal of Voice*, [online] 28(5), pp.653.e1–653.e7. doi:<https://doi.org/10.1016/j.jvoice.2014.01.011>.

ESTILL VOICE INTERNATIONAL LLC (2026). Estill Voiceprint Plus (w/ Figure Recordings & Testing Protocol). [online] Estill Voice International LLC. Available at: https://store.estillvoice.com/products/voiceprint?_gl=1 [Accessed 14 Jan. 2026].

Flynn, A., Trudeau, J. and Johnson, A.M. (2018). Acoustic Comparison of Lower and Higher Belt Ranges in Professional Broadway Actresses. *Journal of Voice*, 34(3). doi:<https://doi.org/10.1016/j.jvoice.2018.10.006>.

Guzman, M., Acevedo, K., Leiva, F., Ortiz, V., Hormazabal, N. and Quezada, C. (2019). Aerodynamic Characteristics of Growl Voice and Reinforced Falsetto in Metal Singing. *Journal of Voice*, 33(5), pp.803.e7–803.e13. doi:<https://doi.org/10.1016/j.jvoice.2018.04.022>.

Guzman, M., Barros, M., Espinoza, F., Herrera, A., Parra, D. and Lloyd, A. (2014). Resonance Strategies Revealed in Rock Singers during Production of High Notes. *Journal of Singing*, 71(2), p.183.

Lebowitz, A. and Baken, R.J. (2011). Correlates of the Belt Voice: A Broader Examination. *Journal of Voice*, 25(2), pp.159–165. doi:<https://doi.org/10.1016/j.jvoice.2009.10.014>.

Lee, Y., Oya, M., Kaburagi, T., Hidaka, S. and Nakagawa, T. (2021). Differences among mixed, chest, and falsetto registers: A multiparametric study. *Journal of Voice*, [online] 37(2). doi:<https://doi.org/10.1016/j.jvoice.2020.12.028>.

LoVetri, J.L., Chmela, A., Coccoziello, J. and Vaughan, M. (2021). A Demographic Study of Professional Belters: Who They Are and What They Do. *Journal of Voice*, 38(2). doi:<https://doi.org/10.1016/j.jvoice.2021.09.019>.

Ma. Ángeles Triana-Pascual, García-López, I. and Gavilán-Bouzas, J. (2023). Quality of the singing voice in sopranos. Influence of the text and the musical accompaniment in the opera singing. *Acta Otorrinolaringologica (english Edition)*, 74(3), pp.160–168. doi:<https://doi.org/10.1016/j.otoeng.2023.05.002>.

Roll, C. (2016). The Evolution of the Female Broadway Belt Voice: Implications for Teachers and Singers. *Journal of Voice*, 30(5), pp.639.e1–639.e9. doi:<https://doi.org/10.1016/j.jvoice.2015.07.008>.

Roubeau, B., Henrich, N. and Castellengo, M. (2009). Laryngeal Vibratory Mechanisms: The Notion of Vocal Register Revisited. *Journal of Voice*, 23(4), pp.425–438. doi:<https://doi.org/10.1016/j.jvoice.2007.10.014>.

Saldias, M., Guzman, M., Miranda, G. and Laukkanen, A.-M. (2019). A Computerized Tomography Study of Vocal Tract Setting in Hyperfunctional Dysphonia and in Belting. *Journal of Voice*, 33(4), pp.412–419. doi:<https://doi.org/10.1016/j.jvoice.2018.02.001>.

Sundberg, J. and Thalén, M. (2015). Respiratory and Acoustical Differences Between Belt and Neutral Style of Singing. *Journal of Voice*, 29(4), pp.418–425. doi:<https://doi.org/10.1016/j.jvoice.2014.09.018>.

Sundberg, J., Thalén, M. and Popeil, L. (2012). Substyles of Belting: Phonatory and Resonatory Characteristics. *Journal of Voice*, 26(1), pp.44–50. doi:<https://doi.org/10.1016/j.jvoice.2010.10.007>.

Appendices

Appendix A

Participant Information Sheet and Consent Form

Participant Information and Consent Form

14/01/2026, 18:02

Participant Information and Consent Form

My name is Ashleigh Dowler and I am a Masters student at Voice Study Centre studying a Masters Degree in Voice Pedagogy, accredited through University of Wales Trinity Saint David (UWTSD). I also am a professional voice teacher, teaching sung and spoken voice with a specialism in CCM (Contemporary Commercial Music - pop/rock/soul/rnb/musical theatre modern styles) singing.

I am looking for approximately 20 singers of all genders and voice types who can belt in the high belt range (above C5), to take part in a research study investigating high belting across different voice types and singers. This project has undergone ethical review by the panel at UWTSD.

If recruited, you will be recorded belting a D5 on a given vowel. Coaching will be included as part of this process to ensure all singers are producing the same type of perceived belt sound. These recordings will then be analysed using acoustic analysis software to gain a deeper understanding of how different voice types produce belt, and audio recordings will be sent anonymously to a group of listeners to gain insights on the perception of the sounds. You will also take part in a short interview which will be recorded and transcribed then deleted following transcription.

While the researcher is an experienced voice teacher you will be responsible for your own vocal health therefore I am only considering participants with no history of vocal pathology, already capable of belting notes above a C5. I am particularly interested in recruiting singers who are assigned male at birth and underwent testosterone driven puberty.

You will be required to attend a minimum of one in-person session in Central Manchester to contribute to the study, the total time for participation shouldn't exceed two hours. All data collected will be held and processed in accordance to [GDPR](#) and will be deleted upon completion of the research project.

Participation is voluntary and no negative consequences will happen by refusing to participate, you may withdraw your consent and end participation in the study at any time. If you choose to do this all data will be destroyed in accordance to GDPR.

If you have any questions email me at ashleigh.dowler@hotmail.co.uk or my supervisor Louisa Morgan louisa@voicestudycentre.com

You may also request copies of the study and any reports or publications arising from your participation. And are welcome to request a debrief email at the conclusion of the research.

<https://docs.google.com/forms/u/1/d/11Rqu5dw3Avf8tmzRb9QR2Kt53tvyT1hx3lwiR7ATWIA/printform>

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Thank you for considering taking part in this exciting research project.

* Indicates required question

1. Email *

2. I have read and understood the information above. *

Mark only one oval.

- ☐ Yes
☐ No

Consent Form

3. Name *

4. Email *

5. I consent to taking part in this research project *

Mark only one oval.

- ☐ Yes
☐ No

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10. I consent to having my voice recorded and shared securely and anonymously with a listener group.

Mark only one oval.

- ☐ Yes
☐ No

11. I consent to having my interview recorded for transcription purposes only. *

Mark only one oval.

- ☐ Yes
☐ No

12. I am able to attend an in-person session in Central Manchester (M1 postcode) *

Mark only one oval.

- ☐ Yes
☐ No

13. I consent to being contacted by email for matters directly relating to my involvement in the study.

Mark only one oval.

- ☐ Yes
☐ No

14. Do you have any access needs that the researcher should be made aware of in order for you to easily participate in this study?

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6. I understand I may withdraw my consent and leave the research study at any time, without negative consequences. And if I choose to do this all data contributed will be deleted.

Mark only one oval.

- ☐ Yes
☐ No

7. I understand I can refuse to answer any question or complete any task during the research project without negative repercussions.

Mark only one oval.

- ☐ Yes
☐ No

8. I have read and understood the nature and purpose of the study, and have had the opportunity to ask questions or request clarity.

Mark only one oval.

- ☐ Yes
☐ No

9. I understand all data I provide for the study will be processed to ensure my identity remains anonymous, unless I disclose information that puts myself or others at risk of harm, in which case the researcher will have to report this to relevant authorities.

Mark only one oval.

- ☐ Yes
☐ No

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15. Please type your name to electronically sign. *

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Appendix B

Semi-structured interview questions

Each interview began with an interview briefing explaining that the interview was semi-structured, the interviewer may ask for further details or ask additional questions if a response prompted, and that participants were able to decline to answer a question for any reason. Participants were also told they could ask for clarity on any questions and could request member checking to ensure they were happy with recorded responses.

1. What is your age?
2. How would you describe your gender?
3. How would you describe your voice type?
4. Could you describe your specific approach to belt the top note on this vowel?
5. How long have you been singing?
6. Would you describe yourself as an amateur, semi-professional or professional singer?

Appendix C

Transcripts of participant Interviews.

Subject 1 Interview Transcript:

AD: Right, okay. Question one. What is your age?

S1: (whispers/laughs) 23.

AD: *laughs* That's okay.

S1: 23, yeah.

AD: Cool. And question two, how would you describe your gender?

S1: Female and I identify as what I was born as as well.

AD: Okay. So, that's cis-female?

S1: Yeah.

AD: Yeah. Um. How would you describe your voice type?

S1: Um.. Powerful...

AD: Okay.

S1: But I I couldn't tell you like, the whole "alto" thing. I feel like I've asked you multiple times and I never remember. But I just say I'm quite a belter.

AD: Yeah.

S1: Generally, my voice is quite loud. Just speaking even.

AD: If you were going to say, erm, one of those categories, and it's okay if the answer is no, one of those categories from Alto, Soprano, Mezzo Soprano, could you kind of put yourself into one of those or guess at one of them?

S1: Could you give me like the range and I feel like it's a.

AD: Yeah, so like alto would be the lowest, Mezzo soprano is the sort of middles and then sopranos are other highest of the high singers.

S1: Mezzo Soprano?

AD: Sure, yeah.

S1: Potentially? Yeah. Put me in the middle.

AD: Cool. Okay, could you describe your specific approach to belt the top notes of that vowel.

S1: Well, engagement is one thing I've really had to use, kind of like thin like my whole body's tensing for it. Erm, opening the back of my throat. I'd say it was quite high, so I'd say my soft palate was quite high as well. Erm... little breath, very little breath. And I felt like my diaphragm was really engaged for it out of everything else. Yeah.

AD: Okay, good. How long have you been singing?

S1: My whole life, I'd say, from when I can ever remember. So probably since, like, five years old. Yeah, it's a long time.

AD: Good, and would you describe yourself as an amateur, semi professional, or professional singer?

S1: I'd still say amateur, yeah.

Subject 3 Interview Transcript:

AD: So. First question is, what's your age?

S3: I'm 26.

AD: And question two, how would you describe your gender?

S3: Male.

AD: And would that be cis-male?

S3: Yes.

AD: And how would you describe your voice type?

S3: Tenor.

AD: You could expand on that as well, if you like.

S3: Tenor... erm... Baritone in some situations, perhaps? I don't think I've got the speaking quality of a tenor necessarily.

AD: OK, could you describe your specific approach to belt the top note on that vowel?

S3: Uh, I.. I think have to engage a lot of abdominal support, as well as using quite thin vocal fold structure. Sort of raising the larynx pretty high. And, I think focusing on sort of a forward, *masky* kind of sound. And I think twang helps as well... Is there anything else useful? Um... I think it's less air flow despite more pressure. And I think, yes, I'm using the kind of larynx, or the kind of vocal cords as resistors to that air flow... more so than I would at a lower pitch.

AD: Okay, good. Nice. Anything else before we move on? That was - that was enough by the way, I'm not saying to really rack your brain to find an answer, but I don't want to skip over in case you're then like, "oh, wait, I meant to say this."

S3: Sure, yeah. I think that'll do, yeah, I'll come back to if I think of anything else.

AD: Cool. Perfect. How long have you been singing?

S3: Um.. On and off for... How are we defining singing?

AD: Oh, I guess I would say, when did you... Yeah, when did you start, I guess?

S3: Probably when I was... 9 or 10. 9 or 10 is the beginning of the informal kind of stage. 19 is when start taking it a little bit more seriously. And then in the last year or so, is when I've been taking it more seriously.

AD: And would you describe yourself as an amateur, a semi professional or a professional singer?

S3: Amateur.

AD: Okay, cool, good.

Subject 4 Interview Transcript:

AD: So first question is, what is your age?

S4: 38. As of a week ago! (Laughs)

AD: How would you describe your gender?

S4: Non-binary, but leaning towards masc at the moment.

AD: And, how would you describe your voice type?

S4: Baritone. Um. never been asked that question before.

AD: That's fine. You can expand on it as well.

S4: Yeah, as in just, casually? Colloquially? Voice quality?

AD: Yeah, so in terms of like range-wise, as you've just said, baritone, but also, yeah, what, how would you describe that

S4: Baritone, quite often get placed in tenor roles, so maybe I'm just lazy. I have quite a smooth vocal, I feel. Soulful I've been told. So it lends itself to R&B to soul and the pop end of that as well. Yes, it's quite resonant thing, of sorts. Um, when I'm being silly and I want to, my falsetto was improving. So I can get up to the heavens, whether it... (laughs) whether I should or not. But yeah, generally more comfy as a baritone.

AD: Cool, um. Right. Could you describe your specific approach to belting the top notes that we just did there? on that vowel..

S4: Erm... It just in my own words.

AD: Yeah, yeah.

S4: None technical is the word that's keeps - is in my brain at the moment. Forcing the note out. Pushing is a word I would use... and closing off my throat. And so it felt like my brain was getting in the way of the belt.. I didn't feel like I was supporting my voice with my breath as I would like to. There's nothing felt like it was coming from the diaphragm. It all felt back it was coming from my chest up. The slide was very helpful to get there. So, yeah, I think technique and what I like to hear probably got in the way of making the note, if that makes sense? So... yeah...

AD: Cool, yeah.. Could you could you describe... So that's really useful for describing what was difficult, you know, and like kind of like what wasn't working.

S4: Oh yeah, yeah.

AD: Can you describe the, so the final couple where were we were getting there? How could you describe what your, yeah, the sort of the same question, but thinking about the successful attempts. Like what, yeah, like what, what was your approach times?

S4: Yeah, sliding up and also er,... How do I even describe this? You... I guess... manipulating my mouth and my tongue in different ways to achieve the note in belt, sort of it was trapped in my mouth at that point. I don't know the terms, but it was like... okay, I'm hearing the belt and feeling the belt quality at that note. So now my brain knows it *can* do it. So then sliding the next time, there's a bit more freedom to then get to the note. It really felt like my head was in the way apart from my voice. And so the less my head was in it, the more successful I was. If that makes sense?

AD: Okay, um, how long have you been singing?

S4: Like professionally, since 2013? So what's that, 12?

AD: That's 12 years.

S4: Yeah, 12 years. But I grew up in church, so and I was a musician in church, I've been singing all my life, in public, if that makes sense? Probably like on stage since about the age of 9 or 10, using my voice.

AD: So if I put like 30 plus years for singing? And then professionally for 12 years.

S4: Yeah, yeah.

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AD: And I guess that answer's my final question as well, which is, would you describe yourself as an amateur, semi professional or professional singer?

S4: Professional. People pay me the money! Hehe.

AD: Okay, good. Thank you. And then that's done.

S4: Cool!

Subject 5 Interview Transcript:

AD: And our first question is, what is your age?

S5: 28.

AD: Question two, how would you describe your gender?

S5: Female.

AD: And would that be, cis-female?

S5: Oh, yeah.

AD: And how would you describe your voice type?

S5: Am I allowed to say, classical mezzo. Otherwise soprano.

AD: Yeah, yeah, yeah. You can expand on that as well, if you'd like.

S5: Yeah, cool.

AD: Right, could you describe your specific approach to belt the top notes, using that vowel?

S5: In general? Well, I guess I can answer it in any way I want! Start off, think about what it feels to shout at. Then try an add on from there... So anchoring, head and neck, anchoring, I'll try and be aware of the velum, but I could tell that I was getting a bit *nasaly* which is ideal. Space...

AD: Could you elaborate a little bit on space? Like what that means.

S5: That's what I'm trying to think yeah.. I'm not sure, I was used to think it was wide, but I think I'm changing my mind on that. So wide and up/down.

AD: And with wide and up and down, could you explain that to me a little bit more? I don't mean in terms of physiology, for example, but more like the sensations.

S5: Erm... the... you know, hitting the the back wall, type of thing.

AD: Is that like of the head?

S5: Even further, like singing to the back wall of the room.

AD: Ah, okay, yes, yeah! Anything else?

S5: Not that I can think of.

AD: It's okay. Yeah, and if afterwards you think of anything, you know what I mean? Like, "oh, actually this" can we can jump back to it.

S5: To be honest, I don't feel like I think about it that much, I feel like I... as you're teaching, I try and think about every little thing, and then when I do it, I don't know, I kind of want to trust that the things that I've learned and worked on, will just kind of do it.

AD: Yeah. Cool. And how long have you been singing?

S5: Yes, as long as I can remember. Um,

AD: So, if I was gonna say, um, so 25 plus years

S5: Yeah, yeah, that'd be right.

AD: Thank you. Would you describe yourself as a amateur, semi professional or professional singer?

S5: Amateur, or semi-professional.

AD: Okay, cool.

Subject 6 Interview Transcript:

AD: Okay, so first question is, what is your age?

S6: 32 years young.. (laughs)

AD: 32. I'll put in brackets "years young."

S6: No, don't. I'll be cringing.

AD: And how would you describe your gender?

S6: Female. I don't know why I had to think about that then.

AD: It's all good. And would that be, am I good to put down cis-female at birth?

S6: Yeah. I feel like I would have told you by now (laughs)

AD: Yes.. I feel right now. It's more just as a clarifier. It's like, I need to like, sort of clarify to the tape, even though it's only going to be me listening to these tapes. But it's like, I'm not making any assumptions about people. You know? Right. How would you describe your voice type?

S6: Ooh, is there options? (Laughs)

AD: Yeah, yeah, yeah. So you could describe it into so first, I guess, in terms of voice range. So, you know, bass, baritone, tenor, alto -

S6: I used to be a soprano.

AD: Okay.

S6: I don't know if I'm still soprano or more like a mezzo now.

AD: Okay.

S6: I don't know, because I always was a soprano girl. Always, always, always. But I feel like my top end's gone a bit, but maybe that's just how I'm seeing my voice and other people would be like, no, he's still different this. But I feel like maybe my lower's got more rich.

AD: Okay, that's. And you can also give a bit of information or just like description on your voice type as in how you would describe it as well? You know. Some people, for example, of used descriptors like, "oh, I'm quite soulful" or, you know, like, "I'd say my voice is quite brassy" or, you know, you know, like, oh, "I think I am a natural belter", like any of those kinds of things as well.

S6: I'd say, I don't know if this I'd say it was quite a powerful voice. Can be a bit soulful, can be a bit hmm, I was going to say smoky, but it's not smoky. It's like erm... maybe smooth.

AD: Cool.

S6: I don't really want to be like it's buttery (laughs) but I would take the buttery.

AD: Okay, and question four. Could you describe your specific approach to belting that vowel on that top note?

S6: Tried to open my mouth more because it sounds nicer.. But it's a bit hard with the. Is it the E or the A?

AD: The ah.

S6: Yeah. It made you want to go, not, maybe sound as nice. But um. But yeah, like you're kind of climbing on top of the note. That's what I feel like. Especially on the slidey ones. That's what it feels.

AD: Is there anything else that you think about or anything else in your in your approach, in terms of how you do it.

S6: Like I said, I'd naturally use my head voice.

AD: So specifically just then.

S6: How did I approach it?

AD: Specifically, yeah, how were you approaching it, in that sound?

S6: I don't know if I naturally thought about it, but obviously you wanted the sound strong and like be a powerful sound, so. Yeah, I just opened it up a bit more and just felt like I - I don't know.. (performs a light slide to herself) I didn't want it to sound too strained, I guess, even that when we did at times

AD: Do you know, what did you do to stop it sounding or strained?

S6: Open up.

AD: Okay. Open up. What exactly?

S6: My mouth (laughs) Oh yeah okay!

AD: Oh, no, no, no, no, no right or wrong, I'm just

S6: Just like, like (sings an a vowel with a very dropped jaw) elongate the mouth... for me.

AD: So are you mostly opening the mouth?

S6: Yeah. You're trying to do that.

AD: Great.

S6: I always stand, do you know... um... I know people say stand relaxed, but that is my relaxed standing, like, upright, but apart.

AD: Yeah, yeah.

S6: Because the time my body works apparently because I'm... that's a tangent but yeah..

AD: Okay. Cool. And yeah, and like with that with that as well, if there's anything else you want to add, feel free to. Make sure the answer is the answer that is true to you and not the answer, you think I want to hear as a voice teacher. You know what I mean? Not that I not that I think you've done that so far.

S6: No, all I was going to say is, apparently I'm hyper-flexible, so like my knees, don't... like me bending my knees is not natural.

AD: Yeah, yeah.

S6: So, like, but that's how I've always learned, you know, stand shoulder width apart

AD: stand straight and it's like -

S6: Yeah be in good posture and it comes out a bit better, but that's what I always just naturally do.

AD: Okay, yeah, nice, nice, good. Okay, ah, Question number five. How long have you been singing?

S6: Since I was about four (laughs) On and off... (laughs) Very off at the minute! (Laughs) Do you know I'm not sang since your thing?

AD: Really? Nice. Um. And would you class yourself as an amateur, semi-professional or professional vocalist?

S6: I'd have said at one point, I was semi-professional, and I used to get paid to gig professionals if you want to count as that. Have you ever got paid to do a gig at 1. professional, maybe not now, because I don't really do that anymore, but I would like to get back into that.

AD: So would you be... Well, would you would those categories then, would you, um

S6: I would say I used to be professional now I feel more... not amateur because I've got the experience.

AD: Yeah, that's the thing. Yeah, it be maybe semi-professional then?

S6: Cause I've got the experience but I'm not doing the... the gigs right now.

AD: Yeah. I'll put them I put for now professional *stroke* semiprofessional. And then, yeah, I can have a think of how I categorise all this later. Because this might be a new category that develops!

Subject 8 Interview Transcript:

AD: So. So first question, what is your age?

S8: 43.

AD: 43. And second question how would you describe your gender? So we've got. Cis, trans, nonbinary, male, female.

S8: Female.

AD: Female. And would that be cis-female?

S8: Yeah, cis.

AD: And how would you describe your voice type?

S8: Oooh... Now that I don't know... I just sing. Does that makes sense to you?

AD: Yeah...

S8: I guess it's a bit of a boring answer isn't it?

AD: No it's good.

S8: That's a really good question. Raspy a bit at times maybe? I think cause maybe I sing a lot of Ella... She's got that kind of, yeah..

AD: And if you were going to put that into, and it's okay if the answer, this is, "oh, actually, I don't know" If you were going to put it into one of the, you know, classifications of alto, mezzo-soprano soprano, maybe even, you know, tenor, what, you know, and it's okay if the answer is "actually not sure."

S8: Probably more soprano.

AD: Okay, um, so question four. What was your specific approach to belt that particular vowel on that note?

S8: Oooh, literally clear my mind in a split second and just go for it with a good breath behind. That's the only way and I don't think about anything else!

AD: Cool. Could you define um what a good breath behind it is?

S8: Um. A deep... A deep breath but also a *deep breath*. So deep breath had lots of depth. Right from the gut, right from the core. Yeah. Yeah. With lots of air, lots of belly air as well. That's my own term belly air!

AD: Belly air.

AD: Yeah.

S8: It looks like. *gestures belly expanding*

AD: And how long how many years have you been singing?

S8: 25 years..

AD: And final question, would you describe yourself as an amateur singer, a semi professional singer, or a professional singer?

S8: I would say semi... Semi, yeah... Yeah, I'd say semi, because I've done like the amateurs, musicals and then, yeah, I put myself there. Nicely in the middle

AD: Right, okay. So you've done like some professional singing work and some

S8: Yeah and then some kind of really amateur, but only really at the beginning kind of things. So yeah. I probably like, I'd probably say semi.

AD: Okay, yeah. Yeah, I'd say talking in terms of like right now.

S8: Yeah, yeah. I think I'd say semi then. Although I do professional work now.

AD: Right, Okay. Yeah, yeah, yeah. Okay.

Appendix D

Acoustical Information used for Acoustic Analysis

Harmonic Intensity of each Harmonic (H1 to H8)

	Subject 1	Subject 2	Subject 3	Subject 4	Subject 5	Subject 6	Subject 7	Subject 8
H1	52.6	41.2	37.7	36.8	36.1	39.2	42.3	44.1
H2	64.7	65.1	62	55.3	50.5	61.7	60.9	68.7
H3	61	54.6	41.5	45.1	51.1	61.2	43	53.9
H4	36.4	34.5	34.6	31.5	33.7	33.4	40.9	33.2
H5	41.8	32.9	37.5	33	45.6	40.7	31.4	30.6
H6	33	38.6	40.6	27.1	26.5	30.9	34.3	37.1
H7	37.2	40.9	27.4	20.7	43.7	42.7	32.4	32.8
H8	36.2	19.6	33.7	19	18.3	39.2	30.7	47.1