Module 3

BMPF7008

Working and Learning: An introduction to Work-Based Higher Education

Can changes in facial expression serve as a tool to improving tuning competency in novice singers?

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Project proposal

1. Project title

Can changes in facial expression serve as a tool to improving tuning competency in novice singers?

2. The context

Historically, within a pedagogical setting, there is evidence to suggest that facial expression was considered an important contributor to overall voice quality, known as ‘timbre’ in music (Lamperti, 1877; Tosi, 1723). The advent of spectrographic technology in the 20th century has made it possible to analyse graphically, the harmonic features of a singer’s voice and, as such, scientifically verify that facial musculature can alter the spectra of the voice (Bozeman, 2019; Miller, 1996, 2004; Nair, 1999). While the significance of facial expression on timbre is highlighted in pedagogical texts and research (Appelman, 1967; Chapman, 1981, Titze, 1981), there is limited evidence to suggest that it was specifically employed as a tool to improving tuning.

3. The justification

‘Tuneful’ singing is considered a foundational singing skill (Bunch-Dame, 2006). However, this often presents as a major challenge to improvement for beginner singers (Numminen et al., 2015). Therefore, evidence for techniques and tools that may improve tuning accuracy, could expedite learning. Within the context of the researcher’s area of professional practice, one-to-one adult singing lessons, the historical verbal instruction (Mancini, 1774) to ‘lift the cheekbones’ or ‘smile’ has been observed to produce a perceptual improvement in tuning. This study aims to explore this observation within the context of existing research and by using spectrographic technology to capture and analyse the vocal spectra of individual singers while they are directed in changes in facial expression.

4. The intended impact

Rather than providing conclusive evidence, the research aims to improve understanding and provide transferable findings (Lincoln and Guba, 1985). These might include identifying language and methods that can be employed in the studio beyond the research setting and which may also hold value for the wider community of teachers.

5. The outlined intention

As singing involves a multitude of variables that are difficult to separate or conclusively measure (Herbst, 2016; Zhang, 2016), a pragmatic approach to allow for necessary flexibility will be undertaken. This mixed methodologies study will measure quantifiable changes in spectrographic outputs while singers employ varying facial expressions and solicit qualitative participant feedback in the form of a short interview.

The study will use a purposive convenience sample of 6-10 consenting adults at the early stages of learning.

The research will be undertaken between April to June 2024 and carried out in the researcher's private studio.

Methods

- A literature review of existing research relating to the impact of facial expression on tone and on spectrographic analysis of the singing voice along with research on poor pitch singing.
- Using Voce Vista software and a condenser microphone, the participant will record melodic patterns while using three prescribed facial postures.
- Participant feedback about the experience will be drawn from short semi-structured interviews, which may identify emergent themes and insights.
- Spectrographic analysis of the recorded pitch relative to the target pitch will be measured. Analytics per participant, per facial expression will be followed by comparisons of the effects of facial expression on each exercise and finally, statistics will be recorded between each facial expression over the whole experiment. The metric to be used is cents, with 100 cents representing 1/2 musical tone.

6. Ethics and insider research

S*ocial situatedness* is a key facet of insider research and will seek to mitigate unintentional bias by highlighting the role of the researcher as an interpreter of emerging information (Easterby-Smith et al., 2018; Lave and Wenger, 1991). Additionally, the insider researcher will actively seek to diminish any implied pressure, or make assumptions about participation, in line with ethical principles laid out by UWSTD (appendix #). They will present the aims, processes and level of participation in unambiguous language that seeks to reassure and mitigate uncertainty. The participant can be assured that through a structured consent protocol (apendix), their names and identity will remain anonymous throughout and after the research. Additionally, that any research materials generated through their participation will be destroyed following the end of the research. The collaborative nature of working with an institution, such as UWTSD, will allow for ongoing feedback and scrutiny by experienced tutors, throughout the planning, execution and analysis phases of the project (Costley et al, 2010) thus providing a framework for accountability.

7. Personal learning outcomes

- An improved understanding of spectrography
- An improved understanding of the reasons and manifestations of poor pitch singing
- An improved understanding of the role of facial expression in singing
- The gaining of skills and knowledge in undertaking and presenting research

- The gaining of an introduction to statistical data analysis

The Report

Can changes in facial expression serve as a tool to improving tuning competency in novice singers?

Introduction

Historically, within a vocal pedagogical setting, facial expression was widely considered an important contributor to overall voice quality, known as ‘timbre’ in music (Lamperti, 1877; Tosi, 1723). The advent of spectrographic technology in the 20th century allows contemporary pedagogues to graphically analyse the impact of facial musculature, including lip shape and flaring the nostrils, on the spectra of the voice (Bozeman, 2019; Miller, 1996, 2004; Nair, 1999; Obert, 2023). As a result, the acoustic effects of facial expression on the voice, is now evidenced in contemporary texts and research (Appelman, 1967; Chapman, 1981, Miller, Titze, 1981). However, although the use of spectrographic technology is now a commonplace feature in singing training, there is currently limited research that explores its use as a tool in analysing the impact of facial expression on tuning. ‘Tuneful’ singing, (i.e., the ability to match accurately the written notes of a melody) is considered a foundational singing skill (Bunch-Dame, 2006, Dalla Bella, 2009; Edmonds et.al, 2023; Pfordresher and Brown, 2007), but, within the context of the author’s area of professional practice, one-to-one adult singing lessons, it often presents as the major challenge to improvement for beginner singers. This lack of perceived innate ability can lead learners to self-report as tone-deaf or conclude that natural talent is an essential ingredient to successful singing (Pfordresher and Brown, 2007; Wise and Sloboda 2008). However, the historical verbal instructions to ‘lift the cheekbones’ or ‘smile’ (Mancini, 1774), or the more contemporaneous iteration to adopt the 'Nashville squint’ which requires upper lip lift, teeth showing and scrunched nose (Obert; 2023), have been observed to assist in improving tuning, particularly in the higher ranges. This mixed methods study (Denzin, 1978; Patton, 1999) explores the perceived relationship between tuning and facial expression, which may provide the basis for devising remedial strategies. This study aims to explore this observation within the context of existing research and by using spectrographic technology to capture and analyse the vocal spectra, particularly the fundamental frequency (called a ‘note or ‘pitch’ in music) produced by individual singers while they are directed in changes in facial expression. Within the context of singing training, it is hoped that any findings will go some way to dissuading the student from a prevailing belief in innate fixed abilities (Dweck, 2008; Welch 2001; and Whidden, 2009), and that overcoming obstacles is a normal part of learning and not a sign of chronic ineptitude (Numminen et al., 2015).

Literature Review

What is poor pitch singing and why does it happen?

Understanding why some people are challenged by poor pitch singing (colloquially referred to as ‘out-of-tune’ singing) is particularly complex, as the very nature of singing involves a multitude of variables that are difficult to separate or conclusively measure (Herbst, 2016; Zhang, 2016). These include neurological, psychological, physiological and artistic phenomena as well as cultural influences (Numminen, A. et al. 2015). Using a model of a Vocal Sensorimotor Loop (VSL), Berkowska and Dalla Bella (2009) have identified a range of perceptual and motor planning components that all play a vital part of the auditory-phonatory circuit. They conclude that the malfunctioning of only one part of the loop will affect the entire system, and therefore the interdependency of these components makes the identification of a single cause difficult. Essentially, successful pitch accuracy requires the coordination of complex auditory perception, motor abilities and functioning memory systems (Hutchins & Peretz, 2012; Dalla Bella, 2012; Pfordresher & Brown, 2007; Watts et al., 2003; Welch, 1983). In the professional practice poor pitch singing is more prevalent in the higher ranges, so it is interesting to note that the mechanical adjustments required for pitch elevation take longer to implement than those required for lowering the pitch (Sundberg, 1979, Titze, 1994), potentially suggesting a motor planning deficit (Dalla Bella et al., 2012). Pitch elevation requires the activation of the crycothyroideus muscle which is a muscle that can be developed with training (Sundberg, 1979, Thomson and Russo, 2007), and may be a consideration for why some singers find higher pitches more challenging in the early stages of training.

The literature is inconclusive in determining a fixed metric for measuring poor pitch singing, with research suggesting cut-off value ranges of 50 cents (¼ tone) and up to 100 cents (1/2 tone, also called a ‘semitone’), off the target note (Berkowska & Dalla Bella, 2013; Demorest & Clements, 2007; Cobes, 1972; Hutchins & Peretz, 2012; Hutchins, Roquet, & Peretz, 2012). In one listening test, trained singers were unable to discriminate pitch differences under 20-cents (Howard and Angus, 2017), however, Sundberg (1990) argues that highly skilled musicians can detect errors of 5-cents which relates to 0.3% of the frequency. Perhaps this illustrates the perceptive or, subjective, nature of auditory pitch assessment in the singing studio, supporting the use of spectrographic technology for teaching. Additionally, the dampening or boosting of particular frequencies, which contributes to timbre (Sundberg, 1990), might influence how the listener perceives the pitch. Pfordresher et.al. (2010), highlight that poor pitch singing can manifest in two ways; as a lack of accuracy or a lack of precision; ‘accuracy’ describes how close the sung pitch or interval is to the target note, which can be measured in cents, and ‘precision’ represents the consistency in the repetition of the same notes or the relative pitch (Dalla Bella, 2009). Relative pitch describes the distance between notes or how notes relate to each other in a melody (Downie, 2003). Simply put, a person who is unable to sing an isolated note with accuracy might be able to confidently sing the tune to ‘happy birthday’, demonstrating that their relative pitch is competent (Berkowska & Dalla Bella, 2013, Mcquade, 2016; Nichols and Pfordresher 2018). In summary, while it may be possible, through spectrographic imaging, to measure pitch accuracy, the literature

suggests that determining a single cause for poor pitch singing is almost impossible due to the complex nature of the auditory phonatory circuit.

What is known about facial expression in singing and its effect on sound production?

Ascending vocal pitch range has been associated with heightened emotional arousal in performance, which may account for changes in facial expression in the higher ranges (Scherer, 2003), this extends to instrumentalists, not just to singers (Fisher et al., 2020). Facial expression may also be an unconscious emotional response to the text or music, or more deliberately, as a system of emotive communication with the audience (Pinto et al. 2014). Thompson and Russo (2007) and Titze (1994) posit that physical repositioning of the vocal apparatus may manifest outwardly as changes in facial and body posture. Certainly, pitch elevation, when examined through video endoscopic research, combined with spectrographic analysis, demonstrates the complexity of the process ie., considerable contracting of the lateral pharyngeal walls, creating a narrow tube, raising of the soft palate resulting in the velopharyngeal port narrowing particularly for higher frequencies (Janagisawa et al., 1991). The McGurk Effect (1976) is a term widely used in contemporary settings to describe the phenomenon of the merging of auditory-visual information into a unified perception of what's been heard, perhaps highlighting the importance of facial expression in the interpretation of sound. In the absence of an auditory signal, it was found that melodic information, specifically varying pitches, transmitted by singers to audiences through facial expression was effectively interpreted by the viewer/listener, illustrating the McGurk Effect (Thompson & Russo, 2007). Classical singers are widely observed to maintain flared nostrils from the on-set of a phrase, which has been revealed, through nasofiberoscopy, to elevate the soft palate and widen the pharyngeal and epi-laryngeal inlets (Aura et al., 2018). This 'smelling'-related connection between the face and larynx, also supported by Miller (2006), has influenced the choice of facial postures for this study. Evidence of an intermodal association between facial expression and vocal pitch height has found that elevation of the eyebrows often correlates to pitch raising (Huron et al. 2009). However, with the increasing popularity of facial botox, as observed in the professional practice, this may become less obvious in contemporary performance, but remains a frequently observed phenomenon in accomplished singers. The zygotematicus muscles (that give the impression of lifting the cheek bones) are major muscles of facial expression and, according to McQuade (2016) and Miller (1996), can contribute to changes in the shape of the vocal tract, thereby affecting vocal timbre and amplitude. McQuade (2016) finds that lifting the zygomatic gives greater acoustic intensity (94.2%) contributing to timbre. Titze (2001) observes that singers can 'feel' symptoms of voice generation on their faces. While facial postures have been examined in many singing studies historically (Appelman, 1967; Chapman, 1981, Miller, Titze, 1981), the literature accessed for this paper, from which this research has gratefully benefitted, suggests a variety of reasons; these include, but are not limited to, an emotional response to the music or text, a means of communication to an audience, outward manifestations of physiological changes in the vocal mechanism and a means of controlling amplitude and timbre.

Methods

Eleven participants recorded eight exercises in the same order, while using three different prescribed facial expressions, also in the same order. These recording were run through spectrographic software and were analysed for pitch accuracy. In this study the independent variables are prescribed facial expressions, with the dependent variable being any variation in fundamental frequency occurring as a result of these changes in expression.

Participants

The purposive sample of novice adult singers (n = 11, 5m, 6f) with varying levels of skill, was drawn from the professional practice and are all previously known to the researcher. An email requesting participants who self-identified as beginner or novice singers was sent to 347 previous and existing students. As the research question is focussed on developing strategies for novice singers, it is that group that were selected over more accomplished singers. Furthermore, accomplished singers may have tuning strategies that extend beyond facial expression, which would be difficult to isolate (Herbst, 2016; Numminen, et al. 2015; Zhang, 2016). Some selected participants had demonstrated habitual poor pitch singing in their lessons and, as such, were of particular interest to the aims of this study.

Apparatus

Participant recordings were made using a T-bone SC-1100 condenser microphone fitted with an SZ-ISOBALL foam isolating shield. This was connected via a Scarlett 2i2 audio interface, to an Apple i-Mac M1 desktop computer running Voce-Vista software. Audio-Technica ATH-M50x studio headphones were used by the participants and the researcher during the recording. The post-experiment interviews were recorded onto an iPhone 11 smartphone and final spectrographic analysis undertaken through Praat software.

Procedure

The research was undertaken in a private studio, that also serves as the teaching studio and is an environment that is familiar to all. Each session began with a ten-minute warm-up of fricative glides, trills and short scales, an opportunity for the participant to acclimatise to the demands of the process gradually. Under the instruction of the researcher, the participant learned the two exercises to be recorded. As the accuracy of pitch matching is significantly improved by a live voice model, it was considered important that learning the exercises should be undertaken with the researcher modelling (Granot et al. 2013). The first exercise is based on the cardinal vowel sounds of [a] and [i] with the third note of each phrase being extended (figure 1). These long notes were included to ensure that adequate audio was captured for analysis, a requirement that the participants were made aware of. In spectrographic imaging, vowels generate the maximal information about the pitch, therefore no consonants were used in the first exercise (Murayama et al. 2004). As accuracy

in copying pitches decreases as the sequences get longer (Pfordresher et al., 2010), these phrases remain short and repetitive. Pitch accuracy also tends to decrease with faster tempi (Dalla Bella et al. 2006; Sundberg, 1979) therefore the speed of the exercises was kept moderately slow. Additionally, singing single pitch vowels reduces linguistic demands and memory load and has shown to be easier for novice singers to undertake (Berkowska and Dalla Bella, 2009a). The choice of notes reflects that pitch accuracy, within the professional practice, has been observed to decrease as the pitch rises, therefore the exercises increase incrementally in pitch. Lower voices sang down the octave or learned alternative pitches. It should be noted that the pitches themselves were only moderately high to reflect the general level of ability, as assessed by the researcher and, had the participants been more experienced, are likely to have been higher to account for the longer development period (Sundberg, 1979; Thomson and Russo, 2007).

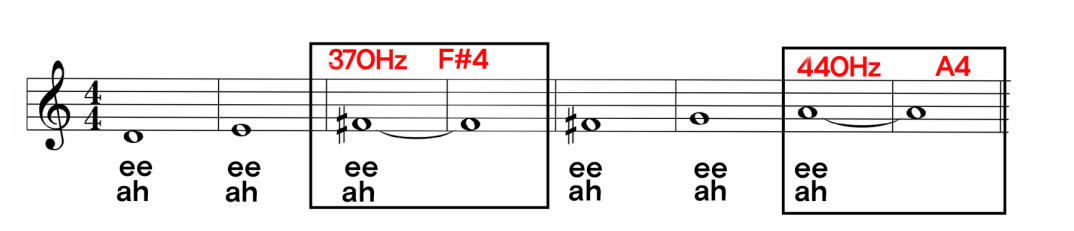


Figure 1. First vowel exercise (notes to be measured are highlighted).

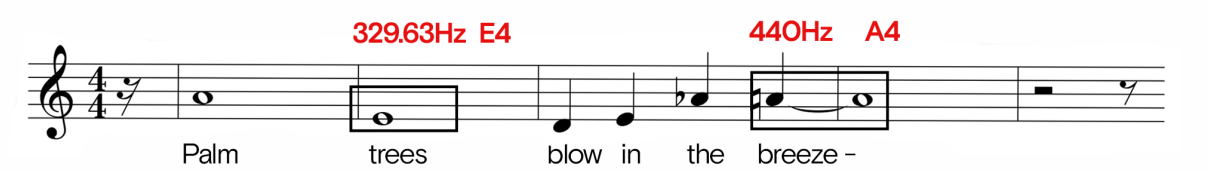


Figure 2. First word exercise

The second exercise was a word-based phrase (figure 2), and, in contrast to the vowels sequence, modulates melodically both downwards and upwards in pitch. In order not to depend on pre-mapping by the Vocal Sensorimotor Loop, the melody was written for the purposes of this study and was therefore previously unknown to the participants (Brown et. al., 2004; Zarate, 2013). The notes to be examined were the second and last. Both exercises were practiced until the participant and the researcher agreed that a sufficient level of proficiency had been achieved and that the participant felt confident. Overall, the participants would generate a total of 528 fundamental frequency readings over eight pitch-varying exercises.

Facial Expressions

Further to learning the exercises, the participant received instructions on the three prescribed facial postures. These included 13-images of singers' faces (exclusively the face), verbal directions and written descriptors (figure 3). The postures included; 1. Neutral face; 2. Squinty face; 3. Sniff the Rose (abbreviated henceforth to the Rose). As current research on facial expression in singing

appears mostly concerned with timbre, rather than tuning, the facial postures were selected based on evidence that supports a correlation between expression and timbre. Each posture needed to be easy for the participant to undertake and to be contrasting. The order of execution of the facial expressions was consistent across the entire experiment: Neutral, Squinty and the Rose. As Neutral presents as 'relaxed' and contextually less extreme, it was considered to be the easiest of the facial expressions and would therefore be the the first to be used in each exercise. The procedure needs to consider the relative lack of experience of the participants. Changing the order between participants, although potentially interesting, may have introduced anomalies that go beyond the scope of this research.

1. Neutral face required a relaxed jaw, forehead and lips. An unenergised, dead-pan expression to be maintained irrespective of pitch. As vocal pedagogy focuses on relaxation and a lack of tension (Fisher et al, 2020), it would be interesting to discover if a completely relaxed face might impact tuning.
2. In contemporary commercial singing, the squinting face is frequently observed in live performance across all styles, notably in the higher ranges. Artists including Tom Jones, Celine Dion, Billie Eilish, Whitney Houston and many more, can been observed to squint as though being squirted in the eyes, recruiting the zygomatic musculature which gives the impression of lifting the cheekbones (McQuade, 2016). Additionally, the top lip is pulled up revealing the top teeth (Obert, 2023).
3. The Rose posture draws on the historic classical pedagogical instructions to smile, lift the eyebrows and cheekbones, flair the nostrils and show the teeth (Mancini, 1774). These facial postures are evidenced contemporaneously by world-renowned classical singers including Pavarotti, Bartoli and Fleming. Additionally, eyebrow lifting (procerus muscles) and nostril flaring (musculus nasalis) are commonly observed just before starting and during singing (Aura et. Al., 2018). Miller (2006) finds value in the historical adage to breathe in as though inhaling the fragrance of a rose, as a strategy to control resonance, inspiring the description for this facial expression.

For the recording, the individual was seated in front of a mirror adorned with the enlarged photo-images (figure 3), descriptive words and the musical notation (figures 1 and 2). The studio floor was marked with masking tape in order to ensure that the position of the chair and the microphone were consistent for every participant and that their mouths should be a similar distance from the microphone. The condenser microphone was positioned approximately 30cm from the singer's mouth (Kutsal, 2023, Titze, 1993). It was important to isolate the voice signal as much as possible for a clean voice reading (Downie, 2003; Voce Vista Guide Book, 2024). Therefore, acoustic curtains were drawn alongside the participant and pre-recordings of the piano-accompaniment for the exercises were played through headphones. Only one ear was covered, allowing the participant to hear themselves in the ambient environment with the uncovered ear. Although there is evidence that supports occluding both ears for reducing pitch drift (Edmunds and Howard, 2023), internal frequency transmission through bone and muscle favours lower frequencies which can

affect self-perception of the sound (Edmunds and Howard, 2023). Additionally, there is historical research that posits that the external sound source increases the ability to assess the accuracy of the singing, thus contributing to the one-ear only decision (Bekesy, 1948). The piano recordings included verbal instructions, starting notes and count-ins for every exercise, providing as much clarity as necessary. Similar research revealed that participants preferred the choice of the sound of the piano to other sounds (Nápoles, 2019). The total recording time for each participant was nine minutes exactly and there were to be no breaks or repeat attempts. During the recording, visual observations were made by the researcher.



1. Neutral prompts

Relaxed jaw
Relaxed eyebrows
(not angry or sad, just emotionally neutral)
Baggy cheeks

2. Squinty prompts

Scrunched nose
Screwed eyes
(imagine you have been squirted in the eyes)
Lifted cheek muscles
Show top teeth (grinning smile)

3. Sniff the Rose prompts

Eyebrows lifted
Wide eyes
Nostrils flared
(imagine you are sniffing a beautiful rose or that you have had a lovely SURPRISE!)
Surprised mouth (show your teeth)

Figure 3. Facial posture descriptors used by participants

Interviews

Although this research seeks a quantitative outcome to satisfy the research question, understanding the participants' responses to the demands of the experiment might reveal unexpected observations. Therefore, short, unstructured interviews of no more than five minutes were conducted. The nature of the insider-researcher relationship is collaborative and, as such, could provide deeper insights that are not necessarily available in less-intimate research settings (Costley et al., 2010; Easterby-Smith, 2018). An initial system of deductive coding per facial

expression followed by in-vivo coding relating to participants' responses to each facial expression may identify emerging themes.

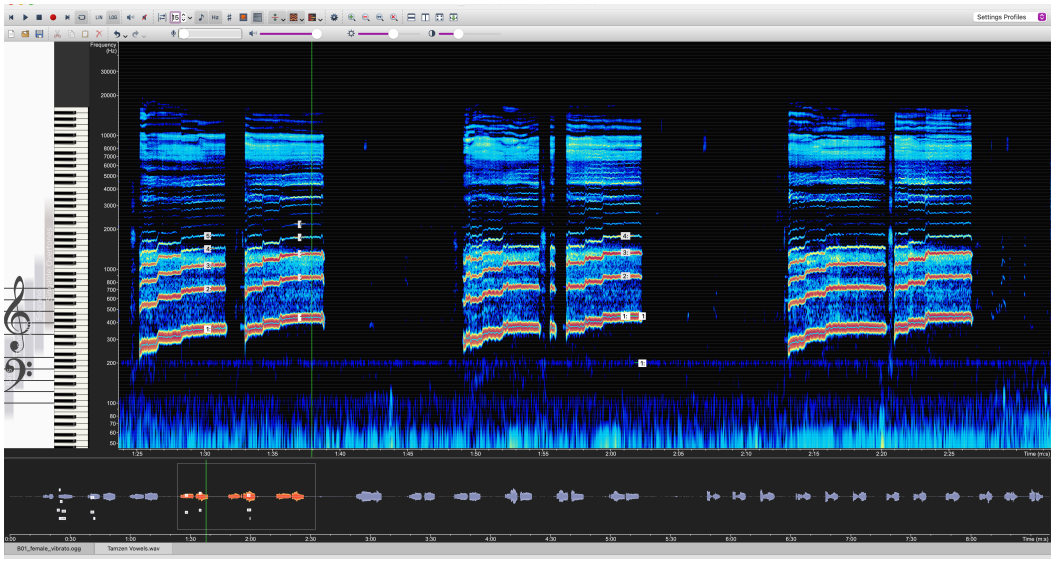
Measuring the data

The only measurement of interest to this study is the fundamental frequency. In order to calculate the mean fundamental frequency over a period of time, the recordings were exported as WAV files from Voce Vista and imported into Praat, a computer software for speech analysis in phonetics (figure 4, p14). This software allows for the selection of a measure of time to be analysed (Boersma, 1993). In this experiment 01:00 second was selected from the middle of the note, avoiding the on-set and off-set due to the likely prevalence of instability at these points. The choice of the selection of 01:00 second of audio was dictated by the average time that participants held the target pitch. As the first note to be analysed in the second set of exercises (figure 2) was very short, the mean pitch was calculated from .50 seconds of audio. The data was collected both in Hertz (frequency) and in the perceptual correlate, musical pitch. In music, semitones (1/2 notes) hold a value of 100-cents, with whole tones being equal to 200-cents. It is the cent calculation that reveals how close the sung note is to the target pitch, for example, 440.62 Herz has a musical value of A4+3 cents (Botros, 2001). Therefore, the metric for determining pitch accuracy in this experiment is calculated in cents.

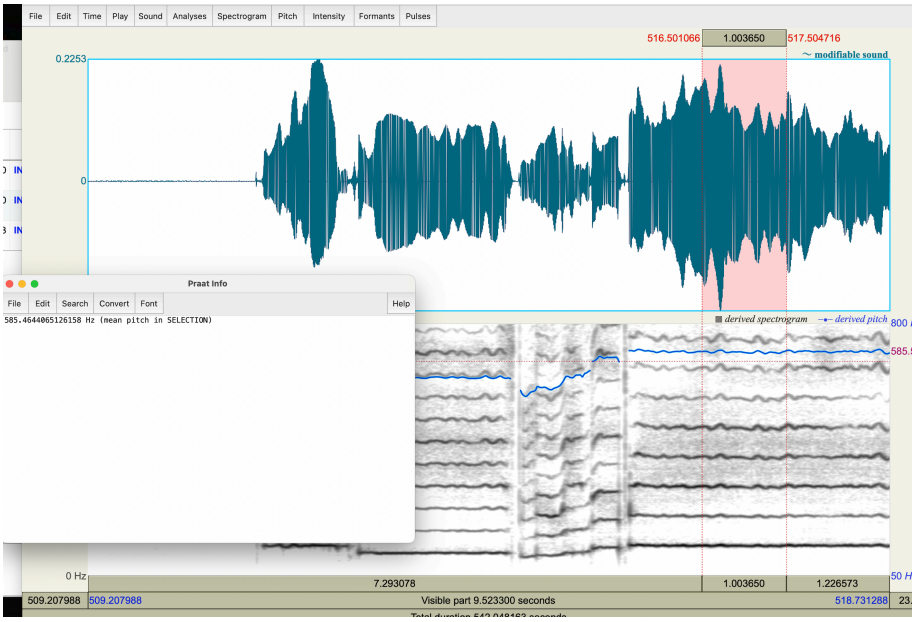
The extracted data was imported into SPSS, a statistical analysis software. The mean value of each of the facial expressions over the whole experiment was used to generate paired sample t-tests to determine any statistical significance. The primary function of the data is to determine whether changing facial expression impacts pitch accuracy, with accuracy measured as zero and all samples being over, under or exactly zero. Two-tailed hypothesis t-tests were used to calculate statistical significance, with a two-sided p-value >0.05 as the determined value of statistical significance (Birkett, 2021). Statistical significance suggests that there is a chance that the event may occur across the wider population (Field and Hole, 2003).

Ethical Considerations

In accordance with the University of Wales and Trinity Saint David's UWTSD ethical guidelines, the participants were fully informed about the purpose of the research, however, to avoid focus or effort in achieving tuning, the terms 'tuning' or 'pitching' were deliberately not used during the experiment. Due consideration was given to the welfare of the participants at all points of the planning; the tasks were proportionate to the level of ability and the experiment could be conducted at variable speeds. Rights to anonymity were honoured and all names were redacted and replaced with letters. Each participant was offered a copy of their signed consent form and each will be emailed the final report, along with an expression of gratitude.



Voce Vista vowel exercise three facial expressions

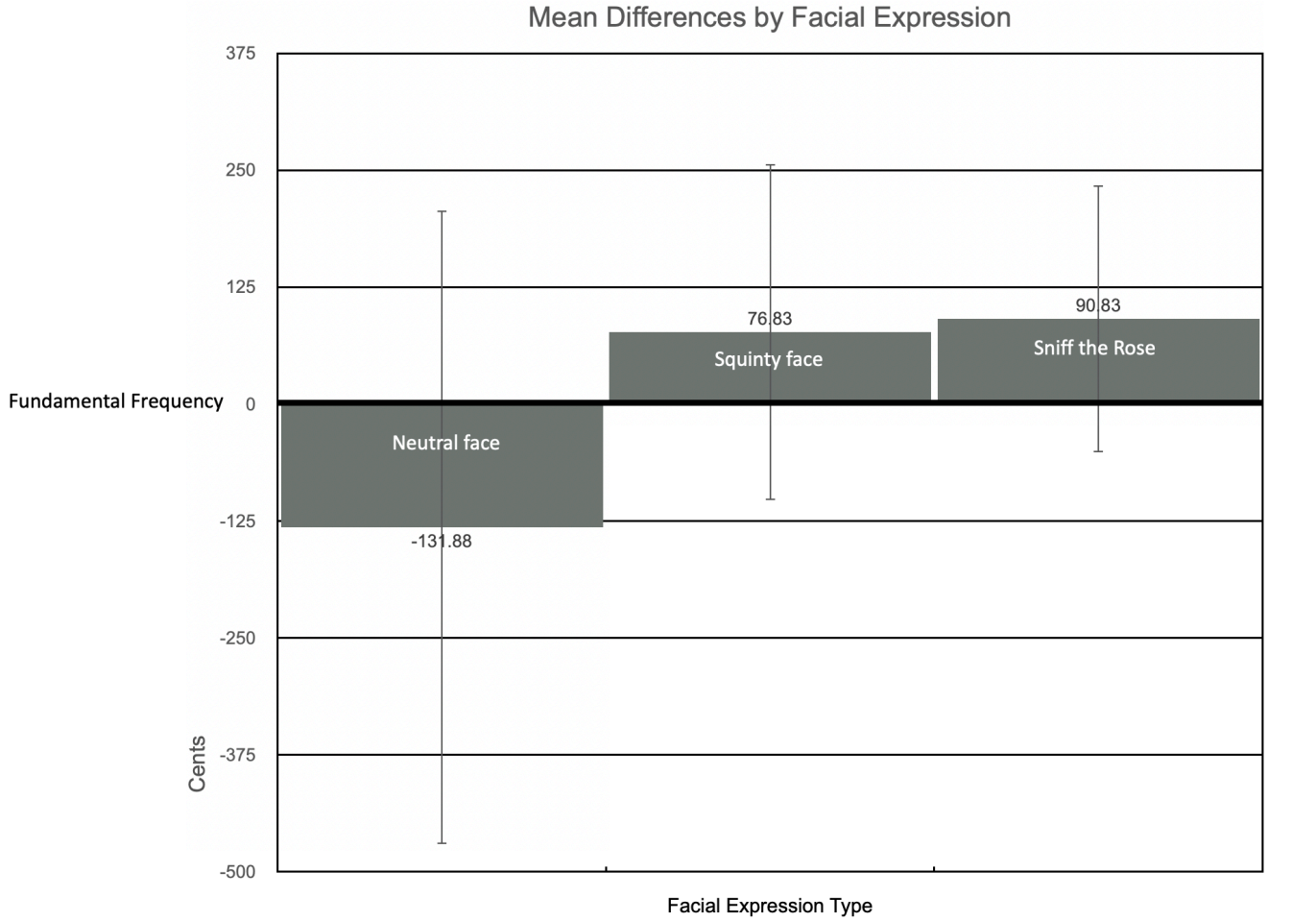


Sample collection using Praat software: palm trees exercise

Figure 4. Capturing the data (illustrative examples)

Results

The initial overview of the results, indicated the presence of two outliers, participants B and H (see appendix G, p71 and p95 for results). To reduce the effect of skewing, the data for participants B and H has been omitted from these results, allowing for 432 remaining measurements from n = 9 participants to be considered.



Note: The mean pitch ratings for specified notes in three conditions, Neutral face, Squinty face and Sniff the Rose are reported above for analysed measurements (*n* = 9). Pitch is measured in cents, with zero representing the fundamental frequency. Standard Deviation is reported in the error bars.

Figure 5. Mean pitch ratings between the three facial expressions with Standard Deviation reported in the error bars

Three paired sample t-tests were conducted in SPSS to determine the relative effect of the three facial postures on the fundamental frequency, using the metric of cents, with zero as the metric for accuracy. The estimated effects sizes were calculated using a standard deviation (*SD*) and standard error of the mean (*SE*).

The comparison between neutral and squinty determined that when the same singers are singing the same phrases using these two facial postures, there is a statistical significance recorded in pitch outcomes in a two-sided t-test ($t = 0.041$, $p > .05$). Neutral face was compared to the Rose

posture and while there is a difference in the overall mean values, the result is determined to be statistically non-significant (t =.078, p <.05). Squinty and Rose also revealed a statistically non-significant result (t = .855, p <.05). These results indicate that there are differences in the mean values of the fundamental frequencies between certain facial expressions and that there is statistically significant data to support the hypothesis that there is a chance that facial expression can impact pitch outcomes beyond the setting of this experiment.

Findings

Overall, the resulting statistics demonstrate, in a small sample of beginner singers (*n* = 9), that changing facial expression impacted the fundamental frequency for these singers. The standard deviations (*SD*) suggest that some singers overshot the margin of error to a significant degree. In-vivo observations noted that some singers exaggerated their facial postures to an 'unnatural' degree, which could account for some of the instances of over-reaching the target. As there is no metric or equipment available to the researcher to measure facial expression, this remains conjecture. The mean data suggests Squinty as being mathematically the closest to the target pitch (zero) across most of the exercises and Rose shows a consistency for above-the-target pitching within the 50-cent allowance. Participants B and H, considered outliers and therefore excluded from the data, were selected for this experiment because they had previously demonstrated serious pitching deficiencies during lessons, probably more so than any other participant. Both had displayed an inability to identify pitch direction or the required octave, meaning that their singing tended to an octave above or below the melody. When directed to use Squinty and Rose, both participants sang up the octave, suggesting perhaps, that the 'raising' quality associated with these expressions was conflated with a request to sing higher notes. This alone, may be indicative of an inability to preconceive the target pitch. Based on the behaviours exhibited by B and H, 'facial pitching' might be a more suitable strategy for those singers who are able to preconceive the note but do not yet have the developed motor skills or muscular flexibility, essential elements of the auditory-phonatory circuit (Berkowska and Dalla Bella, 2009). Sundberg (1979) and Thomson and Russo (2007), posit that these deficits, particularly if occurring in the higher ranges, can be overcome with repetition and muscle development.

Neutral face

It is striking to note the extreme pitch deficit recorded by the execution of the Neutral Face; *M* = (-)131.88 relative to the rose *M* = 90.8333 and squinty face *M* = 76.83, across the whole experiment. Statistical significance suggests that, although the sample is very small and the experiment has several limitations, the Neutral face deficit 'effect' could be representative across the wider population (Field and Hole, 2003). Based on these findings, an emerging consideration might be that a perceptual lack of facial expression, such as Neutral face, might increase the chances of pitch inaccuracy. This evolving theory may be supported by feedback from the post-exercise interviews, with some participants reporting Neutral face to be problematic in achieving high notes; G, a professional orchestra musician, stated that as an instrumentalist, they

internalised the pitch before playing it (Fisher et al, 2020) and that high notes “feel” higher in the head, therefore, attempting to maintain a neutral facial posture on ascending pitches proved challenging. G’s statistics reveal that they were generally below the target pitch on Neutral but never over the threshold of 50-cents, however, they conceded that they had probably instinctively elevated their facial features. Participant A, posited that “Neutral face highlights how singing is easier if you use your face”. Participants I and J also reported that it was difficult to maintain Neutral on ascending intervals as their natural instinct is to raise their faces along with an internalised sensation of elevation. Participant I observed that the descriptor ‘Neutral’ was misleading, suggesting it was in itself an extreme facial expression akin to a theatrical ‘dead-pan’ expression. In contrast, (C and D) expressed Neutral to be the easiest and the most comfortable posture and both associated it with being relaxed. However, D was variously very close to the acceptable negative allowance and as the pitch ascended, went beyond that threshold (up to -110 cents). C was well within the acceptable range for all the postures over the exercises. F, whose voice type is bass-baritone, described Neutral as feeling “lower in the body” and representing their singing norm, strongly identifying with the image of the basset hound as representative of this posture. Other than C, D and F, the consensus, variously, is that Neutral felt under-powered, was a hinderance in high note singing and that the overall sound was dull.

As this research is ultimately concerned with helping singers to improve pitching accuracy, it is worth considering the implications of the results of using the Neutral posture in a pedagogical setting; one of the primary focuses in singing pedagogy is for the singer to learn to avoid excessive tension in the vocal system (Fisher et al., 2020; Larrouy-Maestri and Morsomme, 2014), and many pedagogical texts include the necessity for avoiding stress in the facial musculature (Bunch-Dayme 2006, Kitch et al., 1994, Linklater, 1976, 2006). Perhaps then, consideration should be given to the interpretation of ‘relaxation’. ‘Relaxation’ was a key word used in the description of Neutral for this experiment, and yet the posture was found to be inhibiting. This may suggest that a student instructed to relax their face may variously resort to a static or “dead-pan” posture (participant I) and perhaps the effort to relax in itself, might create tension in the vocal system, when misconstrued. Fisher et al., (2020) highlight the necessity for pedagogues to include training in appropriate facial muscle activation for vocalists and musicians for health and technique. Perhaps another consideration arising in response to the data, is the importance of facial animation in early years teaching to avoid children learning to sing with neutral expressions, which could lead to potential tuning deficiencies in adulthood. The valuable research undertaken by Dr Ed Tronick (1975), known as the ‘Still Face Experiment’ illustrates the power of emotion coaching in early years and, as such, a lack of emotional engagement through facial posture may result in not equating singing with emotional expression, but rather a more abstract or intellectual exercise. Within the context of the research question, the statistically significant outcomes on the Neutral posture, particularly on ascending pitches, might suggest a review of the semantics surrounding the notion of relaxation in singing training for all years.

Sniff the Rose

Squinty and Rose, when compared, showed little statistical difference in the results. However, in terms of developing teaching tools, the participant feedback has yielded some valuable insight. The Rose was the most overtly popular, with a sensation of "fluidity" in the breathing, "it made me want to sing out and perform" (C), "it felt like Rogers and Hammerstein, a performance element" (E), "It felt more dynamic. It felt like more power coming through. Opening everything up, opened me up" (F). "the sound is nicer on Sniff the rose. The sound is rounder" (G), adding that "seeing Pavarotti was useful". Additionally, J adds "breathing-wise, sniff the rose gave me the most energy for the breath. Everything felt more open and that felt good". One participant was observed to instinctively hold an imaginary rose under their nose, as per the images. The word 'surprised' was included in the descriptors and several participants agreed that this was the keyword for enabling the posture with ease, having found that it was hard to maintain the sniffing element through the phrase. The researcher observed, with the exception of G, the participants made adjustments to their shoulder posture while 'sniffing', pulling them back to different degrees, consequently changing the head-neck alignment (Miller, 1996). On exercise two (figure 2), the first note analysed had a downward pitch modulation, and the measurements in fundamental frequency reveal negative frequencies as a norm for this note on the Rose. However, the second note analysed modulated upwards and was consistently above and generally very close to the target pitch. Both notes possessed the same vowel [I]. As similar patterns occur with pitch direction using squinty face, this might suggest that the Rose and Squinty postures are particularly efficient on ascending intervals.

Squinty face

In terms of participant feedback on Squinty, several suggested that the posture helped with accessing the higher notes, particularly on [i]. The observations and feedback reported that Squinty was hard to achieve, with some singers appearing to make strenuous effort. Participant F, although finding it difficult to adopt, felt that it was "potentially easier to reach high notes than sniffing" adding that seeing an image of the singer Tom Jones, was helpful in understanding the requirements. It should be noted that F was found to be considerably over the target pitch on the higher notes, despite reporting a sense of ease. J expressed squinty face as the easiest for accessing high notes "especially showing the teeth and lifting the cheekbones." G agreed that it was easier to produce higher notes, but felt that "Squinty has a more piercing quality to the sound" and preferred the rounder sound produced by the Rose. It was observed that hand gestures were often used to describe the sensations relating to the postures; generally Squinty produced gestures representing 'small' spaces' and in one case, using the hand to form a forward arrow in front of the face. The Rose generally elicited hand gestures representative of roundness.

The experiment itself was praised by the participants for its clarity. Without exception, the participants appeared to enjoy and engaged with the process, with none showing embarrassment at being asked to pull faces and all showing interest in the results.

Limitations

It is not possible to identify a single cause for poor pitch singing (Dalla Bella, 2012; Hutchins & Peretz, 2012; Pfordresher & Brown, 2007; Watts et al., 2003; Welch, 1983), and by the very complex nature of singing (Herbst, 2016; Zhang, 2016) neither is it possible to know, in this experiment, whether it is facial expression alone, that has caused the acoustic changes in the output. For example, the act of sniffing engages the muscles of the nostrils and elevates the soft palate, which changes the shape of the vocal tract, thus impacting the vocal spectra (Aura et al, 2019; Miller, 2006). The observation that participants pulled their shoulders back on the Rose posture, might have had a bearing on the acoustic output. One might argue that it is these manoeuvres, rather than facial expression in itself that elicits changes in the fundamental frequency. It is also difficult to measure facial expression as the perception and execution is likely to be different from person to person, as highlighted by participant D who found it “difficult to distinguish differences between squinty face and the rose”. Additionally, the participants tended to use exaggerated facial postures to a degree that may have affected the pitch outcomes. However, without the benefit of high definition and motion capture video, neither of which was available to the researcher, it remains impossible to get an exact metric (McQuade, 2016). A further limitation to the study is that the sample size is very small to be truly representative of the population and it is limited to amateur singers. If the study were to be repeated, an examination of more advanced singers using more naturalistic interpretations of the postures and who are working across different genres, might be of value.

Conclusions

Singing in tune is considered a foundational skill (Bunch-Dame, 2006, Dalla Bella, 2009; Edmonds et.al, 2023; Pfordresher and Brown, 2007), however, it can present as a major challenge to some people. Finding remedial strategies for improving pitch accuracy is complicated, involving a complex array of phenomena, thereby making the identification of a single cause, difficult (Berkowska and Dalla Bella, 2009; Herbst, 2016; Numminen, A. et al. 2015; Zhang, 2016). Building on historical and contemporary vocal pedagogical texts (Bozeman, 2019; Miller, 1996, 2004; Obert, 2023; Lamperti, 1877; Tosi, 1723) the research sought to explore a correlation between facial expression and pitch accuracy using spectrographic imaging. The statistical results demonstrated that Neutral face consistently recorded negative target pitching and the qualitative element of the study aligned with these findings, with participants positing that Neutral can feel inhibiting, particularly in higher singing. In contrast, the postures that elevated the facial features, Squinty and the Rose, delivered either above or very close to the target pitch, most notably on ascending intervals and presented as helpful in high singing. These results, along with participant feedback, suggest that using the face as a remedial tool for poor-pitching in singing training could have benefits. However, two outliers who were found to be unable to judge pitch direction or octave, may indicate that the use of facial expression in this context might not be effective for all singers. In conclusion, despite the limitations of the study, a statistically significant result was found

between Neutral and the other two postures suggesting that a larger sample group, with a pre-tested minimum pitching proficiency might add depth to the findings.

Appendix A: References

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Appendix B: UWTSD Ethical Approval

APPLICATION FOR ETHICAL APPROVAL

In order for research to result in benefit and minimise risk of harm, it must be conducted ethically. A researcher may not be covered by the University's insurance if ethical approval has not been obtained prior to commencement.

The University follows the OECD Frascati manual definition of **research activity**: "creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications". As such this covers activities undertaken by members of staff, postgraduate research students, and both taught postgraduate and undergraduate students working on dissertations/projects.

The individual undertaking the research activity is known as the "principal researcher".

Ethical approval is not required for routine audits, performance reviews, quality assurance studies, testing within normal educational requirements, and literary or artistic criticism.

Please read the notes for guidance before completing ALL sections of the form.

This form must be completed and approved prior to undertaking any research activity. Please see Checklist for details of process for different categories of application.

Delete the Guidance Notes at the end of the form BEFORE submitting your application

SECTION A: About You (Principal Researcher)

1	Full Name:		Tanya Holt			
2	Tick all boxes which apply:		Member of staff:	☐	Honorary research fellow:	☐
3	Undergraduate Student	☐	Taught Postgraduate Student	☒	Postgraduate Research Student	☐

4	Institute/Academic Discipline/Centre:	Institute of Health and Management
5	Campus:	Carmarthen
6	E-mail address:	tanya@tanyaholt.co.uk
7	Contact Telephone Number:	07949 443118
	For students:	
8	Student Number:	2246139
9	Programme of Study:	MA in Professional Practice (Voice Pedagogy)

10	Director of Studies/ Supervisor:	Julie Crossman/ Debbie Winter

SECTION B: Approval for Research Activity

1	Has the research activity received approval in principle? (please check the Guidance Notes as to the appropriate approval process for different levels of research by different categories of individual)		**YES**	☒	**NO** ☐
					Date
2	If Yes, please indicate source of approval (and date where known): ***Approval in principle must be obtained from the relevant source prior to seeking ethical approval***	Research Degrees Committee	☐		
3		Institute Research Committee	☐		
4		Other (write in) WAPPAR Ethics Board Representative	☒		

SECTION C: Internal and External Ethical Guidance Materials

	Please list the core ethical guidance documents that have been referred to during the completion of this form (including any discipline-specific codes of research ethics, and also any specific ethical guidance relating to the proposed methodology). Please tick to confirm that your research proposal adheres to these codes and guidelines.		
1	**UWTSD Research Ethics & Integrity Code of Practice**		☒
2	**UWTSD Research Data Management Policy**		☒
3	This may include codes of conduct of professional bodies or overseas laws (particularly for data protection).		☐

SECTION D: External Collaborative Research Activity

1	Does the research activity involve collaborators outside of the University?		**YES**	☐	**NO**	☒
2	If Yes, please provide the name of the external organisation and name and contact details for the main contact person and confirmation this person has consented to their personal data being shared.as part of this collaboration.					
3	Institution					

4	Contact person name					
5	Contact person e-mail address					
6	Has this individual consented to sharing their details on this form?		**YES**	☐	**NO**	☐
7	Are you in receipt of a KESS scholarship?		**YES**	☐	**NO**	☐
8	Is your research externally funded		**YES**	☐	**NO**	☐
9	Are you specifically employed to undertake this research in either a paid or voluntary capacity?	Voluntary	**YES**	☐	**NO**	☐
10		Employed	**YES**	☐	**NO**	☐
11	Is the research being undertaken within an existing UWTSD Athrofa Professional Learning Partnership (APLP)	If YES then the permission question below does not need to be answered	**YES**	☐	**NO**	☐
12	Permission to undertake the research has been provided by the partner organisation	(If YES attach copy) If NO the application cannot continue	**YES**	☐	**NO**	☐

Where research activity is carried out in collaboration with an external organisation

13	Does this organisation have its own ethics approval system?	**YES**	☐	**NO**	☐
14	If Yes, please attach a copy of any final approval (or interim approval) from the organisation				

SECTION E: Details of Research Activity

1	Indicative title:	Can changes in facial expression improve tuning in the beginner singer? An exploration of the correlation between facial expression and pitch.		
2	Proposed start date:	18th March 2024	Proposed end date:	1st July 2024

3	**Introduction to the Research (maximum 300 words)** **Ensure that you write for a <u>Non-Specialist Audience</u> when outlining your response to the three points below:** • *Purpose of Research Activity* • *Proposed Research Question* • *Aims of Research Activity* • *Objectives of Research Activity* Demonstrate, briefly, how **<u>Existing Research</u>** has informed the proposed activity and explain • *What the research activity will add to the body of knowledge* • *How it addresses an area of importance.*
4	**Purpose of Research Activity** The purpose of this project is to test a developing, practice-based theory that suggests that changes in facial expression can improve pitch accuracy in beginner singers. Existing published research demonstrates a correlation between facial expression and sound quality, which can be a useful tool both for artistic expression and for accessing higher notes in singing. However, my practice based observations suggest that this could also extend into pitch improvement. In my studio, pitch inaccuracy is one of the biggest challenges facing beginner singers, with progress often being slow and disheartening. Equally, as a teacher, these challenges extend to finding appropriate strategies to assist the learner. Therefore, this research has the potential to hold value for teacher and learner alike.
5	**Research Question** Exploring the interplay between varying facial expressions and the harmonic structures of the resulting sound waves; do some facial expressions dampen higher frequencies creating a perceptually ‘flatter’ tone?
6	**Aims of Research Activity** To better understand the relationship between the muscles of the face and pitch in order to develop strategies to assist singers in improved tuning.
7	**Objectives of Research Activity** Using spectrographic technology, I will analyse how changes in facial expression affect the harmonic frequencies of the resulting sound waves. The spectrogram reveals which frequencies are dampened and which are boosted; this information may indicate an unfavourable dampening or boosting of harmonics, which can result in the perception of ‘out of tune’ singing. During the research, the singer will be guided in experimenting with repetitive, simple melodic patterns, using a selection of visual and verbal cues given by the researcher, to guide facial expression. Comparisons between spectrographic imaging of the same melodic pattern with differing facial expressions will be analysed.
8	**Proposed methods (maximum 600 words)** Provide a brief summary of all the methods that **may** be used in the research activity, making it clear what specific techniques may be used. If methods other than those listed in this section are deemed appropriate later, additional ethical approval for those methods will be needed.

9	A mixed methodology encompassing the following: 1) **Literature review**: including existing academic research on vocal acoustics, spectrographic analysis, vocal anatomy and the use of verbal and visual imagery in motor learning. The literature will inform the choice of imagery, verbal and visual, used to direct the participants during the spectrographic recording phase of the research. 2) **Journalling**. Rich descriptive qualitative data will be captured through the observation of changes, patterns and developments in individuals' perspectives and experiences. This data may help build a lexicon of terms that can be used for replicating the experience beyond the research setting. 3) **Observation** of the participant by the principal researcher. Observing whole body posture, head/neck alignment, jaw position. A qualitative analysis of this data may reveal patterns and themes that occur beyond adjustments in facial posture. 4) **Visual analysis**: analysing the spectrogram. The study is looking for recurring themes and commonalities in the data captured, as such this will include a quantitative data analysis of the harmonic changes recorded in the spectrogram across the study. 5) **Recording / audio analysis**; Although this study is concerned with the spectrographic output as a data source, the accompanying audio may provide a deeper qualitative understanding of the visual data. 6) **Questionnaire**: To maintain a true qualitative approach, instead of solely counting responses, the questionnaire intends to capture emerging patterns and themes and personal experiences. 7) **Interview:** A rich qualitative description of the participants' opinions, perceived educational or emotional feedback could be included as part of the research findings.

10	**Location of research activity** Identify all locations where research activity will take place.
11	All research to be undertaken in a dedicated home studio. A sound proof, private, purpose-built and stand-alone, garden music studio. This space is exclusively used by the principal research and their clients. (this box should expand as you type)
12	**Research activity outside of the UK** If research activity will take place overseas, you are responsible for ensuring that local ethical considerations are complied with and that the relevant permissions are sought. Specify any local guidelines (e.g. from local professional associations/learned societies/ universities) that exist and whether these involve any ethical stipulations beyond those usual in the UK (provide details of any licenses or permissions required). Also specify whether there are any specific ethical issues raised by the local context in which the research activity is taking place, for example, particular cultural and/or legal sensitivities or vulnerabilities of participants.
13	*(this box should expand as you type)*

14	Use of documentation not in the public domain: Are any documents **NOT** publicly available?	**NO**	☒
		YES	☐
15	If Yes, please provide details here of how you will gain access to specific documentation that is not in the public domain and that this is in accordance with prevailing data protection law of the country in question and England and Wales. *(this box should expand as you type)*		

SECTION F: Scope of Research Activity

1	**Will the research activity include:**	**YES**	**NO**
2	Use of a questionnaire or similar research instrument?	**X**	☐
3	Use of interviews?	**X**	☐
4	Use of diaries?	**X**	☐
5	Participant observation with their knowledge?	**X**	☐
6	Participant observation without their knowledge?	☐	**X**
7	Use of video or audio recording?	**X**	☐

8	Access to personal or confidential information without the participants' specific consent?	☐	**X**
9	Administration of any questions, test stimuli, presentation that may be experienced as physically, mentally or emotionally harmful / offensive?	☐	**X**
10	Performance of any acts which may cause embarrassment or affect self-esteem?	☐	**X**
11	Investigation of participants involved in illegal activities?	☐	**X**
12	Use of procedures that involve deception?	☐	**X**
13	Administration of any substance, agent or placebo?	☐	**X**
14	Working with live vertebrate animals?	☐	**X**
15	Other primary data collection methods, please explain in this box For example, 'focus groups'. Please indicate the type of data collection method(s) in this box and tick the accompany box.	☐	**X**
16	Details of any other primary data collection method: (this box should expand as you type)		

If NO to every question, then the research activity is (ethically) low risk and **may** be exempt from **some** of the following sections (please refer to Guidance Notes).

If YES to any question, then no research activity should be undertaken until full ethical approval has been obtained.

SECTION G: Intended Participants

1	**Who are the intended participants:**	**YES**	**NO**
2	Students or staff at the University?	☐	**X**
3	Adults (over the age of 18 and competent to give consent)?	**X**	☐
4	Vulnerable adults?	☐	**X**
5	Children and Young People under the age of 18? (Consent from Parent, Carer or Guardian will be required)	☐	**X**
6	Prisoners?	☐	**X**
7	Young offenders?	☐	**X**
8	Those who could be considered to have a particularly dependent relationship with the investigator or a gatekeeper?	☐	**X**
9	People engaged in illegal activities?	☐	**X**
10	Others (please identify specifically any group who may be unable to give consent) please indicate here and tick the appropriate box.	☐	**X**
11	Other – please indicate here:		

12	**Participant numbers and source** Provide an estimate of the expected number of participants. How will you identify participants and how will they be recruited?	
13	How many participants are expected?	6-10
14	Who will the participants be?	Existing private clients in a 1-2-1 singing teaching setting. These include adults of any gender, with no upper age limit.
15	How will you identify the participants?	As pitch inaccuracy is more likely to occur in the beginner singer, it is that group that presents as the ideal participant for this study. Unlike experienced singers, this group is unlikely to have developed sufficient vocal technique to draw on other tuning strategies. Existing students who are challenged by pitch accuracy, will be individually invited to participate in the study. An initial approach will be made by email, out of lesson time, and will include an overall description of the aims of the study and an outline of their participation. Further detailed information will provided to expressions of interest. I will also offer telephone conversations to those who would prefer

16	**Information for participants:**	**YES**	**NO**	**N/A**
17	Will you describe the main research procedures to participants in advance, so that they are informed about what to expect?	☒	☐	☐
18	Will you tell participants that their participation is voluntary?	☒	☐	☐
19	Will you obtain written consent for participation?	☒	☐	☐
20	Will you explain to participants that refusal to participate in the research will not affect their treatment or education (if relevant)?	☒	☐	☐
21	If the research is observational, will you ask participants for their consent to being observed?	☒	☐	☐
22	Will you tell participants that they may withdraw from the research at any time and for any reason?	☒	☐	☐
23	With questionnaires, will you give participants the option of omitting questions they do not want to answer?	☒	☐	☐
24	Will you tell participants that their data will be treated with full confidentiality and that, if published, it will not be identifiable as theirs?	☒	☐	☐
25	Will you debrief participants at the end of their participation, in a way appropriate to the type of research undertaken?	☒	☐	☐
26	If NO to any of above questions, please give an explanation			
27	*(this box should expand as you type)*			

28	**Information for participants:**	**YES**	**NO**	**N/A**
29	Will participants be paid?	☐	☒	☐
30	Is specialist electrical or other equipment to be used with participants?	**X**	☐	☐
31	Are there any financial or other interests to the investigator or University arising from this study?	☐	☒	☐
32	Will the research activity involve deliberately misleading participants in any way, or the partial or full concealment of the specific study aims?	☐	X	☐
33	If YES to any question, please provide full details			
34	The use of a professional T-Bone condenser microphone will be used for spectrographic voice analysis. The microphone will feed into an Apple i-mac desk-top computer via *Focusrite Scarlett-212* audio interface. *Voce-Vista* is the spectrographic software being used for this study. *(this box should expand as you type)*			

SECTION H: Anticipated Risks

1	**Outline any anticipated risks that may adversely affect any of the participants, the researchers and/or the University, and the steps that will be taken to address them.** If you have completed a full risk assessment (for example as required by a laboratory, or external research collaborator) you may append that to this form.		
2	**Full risk assessment completed and appended?**	**Yes**	☐
		No	☒
3	**Risks to participants** For example: emotional distress, financial disclosure, physical harm, transfer of personal data, sensitive organisational information		
4	Risk to Participant: 1. The participant is unaware of their lack of ability to pitch accurately and as such being asked to participate might be demotivating or lead to self consciousness. 2. That the participant feels they must 'out of duty to the teacher' participate in the research, when they would rather not. 3. That anonymity and confidentiality may be compromised 4. Using a microphone that has been used by others previously who may have coughs or colds.	*How will you mitigate the Risk to Participant* 1. The atmosphere in the studio is one of encouragement and motivation and centred on improvement and solutions. As such, negative language that implies a deficiency is avoided. 2. The aspect of 'duty' will be addressed in the opening conversation about the research, with it being made clear that there is absolutely no pressure to be involved or not. Equally, the participant will be aware that they can withdraw at any time and if they are unhappy about any aspect, they can contact UWTSD. 3. The participant can be assured that through a structured consent protocol, their names and identity will remain anonymous throughout and after the research. Additionally, that any research materials generated through their participation will be destroyed following the end of the research. 4. Ensuring that the microphone is sanitised between participants.	
5	If research activity may include sensitive, embarrassing or upsetting topics (e.g. sexual activity, drug use) or issues likely to disclose information requiring further action (e.g. criminal activity), give details of the procedures to deal with these issues, including any support/advice (e.g. helpline numbers) to be offered to participants. Note that where applicable, consent procedures should make it clear that if something potentially or actually illegal is discovered in the course of a project, it may need to be disclosed to the proper authorities		
	(this box should expand as you type)		

6	**Risks to investigator** For example: personal safety, physical harm, emotional distress, risk of accusation of harm/impropriety, conflict of interest	
	Risk to Investigator: 1. That I may lose my clients who feel obliged to participate and, as such, stop coming to their lessons. My private practice is also my main business and as such, my primary income. I cannot afford for this to happen. 2. That by suggesting that a singer is out of tune and needs assistance in this area, may be upsetting and the singer may become defensive and resistant to direction or leave a bad business review. 3. That there may be a negative shift in the relationship dynamic between teacher and researcher 4. That as a solo-practitioner, I am vulnerable to physical harm from participants 5. There is a risk that I cannot persuade enough singers to participate in the research resulting in insufficient data collection or voiding the research altogether.	*How will you mitigate the Risk to Investigator:* 1. Using appropriate language to allow the singer to feel that there is no obligation and that my opinion of them will in no way be diminished. 2. The aim of a singing lesson is to facilitate improvement and seek solutions to problems. This is achieved by creating an environment that feels safe and will generate trust between teacher and student. A teacher needs to be empathetic and psychologically attuned to the needs of the particular student, using language that cannot be misconstrued for anything other than encouragement. 3. Awareness that the research should be undertaken outside the framework of a lesson to keep the two separated. Any learning extracted from participating in the study can be brought into the singing studio independently. 4. My neighbours who have a view of my studio from their homes are aware that I work on my own and understand the nature of my business. They have keys in the event of an emergency. I don't teach without without pre-payment and without obtaining personal details. Having this information may invoke a level of accountability in the behaviours of visiting clients. Essentially, the participants must already be known to me. 5. In the event that I am unable to secure adequate participation to produce meaningful results, I will consider a different approach to answering the research question. This might include a thorough exploration of related research or perhaps an investigation of the experiences of other singing teachers who use facial expression as part of their
7	**University/institutional risks** For example: adverse publicity, financial loss, data protection	

	Risk to University: 1. When undertaking this research, I am acting as a member of the University, therefore any perceived lack of professionalism may damage the reputation of the university. 2. Potential claims of negligence could be made against the university, for poorly conducted research undertaken by research students. The university has taken steps to minimise the risks to its reputation by the provision of an ethics code of practice which aims to govern all insider researcher investigations. Any breach of these, puts the university at risk.	*How will you mitigate the Risk to University:* 1. Professionalism includes being well organised and well prepared in addition to clarity and honesty in all my dealings relating to this research. Upholding high standards in the manner in which the research is undertaken and in the integrity of the research data itself, are vital in this regard. 2. To minimise the potential for claims of negligence, I will comply with the ethical, legal and professional frameworks, obligations and standards as required by statutory and regulatory authorities, as well as the university's Research Integrity and Ethics Code of Practice. I have read and understand the behaviours that constitute misconduct; these include fabrication, falsification, plagiarism, failure to meet ethical, legal and professional obligations and improper dealing with allegations of misconduct, all constitute malfeasance and are therefore regarded as misconduct.

8	**Disclosure and Barring Service**			
9	If the research activity involves children or vulnerable adults, a Disclosure and Barring Service (DBS) certificate must be obtained before any contact with such participants.	**YES**	**NO**	**N/A**
10	Does your research require you to hold a current DBS Certificate?	☐	**X**	☐

SECTION I: Feedback, Consent and Confidentiality

1	**Feedback** What de-briefing and feedback will be provided to participants, how will this be done and when?
	I will provide my email address and all the participants will be able to contact me by this means for further information and the results. An overview of the results will be provided after the research has been submitted and marked, and will available on request.

2	**Informed consent** Before consent is obtained, all potential participants will be provided with a full description of the aims of the research and the ethical principles and constraints by which the research is being undertaken. This will include a detailed description of the process of collecting and testing data and the assurance of confidentially and anonymity (in accordance with the DPA 2018). The precise details of their participation will be clearly stated. The participants will understand that they can withdraw at any time and will participate in the full knowledge that their rights will be upheld and respected throughout the process. In the event of consent, the participant and the principal researcher will be bound by these terms.
	The paper questionnaires and the spectrographic recordings used in this study count as personal data and will require an appropriate consent form. All consent forms must obtain approval from the supervising tutor before use.
3	**Confidentiality / Anonymity** Set out how anonymity of participants and confidentiality will be ensured in any outputs. If anonymity is not being offered, explain why this is the case.
	No participant names or identities will be included in any of the research data. While the data is being processed by the researcher, it will be stored on a desktop password-protected, personal computer that is locked away when not being used and can only be accessed by the principal researcher. This data will be backed up and stored on an encrypted and password protected external hard drive that is stored in a different location to the computer and not accessible to anyone other than the principal researcher. Once the research has been marked and graded, the data will be destroyed by shredding paper questionnaires and by erasing the external hard drive and deleting any related files from the computer, thereby eliminating any chance of identifying the participant.

SECTION J: Data Protection and Storage

In completing this section refer to the University's Research Data Management Policy and the extensive resources on the University's Research Data Management web pages (http://uwtsd.ac.uk/library/research-data-management/).

1	Does the research activity involve personal data (as defined by the General Data Protection Regulation 2016 "GDPR" and the Data Protection Act 2018 "DPA")?	**YES**	**NO**
	"Personal data" *means any information relating to an identified or identifiable natural person ('data subject'). An identifiable natural person is one who can be identified, directly or indirectly, in particular by reference to an identifier such as a name, an identification number, location data, an online identifier or to one or more factors specific to the physical, physiological, genetic, mental, economic, cultural or social identity of that natural person.*	**X**	□
2	If YES, provide a description of the data and explain why this data needs to be collected:		

	The gathering of personal data for the purposes of undertaking this research will include the following: • Screen recordings of participants' spectrographic feedback imaging. This information is integral to identifying harmonic patterns. • The accompanying audio recording of the participant's voice, recorded during spectrographic analysis, which adds further understanding to the graphic feedback being examined. • Paper questionnaires to monitor the participants' feedback during the experience are also important in understanding the sensations experienced and for learning to repeat any positive outcomes in a non-research setting. Each type of personal data will require the submission of specific personal data consent forms.		
3	Does it involve special category data (as defined by the GDPR)?	**YES**	**NO**
	"Special category data" *means sensitive personal data consisting of information as to the data subjects' –* *(a) racial or ethnic origin,* *(b) political opinions,* *(c) religious beliefs or other beliefs of a similar nature,* *(d) membership of a trade union (within the meaning of the Trade Union and Labour Relations (Consolidation) Act 1992),* *(e) physical or mental health or condition,* *(f) sexual life,* *(g) genetics,* *(h) biometric data (as used for ID purposes),*	☐	X
4	If YES, provide a description of the special category data and explain why this data needs to be collected:		
	(this box should expand as you type)		

5	Will the research activity involve storing personal data and/or special category data on one of the following:	**YES**	**NO**
6	Manual files (i.e. in paper form)?	X	☐
7	University computers?	☐	**X**
8	Private company computers?	☐	**X**
9	Home or other personal computers?	**X**	☐
10	Laptop computers/ CDs/ Portable disk-drives/ memory sticks?	**X**	☐
11	"Cloud" storage or websites?	☐	**X**
12	Other – specify:	☐	**X**

13	For all stored data, explain the measures in place to ensure the security of the data collected, data confidentiality, including details of password protection, encryption, anonymisation and pseudonymisation:		
	While being processed, data will be kept on a password-protected desktop computer that remains locked up when unattended and backed up to password protected, encrypted, external hard drive, kept in a operate location. No-one, other than the principal researcher, has access to the passwords or data, either now or over the course of the research and beyond. Digital copies will be made of data collected using non-digital means, including paper questionnaires, and stored securely in the same manner as other digital assets described above. Paper questionnaires will be stored in a lockable cupboard in the studio where the research is being undertaken and will be shredded following the completion of the research.		
14	**All Data Storage**		
15	Will the research activity involve any of the following activities:	**YES**	**NO**
16	Electronic transfer of data in any form?	**X**	□
17	Sharing of data with others at the University?	**X**	□
18	Sharing of data with other organisations?	□	**X**
19	Export of data outside the European Union or importing of data from outside the UK?	□	**X**
20	Use of personal addresses, postcodes, faxes, emails or telephone numbers?	**X**	□
21	Publication of data that might allow identification of individuals?	□	**X**
22	Use of data management system?	□	**X**
23	Data archiving?	□	x
24	If YES to any question, please provide full details, explaining how this will be conducted in accordance with the GDPR and DPA (and/or any international equivalent):		
	It will be necessary to share data with the presiding tutor, Pippa Anderson, as part of the evaluation and tutoring process. All data transfers will be encrypted and password protected. An external hard drive used to store data will be password protected. The data will be stored until the completion of the project and then deleted. In accordance with the DPA2018, participants will have the right to ask to see what data is held relating to them, and this data will be deleted immediately if the participant requests this, in which case the data will not be used in the project. Participants will be able to communicate with me about the logistical and overall nature of the research through my work email address. My email is password protected and can be accessed through the desktop and through my mobile phone. All data will be collected in person and there will be no circumstance, other than with my tutor, when personal data will be submitted by email. I will provide a research results overview via email to any participant that asks. As all of the participants are already known to me, I will necessarily have their personal contact information on file which includes an email address and a telephone number.		
25	List all who will have access to the data generated by the research activity:		

	The principal researcher Any participant that wishes to see what data is held relating to them. The presiding research supervisor, Pippa Anderson, and any other requesting member of staff at the Voice Study Centre or UWTSD.		
26	List who will have control of, and act as custodian(s) for, data generated by the research activity:		
	The principal researcher - Tanya Holt		
27	Give details of data storage arrangements, including security measures in place to protect the data, where data will be stored, how long for, and in what form. Will data be archived – if so how and if not why not.		
	All data will be encrypted and kept in a password protected external hard drive that will be reformatted at the end of the project in order to destroy the data. The data will be stored until the completion of the project and then deleted.		
28	Please indicate if your data will be stored in the UWTSD Research Data Repository (see https://researchdata.uwtsd.ac.uk/). If so please explain. (*Most relevant to academic staff*)		
	(this box should expand as you type)		
29	Confirm that you have read the UWTSD guidance on data management (see https://www.uwtsd.ac.uk/library/research-data-management/)	**YES**	**X**
		NO	□
30	Confirm that you are aware that you need to keep all data until after your research has completed or the end of your funding	**YES**	X
		NO	□

SECTION K: Declaration

31	The information which I have provided is correct and complete to the best of my knowledge. I have attempted to identify any risks and issues related to the research activity and acknowledge my obligations and the rights of the participants. In submitting this application I hereby confirm that I undertake to ensure that the above named research activity will meet the University's Research Ethics and Integrity Code of Practice which is published on the website: https://www.uwtsd.ac.uk/research/research-ethics/		
	Signature of applicant:	Tanya Holt	**Date: 15/02/2024**

For STUDENT Submissions:

32	Director of Studies/ Supervisor:		**Date:**
33	Signature:		

For STAFF Submissions:

34	Academic Director/ Assistant Dean:		**Date:**
35	Signature:		

Checklist: Please complete the checklist below to ensure that you have completed the form according to the guidelines and attached any required documentation:

X	I have read the guidance notes supplied before completing the form.
X	I have completed **ALL RELEVANT** sections of the form in full.
X	I confirm that the research activity has received approval in principle
□	I have attached a copy of final/interim approval from external organisation (**where appropriate**)
□	I have attached a full risk assessment (and have NOT completed Section H of this form) (where appropriate) *ONLY TICK IF YOU HAVE **ATTACHED A FULL RISK ASSESSMENT***
X	I understand that it is my responsibility to ensure that the above named research activity will meet the University's Research Ethics and Integrity Code of Practice.

X	I understand that before commencing data collection all documents aimed at respondents (including information sheets, consent forms, questionnaires, interview schedules etc.) must be confirmed by the DoS/Supervisor, module tutor or Academic Director.
X	I have deleted the guidance notes before submitting the PG2 for consideration

Appendix C: Research Approval Letter

TANYA HOLT

SINGING TEACHER & VOCAL COACH

9th February 2024

To the University of Wales Trinity Saint David,

Research Title: *Can changes in facial expression improve tuning in the beginner singer? An exploration of the correlation between facial expression and pitch.*

I confirm that I approve that the research proposed, *Can changes in facial expression improve tuning in the beginner singer?* can be carried out by Tanya Holt, of Tanya Holt Singing Teacher and Vocal Coach based at 27 Trafalgar Grove, between 18th March 2024 - 1st July 2024.

Kind Regards,

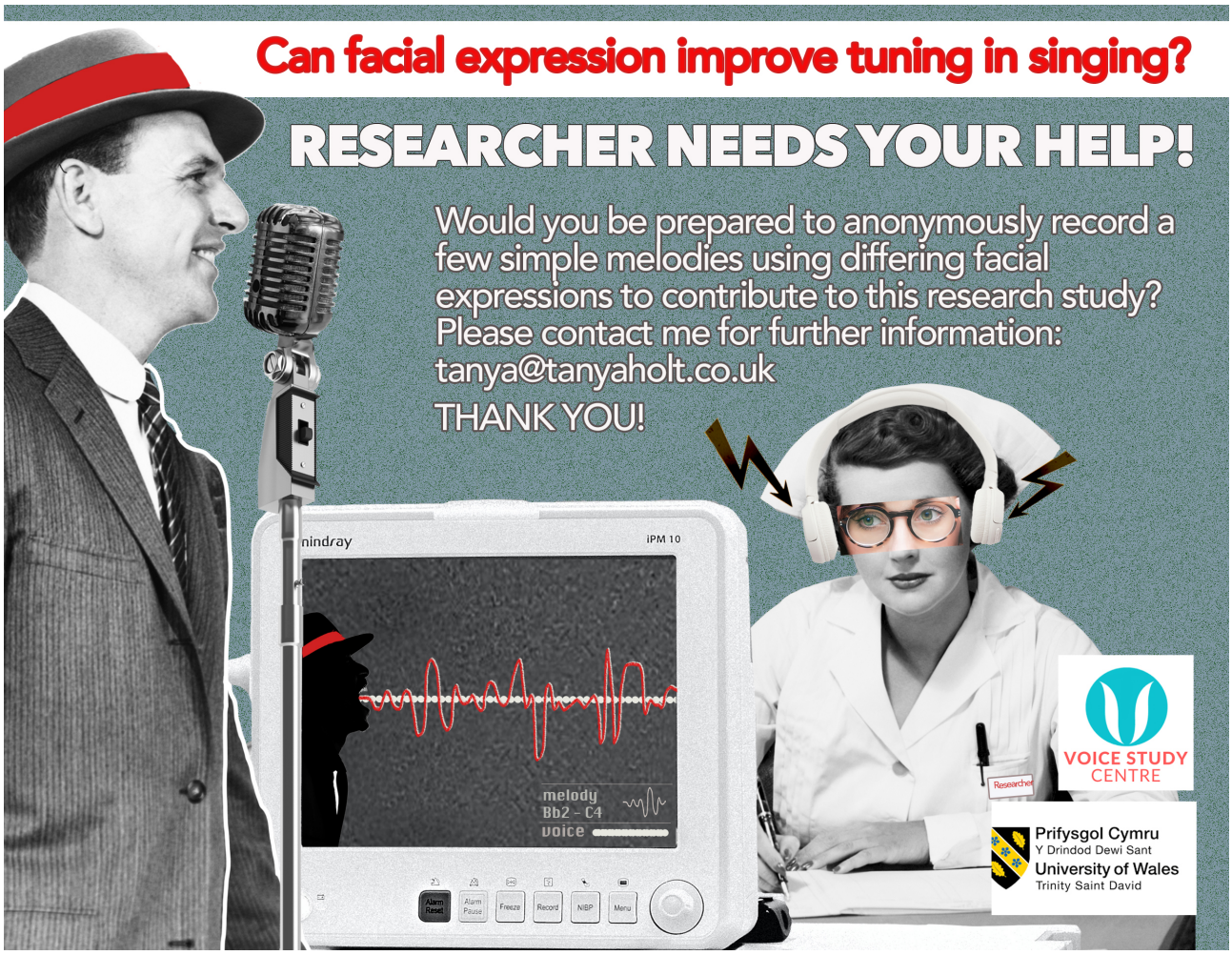
Tanya Holt

Tanya Holt

27 TRAFALGAR GROVE, LONDON SE10 9TB

tanya@tanyaholt.co.uk 07949 443118

Appendix D: Participant Recruitment flyer



Appendix D: Participant Consent Form - Blank

Participant Consent Form

Study Title: Can changes in facial expression serve as a tool to improving tuning accuracy in novice singers?
Principle Researcher: Tanya Holt
Contact information: tanya@tanyaholt.co.uk

Activity location: 27 Trafalgar Grove, London SE10 9TB
Research period: 26th April - 26th May 2024
Participation criteria: Adults only (18+). Self identifying as a novice singer

This research is being undertaken under the supervision of the University of Wales & Trinity Saint David (UWTSD) and the Voice Study Centre Ltd., as part of their Professional Masters in Vocal Pedagogy. Under the terms of these institutions, signed consent is mandatory and a pre-requisite to participation. The implementation of this study has received approval from UWTSD Ethics Committee.

Aims of the research

The significance of facial expression on timbre (overall voice quality) is abundantly highlighted both in contemporary acoustic research (Bozeman, 2019; Miller, 1996, 2004; Nair, 1999), and in historical teaching texts, from as far back as 1723 (Lamperti, 1877; Tosi, 1723). However, there is limited evidence to suggest that facial expression has been specifically employed as a tool to improving tuning accuracy in singing. The aim of this study is to use spectrographic technology to build on this research and explore the interrelationship between facial musculature and the pitch of the sound produced. Spectrography is non-invasive and uses recorded voice samples to provide a visual depiction of the harmonic details of a person's voice. The software can detect and measure the minute changes in pitch that occur. By contrasting repeated melodic patterns sung by the same singer using different facial expressions, there may be evidence that certain postures can improve pitch accuracy. In the event of finding a correlation, further research may enable the development of singing teaching tools.

A summary of what's involved

The participant will record short melodies using different facial expressions. These recordings will capture spectrographic information that will form part of the data for this study. The melodies used will range from a single vowel sound held on a sustained note, to a 7 note melody. The estimated recording time is approximately 20-minutes.

How will it happen?

Directed by the researcher and using reference photographs, the participant will learn 3-different facial postures, eg. neutral face, smiling etc. Through headphones, the participant will familiarise themselves with pre-recorded piano/voice short melodies. When the recording begins the participant will hear only the piano accompaniment and will sing back and record each melody using the 3-pre learned facial postures. After the recording is complete, the researcher will conduct a short interview with the participant to determine any feedback about the experience.

Anonymity

Participation is anonymous and identities will not be disclosed in any of the data. Additionally personal data such as the recording and spectrographic imaging will be kept securely and be destroyed after the research has been assessed by UWTSD (August, 2024).

Consent

It is important that you feel you understand what is expected from you before you decide to participate, so please feel free to contact the researcher if you have any questions. Please read the following terms, adapted from the Voice Study Centre's (2024) participant consent form, and if you decide to consent, please sign and date the bottom of the contract.

I have had the purpose and nature of the study explained to me in writing and I have had the opportunity to ask questions about the study.

I understand that even if I agree to participate now, I can withdraw at any time.

I understand that the research will be undertaken in person at 27 Trafalgar Grove.

I understand that my participation in this study involves an audio and spectrographic recording of me singing. This will be undertaken under the direction of the principle researcher who may take take observational notes during the recording.

My participation will conclude with an interview about the recording experience

I agree to my interview being audio-recorded.

I understand that all the information I provide for this study will be treated confidentially.

I understand that in any report on the results of this research, my identity will remain anonymous

This will be done by changing my name and disguising any details of my interview which may reveal my identity

I understand that disguised extracts from my interview may be quoted in the researcher's dissertation.

I understand that signed consent forms will be securely retained in a locked room at the research premises, and that original audio recordings will be encrypted and stored on a standalone hard drive on the same premises. These will be kept until the exam board confirms the results on 12th August 2024. Further to this date, consent forms will be shredded and audio files permanently deleted.

I understand that a transcript of my interview in which all identifying information has been removed can be retained for two years from 12th August 2024.

I understand that under freedom of information legalisation I am entitled to access the information I have provided at any time while it is in storage as specified above.

I understand that I am free to contact any of the people leading the research to seek further clarification and information.

I understand that I can refuse to participate in any of the research process, as described above, without any consequences of any kind.

I understand that I will not benefit directly from participating in this research. I am voluntarily agreeing to participate in this research study.

_____

Participant signature & printed name Date

_____ _____ Principle Researcher, signature and printed name Date

Contact information:
Tanya Holt Research supervisor: Melissa Toy tanya@tanyaholt.co.uk mel@voicestudycentre.com
+44 07949 443118_____ _____

Appendix E: Personal Data Consent Form - Blank

Personal Data Consent Form

Study Title: Can changes in facial expression serve as a tool to improving tuning accuracy in novice singers?
Principle Researcher: Tanya Holt

This research is being undertaken under the supervision of the University of Wales & Trinity Saint David (UWTSD) and the Voice Study Centre Ltd., as part of their Professional Masters in Vocal Pedagogy.

- I give permission for my personal data, in the form of audio recordings, to be used by the researcher for this study only and not for any other purpose. I understand that my identity will remain anonymous and that my personal data will be treated securely and with confidentiality.
- I agree that disguised extracts from my recorded interview may be quoted in the researcher's dissertation. This will be done by changing my name and disguising any details of my interview which may reveal my identity.
- Following the formal assessment of this study by the University of Wales and Trinity (12th August 2024), the audio recordings will be destroyed.
- I understand that a transcript of my recorded interview in which all identifying information has been removed can be retained for two years, from 12th August 2024.

_____ _____

Participant signature & printed name Date

_____ _____

Principle Researcher, signature and printed name Date

Contact information:

Tanya Holt
tanya@tanyaholt.co.uk
+44 07949 443118

Research supervisor: Melissa Toy
mel@voicestudycentre.com

VOICE STUDY CENTRE

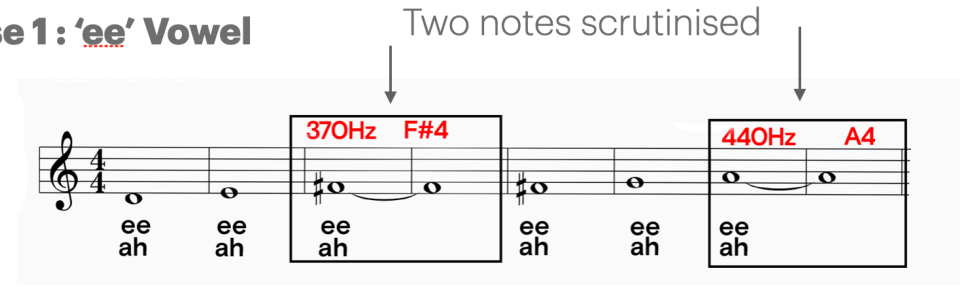
Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

Appendix E: Signed Consent Forms

Due to significant file sizes, these completed forms have been submitted as separate appendices through through Moodle on the UWTSD portal.

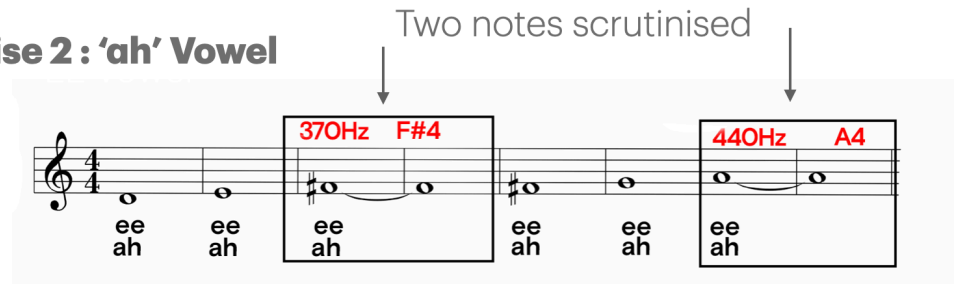
Appendix F: Data per sung note, per exercise, per participant

Exercise 1 : 'ee' Vowel



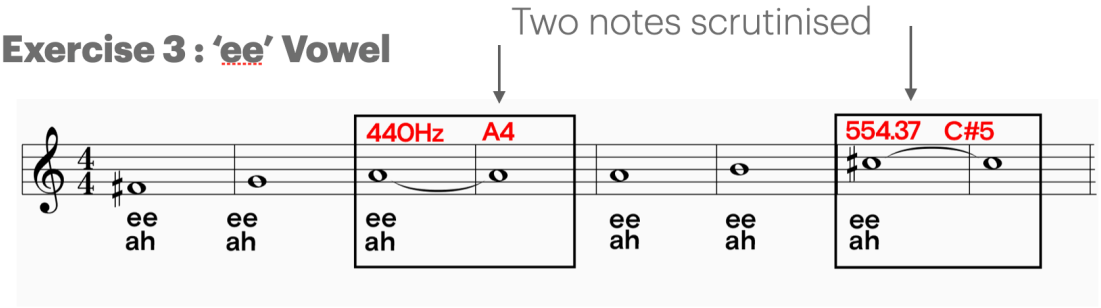
Participant Identity	Neutral Face	Neutral Face	Squinty Face	Squinty Face	Sniff the Rose	Sniff the Rose
A	-229	-196	-11	59	-3	9
C	18	-1	25	17	2	-8
D	8	-21	26	1	60	0
E	-3	4	7	-16	39	-13
F	0	9	-23	6	-16	1
G	-8	-1	-2	17	15	-6
I	-17	21	18	19	-7	13
J	-8	4	21	-2	39	2
K	15	16	22	44	26	26
Mean Pitch	-25	-18	9	16	17	3

Exercise 2 : 'ah' Vowel



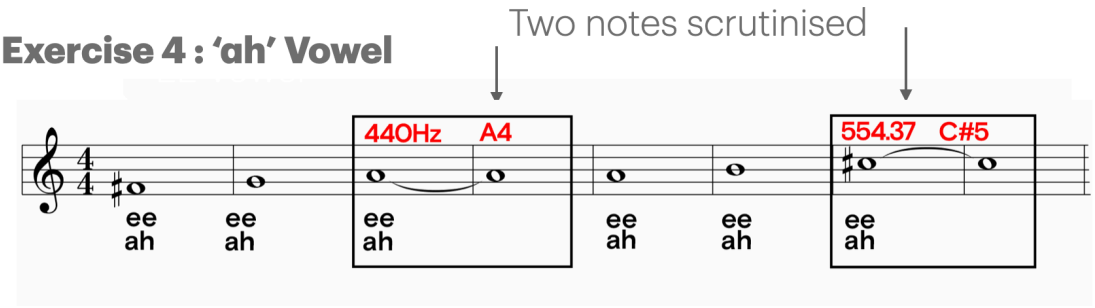
Participant Identity	Neutral Face	Neutral Face	Squinty Face	Squinty Face	Sniff the Rose	Sniff the Rose
A	-61	-26	9	11	-7	14
C	9	5	19	-3	12	-5
D	-251	2	38	-10	60	18
E	25	-1	51	6	-10	-2
F	-23	6	-10	-15	-25	10
G	-17	5	-12	-9	1	-2
I	-24	5	-22	-42	-40	1
J	-8	4	21	-2	39	2
K	23	7	33	-31	45	-5
Mean Pitch	-36	1	14	-11	8	3

Exercise 3 : 'ee' Vowel



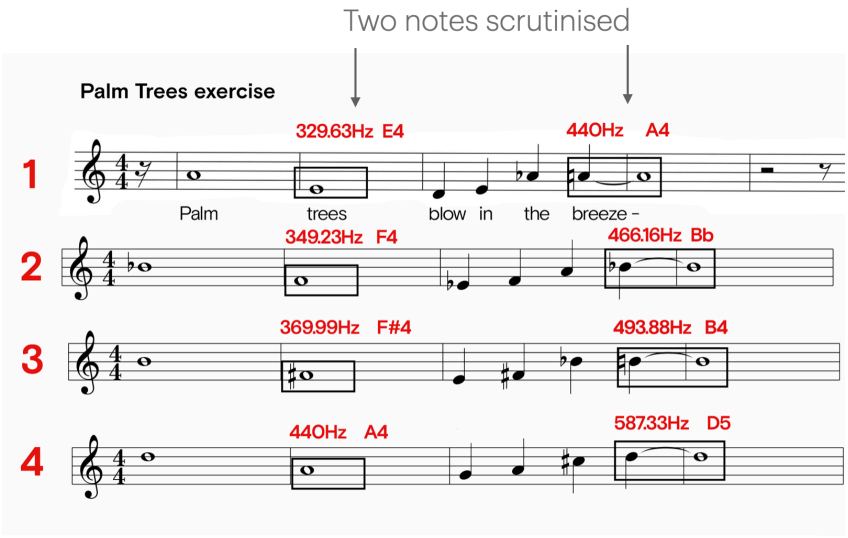
Participant Identity	Neutral Face	Neutral Face	Squinty Face	Squinty Face	Sniff the Rose	Sniff the Rose
A	-5	-295	29	-45	27	-38
C	5	13	14	6	9	-15
D	22	0	81	-39	167	-26
E	10	16	25	8	29	7
F	10	-19	38	-26	17	0
G	3	-12	12	-2	8	6
I	57	16	10	5	29	7
J	-5	-52	11	-13	15	-37
K	27	21	41	47	50	45
Mean Pitch	14	-35	29	-7	39	-6

Exercise 4 : 'ah' Vowel



Participant Identity	Neutral Face	Neutral Face	Squinty Face	Squinty Face	Sniff the Rose	Sniff the Rose
A	-91	-42	11	-29	6	-7
C	-5	-5	-11	-12	-9	-11
D	-56	-26	29	-2	42	-17
E	6	2	4	3	6	2
F	13	0	672	574	-6	15
G	-15	-24	-17	-11	-10	-14
I	6	15	2	16	0	26
J	5	-54	15	-17	2	7
K	19	13	40	29	38	28
Mean Pitch	-13	-13	83	61	8	3

Palm Trees Exercise



Palm Trees: 1

Participant Identity	Neutral Face	Neutral Face	Squinty Face	Squinty Face	Sniff the Rose	Sniff the Rose
A	-188	-88	-67	-13	-97	15
C	18	20	22	14	24	15
D	-41	-44	-11	-21	46	13
E	24	38	6	32	40	16
F	-63	18	-5	-161	-36	15
G	-13	5	0	13	-18	4
I	-270	18	50	19	-24	12
J	3	20	-5	18	26	19
K	17	20	44	14	54	55
Mean Pitch	-57	1	4	-9	2	18

Palm Trees: 2

Participant Identity	Neutral Face	Neutral Face	Squinty Face	Squinty Face	Sniff the Rose	Sniff the Rose
A	-97	-7	-89	-11	-65	28
C	27	10	13	10	15	33
D	-66	-43	-36	-41	-28	-32
E	27	20	23	27	25	19
F	-41	17	-61	2	-9	15
G	6	1	11	-7	-2	-5
I	12	-23	-2	-27	-47	-43
J	8	-10	46	28	36	17
K	13	15	46	26	15	39
Mean Pitch	-12	-2	-5	1	-7	8

Palm Trees: 3

Participant Identity	Neutral Face	Neutral Face	Squinty Face	Squinty Face	Sniff the Rose	Sniff the Rose
A	-134	-28	-29	-14	-22	18
C	15	3	-17	-11	-16	-24
D	-110	-47	-58	-45	194	189
E	22	27	-10	-2	31	66
F	-12	3	-41	-99	40	-8
G	-2	-17	-15	-15	1	0
I	8	19	11	36	-14	8
J	-9	-33	45	10	24	-5
K	5	20	24	40	24	37
Mean Pitch	-24	-6	-10	-11	29	31

Palm Trees: 4

Participant Identity	Neutral Face	Neutral Face	Squinty Face	Squinty Face	Sniff the Rose	Sniff the Rose
A	-162	-171	-47	-71	-28	-33
C	0	-5	3	-6	7	-5
D	-94	-115	-38	-150	-22	-14
E	36	48	-8	22	-1	80
F	19	42	-23	29	41	38
G	-40	2	11	-15	2	18
I	36	23	92	32	-26	25
J	-11	39	42	5	49	12
K	0	22	2	28	25	51
Mean Pitch	-24	-13	4	-14	5	19

Appendix G: Data collection per participant for each exercise

Participant identifier: A Gender: Female Age:30-39
Level of experience in singing: Novice, having lessons. Challenged by pitching in upper registers.

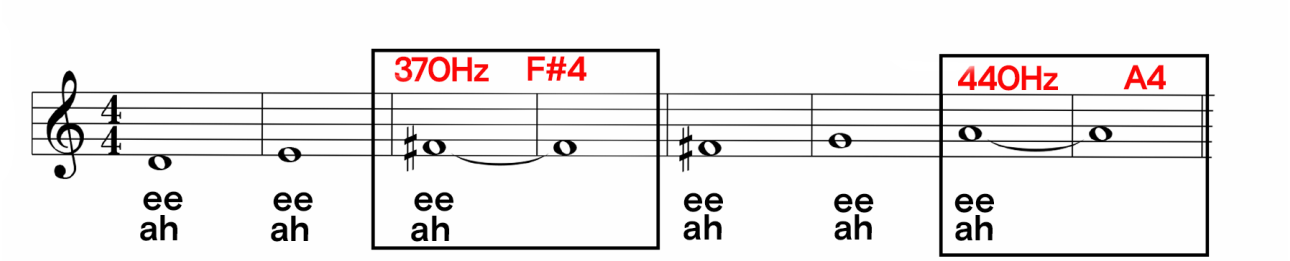
Results illustrated in Hertz, musical pitch and musical cents

100 cents = semitone
50 cents = quarter tone
200 cents = whole tone

IN-TUNE = mean pitch calculated over 1 second <50-cents off target note

FLAT = mean pitch calculated over 1 second >50-cents below target

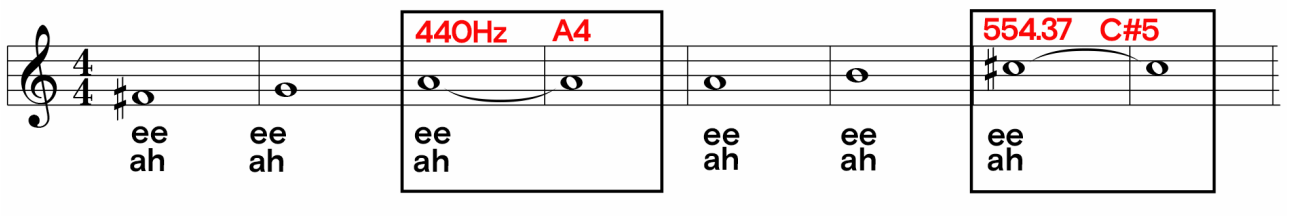
SHARP = mean pitch calculated over 1 second >50-cents above target



1. (EE) Frequency & Target Pitch	370Hz F#4	Cents		440Hz A4	Cents	
Neutral Face	**324.12** E4-29	-229	FLAT	**392.86**Hz G4 +4	-196	FLAT
Squinty Face	**369.70** F#4-11	-11	IN-TUNE	**455.23Hz** Bb4 -41	59	SHARP
Sniff the Rose	**369.40** F#4-3	-3	IN-TUNE	**442.25** A4 +9	9	IN-TUNE

2. (AH) Frequency & Target Pitch	370Hz F#4	Cents		440Hz A4	Cents	
Neutral Face	**357.19** F4 +39	-61	FLAT	**433.34** A4 -26	-26	IN-TUNE
Squinty Face	**371.95** F#4 +9	9	IN-TUNE	**442.88** A4+11	11	IN-TUNE
Sniff the Rose	**368.41** F#4 -7	-7	IN-TUNE	**443.46** A4 +14	14	IN-TUNE

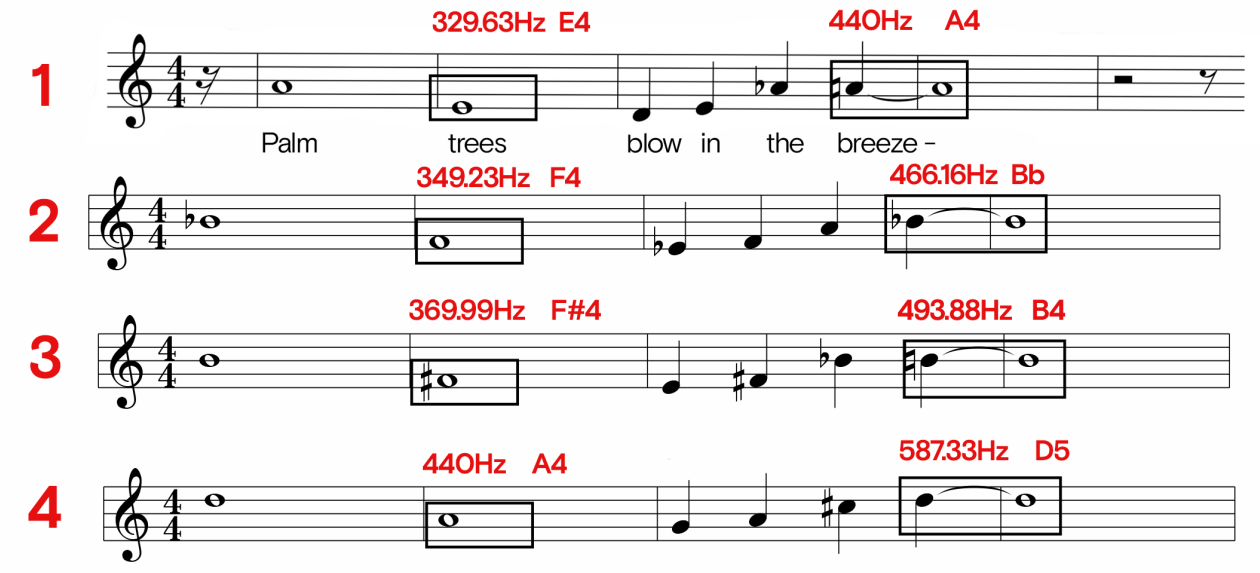
Exercise 1 - Vowels



3. (EE) Frequency & Target Pitch	440Hz. A4	Cents		554.37Hz. C#5	Cents	
Neutral Face	**438.7**Hz. A4-5	-5	IN-TUNE	**525.26**Hz. A4-5	-295	FLAT
Squinty Face	**447.4**Hz. A4+29	29	IN-TUNE	**540**Hz. C#5-45	-45	IN-TUNE
Sniff the Rose	**446.96**Hz A4+27	27	IN-TUNE	**542.36**Hz C#5-38	-38	IN-TUNE

4. (AH) Frequency & Target Pitch	440Hz. A4	Cents		554.37Hz. C#5	Cents	
Neutral Face	**417.57**Hz Ab4+9	-91	FLAT	**541.05**Hz. C#5-42	-42	IN-TUNE
Squinty Face	**442.72**Hz A4+11	11	IN-TUNE	**545.19**Hz. C#5-29	-29	IN-TUNE
Sniff the Rose	**441.49**Hz A4+6	6	IN-TUNE	**552.10**Hz. C#-7	-7	IN-TUNE

Palm Trees exercise



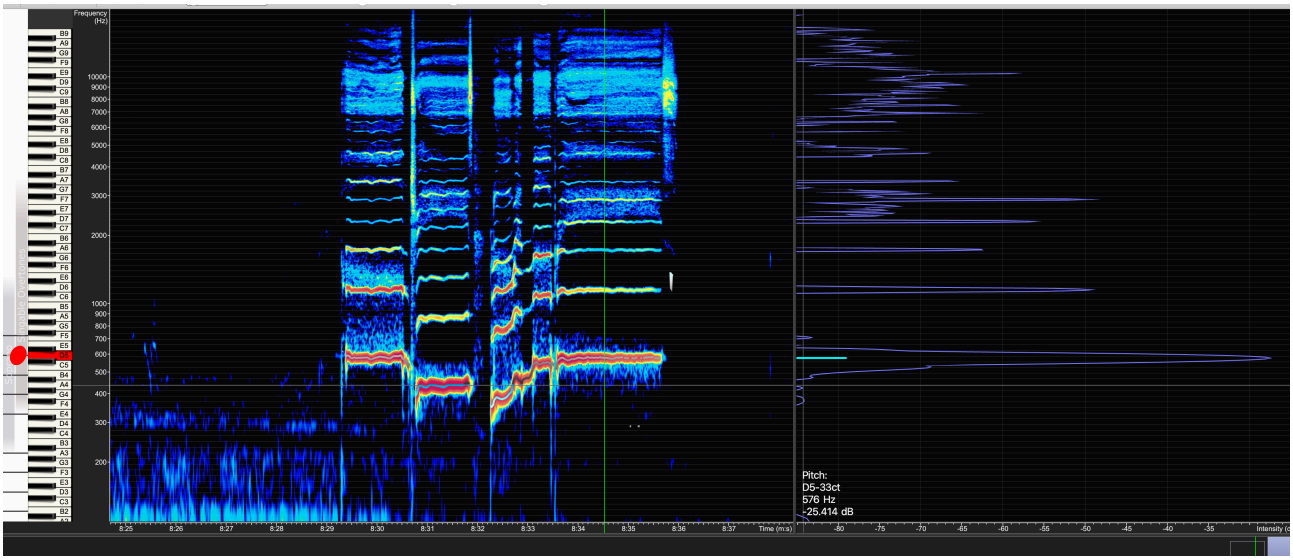
1. Frequency & Target Pitch	329.63Hz E4	Cents		440Hz. A4	Cents	
Neutral Face	**296.42**Hz D4+12	-188	FLAT	**420.59**Hz. Ab4-12	-88	FLAT

1. Frequency & Target Pitch	**329.63Hz** E4	**Cents**		**440Hz.** A4	**Cents**	
Squinty Face	**310.23**Hz Eb4-33	-67	**FLAT**	**436.44**Hz. A4-13	-13	**IN-TUNE**
Sniff the Rose	**314.67**Hz Eb4-3	-97	**FLAT**	**439.52**Hz. A4+15	15	**IN-TUNE**

3. Frequency & Target Pitch	**370Hz. F#4**	**Cents**		**493.88Hz B4**	**Cents**	
Neutral Face	**345.33**Hz. F4-34	-134	**FLAT**	**484.58**Hz. B4-28	-28	**IN-TUNE**
Squinty Face	**360.50**Hz F#4-29	-29	**IN-TUNE**	**494.78**Hz. B4-14	-14	**IN-TUNE**
Sniff the Rose	**366.92**Hz. F#4-22	-22	**IN-TUNE**	**497.03**Hz. B4+18	18	**IN-TUNE**

4. Frequency & Target Pitch	**440Hz. A4**	**Cents**		**587.33Hz. D5**	**Cents**	
Neutral Face	**403.27**Hz. G4+38	-162	**FLAT**	**530.31**Hz. C5+29	-171	**FLAT**
Squinty Face	**426.96**Hz. A4-47	-47	**IN-TUNE**	**564**Hz. C#5+29	-71	**FLAT**
Sniff the Rose	**436.61**Hz. A4-28	-28	**IN-TUNE**	**576.71**Hz. D5-33	-33	**IN-TUNE**

Image: Spectrogram depicting exercise 4 'sniff the rose' 576Hz / D5-33



Interview notes

Interview times from 3-6- minutes.

3 open questions:

1. Open question seeks to gain feedback on whether any of the facial postures made the singing feel easier or harder and was there any change in tone. Were the postures difficult or easy to achieve and can they describe the sensations of each postures.
2. Participate asked about feedback on: Facial posture names, word descriptors of each and visual images.
3. Participant asked if there is anything about the experiment that could be improved or changed

STARTS

Surprised face made it easier. I could tell there was a difference in tone between the faces. Descriptors were clear, I liked the images. They are helpful to see. It definitely changed the pitching. Neutral expression felt harder to get to the high notes for sure. Also dull sounding. Neutral face highlights how singing is easier if you use your face. Squinty face made EE feel easier than AH. Descriptions and images very helpful.

Researcher in vivo observations: Very good at delivering facial expressions. Was relaxed. Upright posture throughout. Professional dancer with an awareness of body alignment.

Participant identifier: B Gender: Male Age:40-49
Level of experience in singing: Beginner singer, just started having lessons. Challenged by pitching

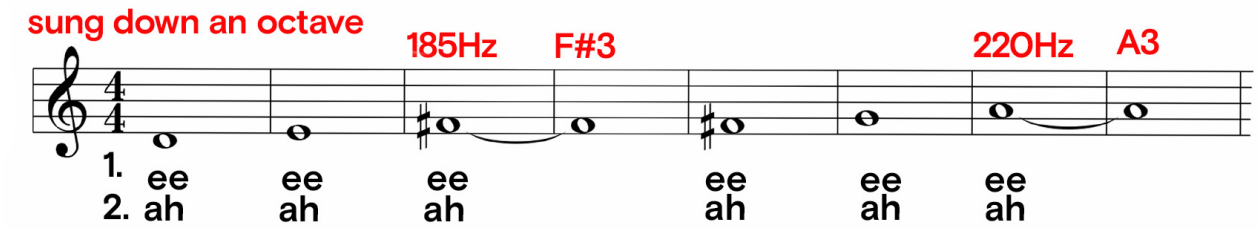
Results are illustrated in Hertz, musical pitch and musical cents
50 cents = quarter tone
100 cents = semitone
200 cents = whole tone

IN-TUNE = mean pitch calculated over 1 second <50-cents off target note

FLAT = mean pitch calculated over 1 second >50-cents below target

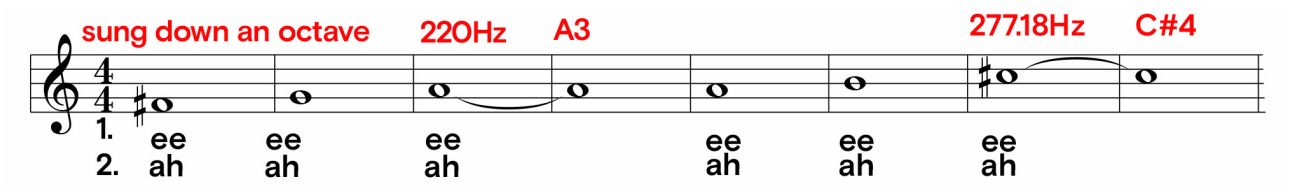
SHARP = mean pitch calculated over 1 second >50-cents above target

Exercise 1 - Vowels



1. (EE) Frequency & Target Pitch	185Hz F#3	Cents		220Hz A3	Cents	
Neutral Face	**190.22** F#3 +48	48	**IN-TUNE**	**216.31** A3-29	-29	**IN-TUNE**
Squinty Face	**187.96** F#3+28	28	**IN-TUNE**	**218.36** A3-13	-13	**IN-TUNE**
Sniff the Rose	**189.70** F#3+43	43	**IN-TUNE**	**211.70** G#3+33	-67	**FLAT**

2. (AH) Frequency & Target Pitch	185Hz F#3	Cents		220Hz A3	Cents	
Neutral Face	**186.95** F#3+18	18	**IN-TUNE**	**211.04** G#3+28	-72	**IN-TUNE**
Squinty Face	**188.07** F#3+29	29	**IN-TUNE**	**217.90** A3-17	-17	**IN-TUNE**
Sniff the Rose	**210.44** G#3+23	223	**SHARP**	**233.02** A#3	100	**SHARP**



3. (EE) Frequency & Target Pitch	220Hz. A3	Cents		277.18Hz. C#4	Cents	
Neutral Face	**216.84** G#3+33	-67	FLAT	**230.61**Hz. A#3-13	-313	FLAT
Squinty Face	**216.78**Hz. A3-26	-26	IN-TUNE	**237.89**Hz. A#3+35	-265	FLAT
Sniff the Rose	**215.85** A3-33	-33	IN-TUNE	**216.36**Hz A3-29	-429	FLAT

4. (AH) Frequency & Target Pitch	220Hz. A3	Cents		277.18Hz. C#4	Cents	
Neutral Face	**222.77**Hz A3+22	22	IN-TUNE	**228.03**Hz. A#3-38	-338	FLAT
Squinty Face	**219.68**Hz A3-3	-3	IN-TUNE	**227.89**Hz. A#3-39	-339	FLAT
Sniff the Rose	**219.38**Hz A3-5	-5	IN-TUNE	**235.66**Hz. A#3+19	-281	FLAT

1. Frequency & Target Pitch	130.81Hz C3	Cents		174.61Hz. F3	Cents	
Neutral Face	**136.77**Hz C#3-23	77	SHARP	**203.12**Hz. G#3-38	262	SHARP
Squinty Face	**142.48**Hz C#3+48	148	SHARP	**208.75**Hz. G#3+9	309	SHARP
Sniff the Rose	**156.63**Hz D#3+12	312	SHARP	**213.45**Hz. G#3+48	348	SHARP

2. Frequency & Target Pitch	138.59Hz C#3	Cents		185Hz. F#3	Cents	
Neutral Face	**133.87**Hz C3+40	-60	FLAT	**176.61**Hz F3+20	-80	FLAT
Squinty Face	**134.69**Hz C#3-49	-49	IN-TUNE	**186.02**Hz. F#3+10	10	IN-TUNE
Sniff the Rose	**136.26**Hz C#3-29	-29	IN-TUNE	**167.42**Hz. E3+27	-173	FLAT

3. Frequency & Target Pitch	146.83Hz. D3	Cents		196Hz G3	Cents	
Neutral Face	**138.95**Hz. C#+4	-96	FLAT	**190.25**Hz. F#3+48	-52	FLAT
Squinty Face	**141.81** C#3+34	-66	FLAT	**194.74**Hz. G3-11	-11	IN-TUNE
Sniff the Rose	**143.38**Hz. D3-41	-41	IN-TUNE	**186.41**Hz. F#3+13	-87	FLAT

4. Frequency & Target Pitch	**174.61Hz.** F3	**Cents**		**233.08Hz.** A#3	**Cents**	
Neutral Face	**140.28**Hz. D3+16	-219	**FLAT**	**189.23**Hz. F#3+39	-361	**FLAT**
Squinty Face	**138.35**Hz. C#3-3	-403	**FLAT**	**188.24**Hz. F#3+30	-370	**FLAT**
Sniff the Rose	**140.01**Hz. C#3+18	-382	**FLAT**	**189.86**Hz. F#3+45	-355	**FLAT**

Interview notes

Open question seeks to gain feedback on whether any of the facial postures made the singing feel easier or harder and was there any change in tone. Were the postures difficult or easy to achieve and can they describe the sensations of each postures.
Participate asked about feedback on: Facial posture names, word descriptors of each and visual images.
Participant asked if there is anything about the experiment that could be improved or changed

STARTS

Most challenging is the neutral face. I felt in both squinty face and sniffing face somehow made me feel like I had more air. More flowing. I felt I was able to hold the notes more easily. I felt the notes were less flat in squinty and sniff the rose. If I compare between the 2, perhaps because squinty face came second after natural face, so it was easier to feel the difference, I was able to modulate the notes more effectively. Sniff the Rose felt more fluid than Squinty. Easier somehow to sing. I found, in terms of making the expressions, in a way, squinty face was easier to do but sniff the rose was easy to set up but I felt it was hard to sustain and had to keep reminding myself. Different aspects of the sniffing the rose, were easy but surprise face was easier.

I found the descriptive words very useful. The titles of the face, squinty face really easy to fit it together. Sniff the Rose, it's much more active, surprise mouth was helpful. Found the text more useful than the images, but I felt I had a good impression of what was required by the words. On sniff the rose, the images helped with the mouth.

Feedback on the experiment itself? A bit of guidance right at the start of the recording. Clarifying the order of the recording a bit better as had assumed palm trees would be done together with vowels. Perhaps playing a bit of the recording to the participant *(following this comment, researcher adjusted the recordings to reflect this observation)*

Researcher observations: Very good at delivering facial expressions. Seem to get tired towards the end of the recording session and facial expressions less acute. Prompted by the imagery,

participant held an imaginary rose to their nostrils every time the facial expression was required. Upright posture throughout.

Participant identifier: C Gender: Female Age:50-59
Level of experience in singing: Self- identifies as beginner. Enjoys singing generally.

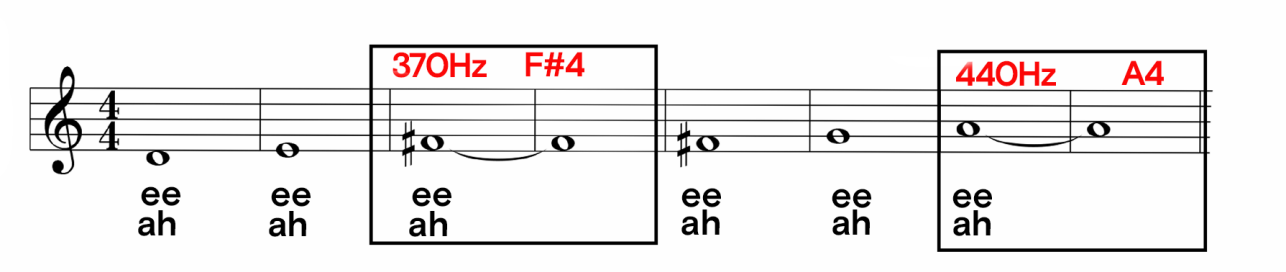
Results are illustrated in Hertz, musical pitch and musical cents
100 cents = semitone
50 cents = quarter tone
200 cents = whole tone

IN-TUNE = mean pitch calculated over 1 second <50-cents off target note

FLAT = mean pitch calculated over 1 second >50-cents below target

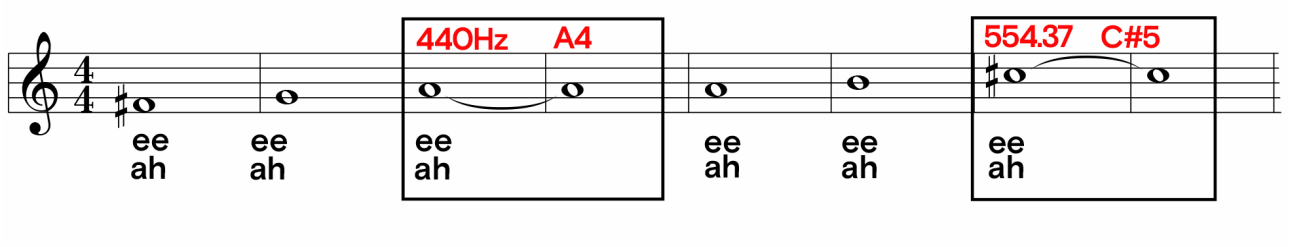
SHARP = mean pitch calculated over 1 second >50-cents above target

Exercise 1 - Vowels



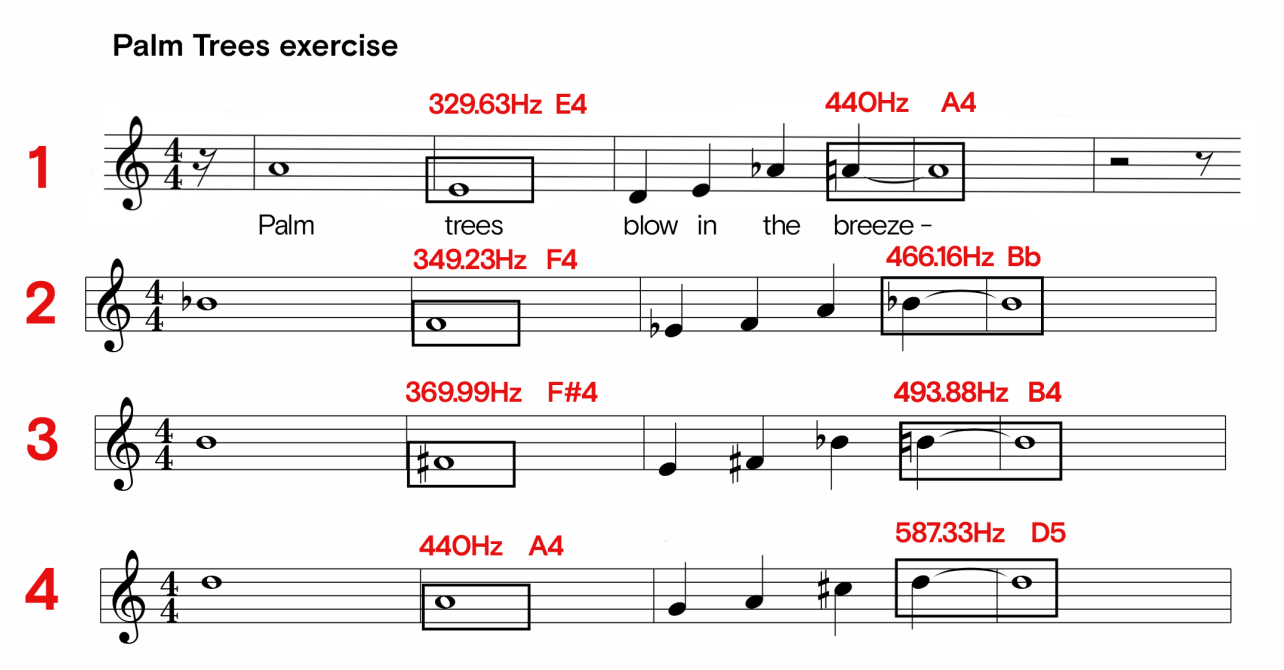
1. (EE) Frequency & Target Pitch	370Hz F#4	Cents		440Hz A4	Cents	
Neutral Face	**373.83** F#4 +18	18	**IN-TUNE**	**439.85** A4-1	-1	**IN-TUNE**
Squinty Face	**375.28** F#4+25	25	**IN-TUNE**	**444.22** A4+17	17	**IN-TUNE**
Sniff the Rose	**370.47** F#4+2	2	**IN-TUNE**	**438.02** A4-8	-8	**IN-TUNE**

2. (AH) Frequency & Target Pitch	370Hz F#4	Cents		440Hz A4	Cents	
Neutral Face	**371.88** F#4 +9	9	**IN-TUNE**	**441.23** A4 +5	5	**IN-TUNE**
Squinty Face	**374.10** F#4 +19	19	**IN-TUNE**	**439.27** A4-3	-3	**IN-TUNE**
Sniff the Rose	**372.56** F#4+12	12	**IN-TUNE**	**438.74** A4-5	-5	**IN-TUNE**



3. (EE) Frequency & Target Pitch	440Hz. A4	Cents		554.37Hz. C#5	Cents	
Neutral Face	**441.27**Hz. A4+5	5	IN-TUNE	**558.62**Hz. C#5+13	13	IN-TUNE
Squinty Face	**443.52**Hz. A4+14	14	IN-TUNE	**556.16**Hz. C#5+6	6	IN-TUNE
Sniff the Rose	**442.29** A4+9	9	IN-TUNE	**549.53**Hz C#5-15	-15	IN-TUNE

4. (AH) Frequency & Target Pitch	440Hz. A4	Cents		554.37Hz. C#5	Cents	
Neutral Face	**438.66**Hz Ab4-5	-5	IN-TUNE	**552.76**Hz. C#5-5	-5	IN-TUNE
Squinty Face	**437.15**Hz A4-11	-11	IN-TUNE	**550.61**Hz. C#5-12	-12	IN-TUNE
Sniff the Rose	**437.84**Hz A4-9	-9	IN-TUNE	**550.90**Hz. C#-11	-11	IN-TUNE



1. Frequency & Target Pitch	329.63Hz E4	Cents		440Hz. A4	Cents	
Neutral Face	**332.99**Hz E4+18	18	IN-TUNE	**444.99**Hz. A4+20	20	IN-TUNE
Squinty Face	**333.82**Hz E4+22	22	IN-TUNE	**443.67**Hz. A4+14	14	IN-TUNE
Sniff the Rose	**334.30**Hz E4+24	24	IN-TUNE	**443.92**Hz. A4+15	15	IN-TUNE

2. Frequency & Target Pitch	349.23Hz F4	Cents		466.16Hz. Bb4	Cents	
Neutral Face	**354.71**Hz F4+27	27	IN-TUNE	**468.97**Hz Bb4+10	10	IN-TUNE
Squinty Face	**351.81**Hz F4+13	13	IN-TUNE	**468.99**Hz. Bb4+10	10	IN-TUNE
Sniff the Rose	**352.20**Hz E4+15	15	IN-TUNE	**475.09**Hz. Bb4+33	33	IN-TUNE

3. Frequency & Target Pitch	370Hz. F#4	Cents		493.88Hz B4	Cents	
Neutral Face	**352.20**Hz. F4+15	15	IN-TUNE	**494.71**Hz. B4+3	3	IN-TUNE
Squinty Face	**366.29** F#4-17	-17	IN-TUNE	**490.62**Hz. B4-11	-11	IN-TUNE
Sniff the Rose	**366.49**Hz. F#4-16	-16	IN-TUNE	**486.97**Hz. B4-24	-24	IN-TUNE

4. Frequency & Target Pitch	440Hz. A4	Cents		587.33Hz. D5	Cents	
Neutral Face	**439.98**Hz. A4	0	IN-TUNE	**585.61**Hz. D5-5	-5	IN-TUNE
Squinty Face	**440.86**Hz. A4+3	3	IN-TUNE	**585.46**Hz. D5-6	-6	IN-TUNE
Sniff the Rose	**441.73**Hz. A4+7	7	IN-TUNE	**585.51**Hz. D5-5	-5	IN-TUNE

STARTS

What did you notice that made your singing feel easier or harder during the experiment

I definitely found neutral face the easiest and more relaxed. I felt like I could just concentrate on what what was happening inside me. My diaphragm I guess. The squinty face was difficult to control. Like I push more get into but I felt that my voice was more in sound out. More pressure. I didn't like squinty face. Surprised face (rose), felt nice. It made me want to sing out and perform. I found myself wanting to pull my shoulders back.

Target note:
Hertz and musical pitch

Did you notice anything about the quality of the sound you created?
I found the squinty face harder for high notes and maybe the Rose one might be helpful if I practiced it in putting the voice forward and being cleaner. I don't know how it sounds but it felt easier.

I noticed that you looked stressed during squinty face and you were using your whole head and body posture. Can we try this now? Oh yes, it's different. I don't think it's your description that's wrong, I just misunderstood.

Any improvements on the experiment? No it was all fine for me.

Descriptive terms for each face? Yes, I understood the instructions. I personally think about my face a lot, as I am a psychotherapist. I think about how my face looks to people so I am familiar with facial expressions. Pictures worked for me. From a psychotherapy point of view, it's about mirroring in childhood. That's how the child learns and children who haven't had a lot of that, or adequate mirroring in child have difficulty in learning and how to communicate via facial expressions. (This participant suggested looking up the Still Face Experiment).
In terms of facial descriptors, very satisfied.

Researcher observations
Used their whole body for the facial expression of Squinty face. Dropping the chin and clenching the jaw. Very exaggerated movement for Sniffing the Rose and body posture improving considerably as a response to the facial gesture.

Off the record discussion about importance of facial expression in primary school teaching. Participant also observed that Gareth Malone is successful at what he does partly because of his facial expressions.

Participant identifier: D Gender: Male Age:40-49
Level of experience in singing: Absolute beginner, 1 lesson

Results are illustrated in Hertz, musical pitch and musical cents
50 cents = quarter tone
100 cents = semitone
200 cents = whole tone

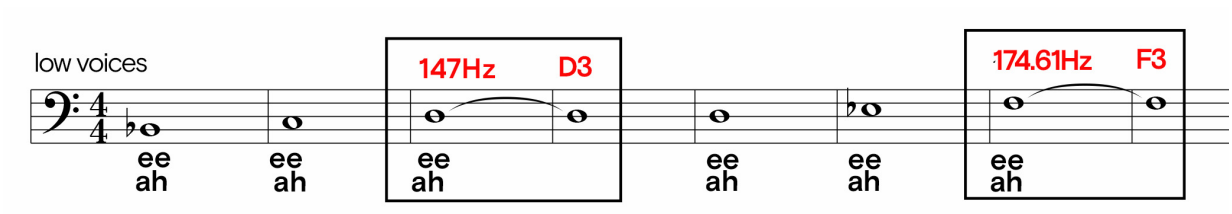
2. Frequency & Target Pitch	**349.23Hz** F4	**Cents**		**466.16Hz.** Bb4	**Cents**	
Neutral Face	**328.71**Hz E4+3	-97	**FLAT**	**463.11**Hz Bb4-7	-7	**IN-TUNE**
Squinty Face	**332.67**Hz E4-11	-89	**FLAT**	**464.73**Hz. Bb4-11	-11	**IN-TUNE**
Sniff the Rose	**337.23**Hz E4+35	-65	**FLAT**	**470.90**Hz. Bb4+28	28	**IN-TUNE**

IN-TUNE = mean pitch calculated over 1 second <50-cents off target note

FLAT = mean pitch calculated over 1 second >50-cents below target

SHARP = mean pitch calculated over 1 second >50-cents above target

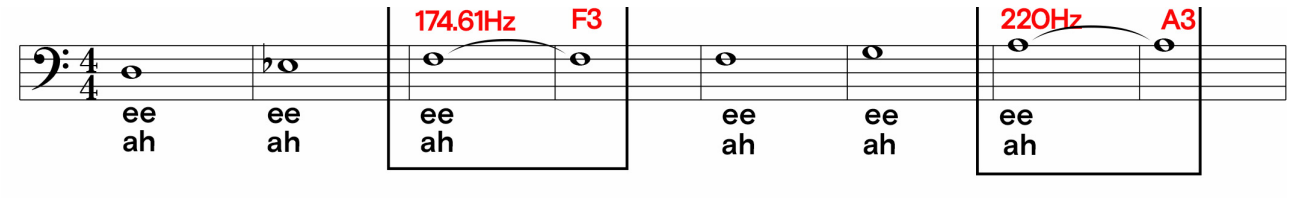
Exercise 1 - Vowels



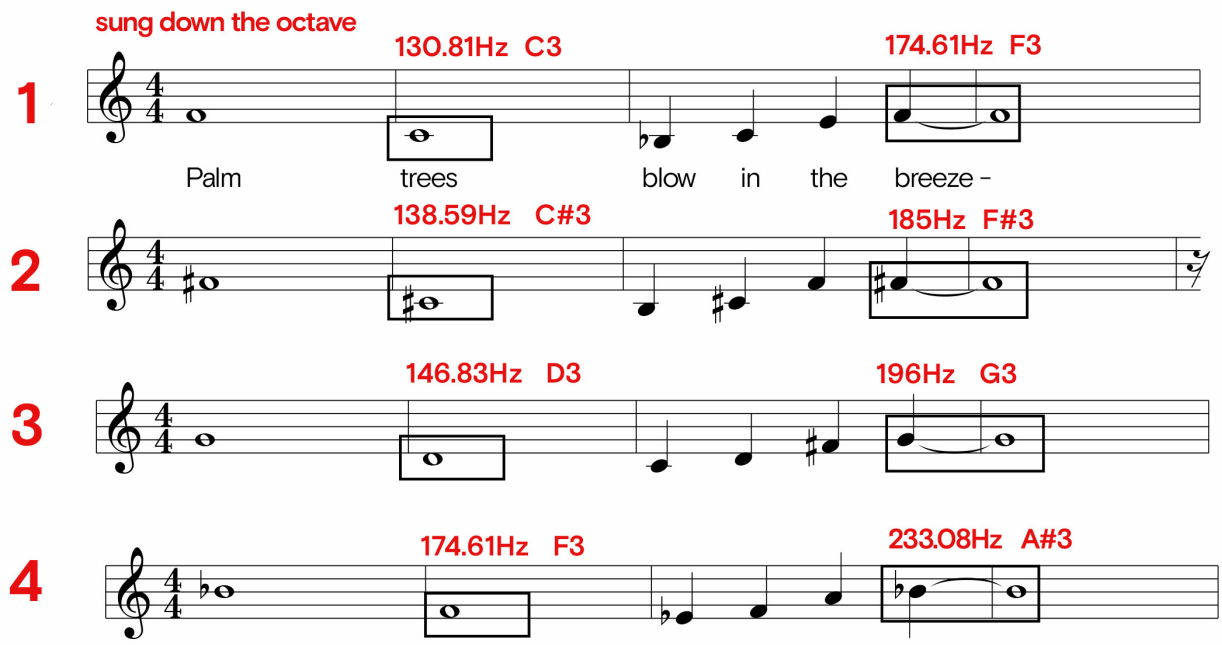
1. (EE) Frequency & Target Pitch	**147Hz** D3	**Cents**		**174.61Hz** F3	**Cents**	
Neutral Face	**147.52** D3+8	8	**IN-TUNE**	**172.52** F3-21	-21	**IN-TUNE**
Squinty Face	**149.02** D3+26	26	**IN-TUNE**	**174.75** F3+1	1	**IN-TUNE**
Sniff the Rose	**152.03** D#3-40	60	**SHARP**	**174.64** F3	0	**IN-TUNE**

2. (AH) Frequency & Target Pitch	**147Hz** D3	**Cents**		**176.61Hz** F3	**Cents**	
Neutral Face	**127.03** B2+49	-251	**FLAT**	**174.81** F3+2	2	**IN-TUNE**
Squinty Face	**150.13** D3+38	38	**IN-TUNE**	**175.62** F3+10	-10	**IN-TUNE**

2. (AH) Frequency & Target Pitch	147Hz D3	Cents		176.61Hz F3	Cents	
Sniff the Rose	**151.99** D#3-40	60	SHARP	**176.45** F3+18	18	SHARP



3. (EE) Frequency & Target Pitch	174.61Hz. F3	Cents		220Hz. A3	Cents	
Neutral Face	**176.80** F3+22	22	IN-TUNE	**220.03**Hz. A3	0	IN-TUNE
Squinty Face	**183.01**Hz. F#-19	81	SHARP	**215.08**Hz. A3-39	-39	IN-TUNE
Sniff the Rose	**193.57** G3-22	167	SHARP	**216.72**Hz A3-26	-26	IN-TUNE



4. (AH) Frequency & Target Pitch	174.61Hz F3	Cents		220Hz. A3	Cents	
Neutral Face	**169.10**Hz E3+44	-56	FLAT	**216.67**Hz. A3-26	-26	IN-TUNE
Squinty Face	**177.59**Hz F3+29	29	IN-TUNE	**219.74**Hz. A3-2	-2	IN_TUNE
Sniff the Rose	**178.92**Hz F3+42	42	IN-TUNE	**217.86**Hz. A3-17	-17	IN-TUNE

1.
2.

1. Frequency & Target Pitch	130.81Hz C3	Cents		174.61Hz. F3	Cents	
Neutral Face	**127.76**Hz C3-41	-41	IN-TUNE	**170.23**Hz. F3-44	-44	IN-TUNE
Squinty Face	**129.97**Hz C3-11	-11	IN-TUNE	**172.52**Hz. F3-21	-21	IN-TUNE
Sniff the Rose	**134.30**Hz C3+46	46	IN-TUNE	**175.90**Hz. F3+13	13	IN-TUNE

2. Frequency & Target Pitch	138.59Hz C#3	Cents		185Hz. F#3	Cents	
Neutral Face	**143.97**Hz D3-34	-66	FLAT	**180.45**Hz F#3-43	-43	IN-TUNE
Squinty Face	**135.64**Hz C#3-37	-37	IN-TUNE	**180.71**Hz. F#3-41	-41	IN-TUNE
Sniff the Rose	**136.33**Hz C#3-28	-28	IN-TUNE	**181.58**Hz. F#3-32	-32	IN-TUNE

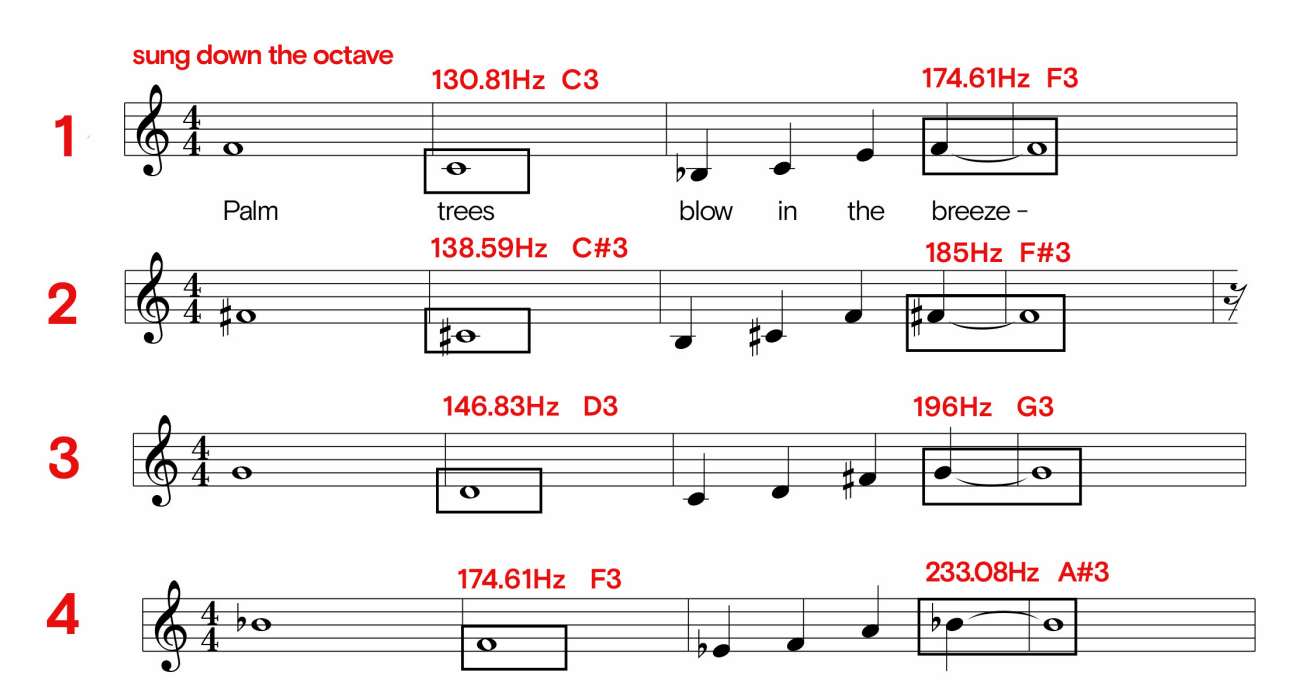
3. Frequency & Target Pitch	146.83Hz. D3	Cents		196Hz G3	Cents	
Neutral Face	**137.80**Hz. C#3-10	-110	FLAT	**190.78**Hz. G3-47	-47	IN-TUNE
Squinty Face	**142.03** C#3+42	-58	FLAT	**190.98**Hz. G3-45	-45	IN-TUNE

3. Frequency & Target Pitch	146.83Hz. D3	Cents		196Hz G3	Cents	
Sniff the Rose	**164.24**Hz. E3-6	194	SHARP	**218.59**Hz. A3-11	189	SHARP

4. Frequency & Target Pitch	174.61Hz. F3	Cents		233.08Hz. A#3	Cents	
Neutral Face	**164.25**Hz. E3-6	-94	FLAT	**218.09**Hz. A3-15	-115	FLAT
Squinty Face	**170.87**Hz. F3-38	-38	IN-TUNE	**213.70**Hz. G#3+50	-150	FLAT
Sniff the Rose	**172.38**Hz. F3-22	-22	IN-TUNE	**231.23**Hz. A#3-14	-14	IN-TUNE

Interview notes

4. Open question seeks to gain feedback on whether any of the facial postures made the singing feel easier or harder and was there any change in tone. Were the postures difficult or easy to



achieve and can they describe the sensations of each postures.

5. Participate asked about feedback on: Facial posture names, word descriptors of each and visual images.
6. Participant asked if there is anything about the experiment that could be improved or changed

STARTS

Did you feel any changes in the quality of the sound or how it felt when you sang?

I felt a loss of control on squinty and Sniffy face. I felt constrained when singing in these faces.

So you found it harder to sing? Yes. Absolutely.

On surprised face (rose) I had a lack of air. I couldn't control the breathing in the new positions.

Did you feel you were holding your breath? Yes absolutely. *(The researcher observed that this was possible)*

OK, perhaps we can do the (rose) facial expression together, now, on Palm Tree blow in the breeze exercise and I am going to ask you to make sure you don't hold your breath back?

(Sing together)

How was that? Slightly better. Yes.

Did you find the descriptors helpful in understanding what was required of you?

Yes definitely. I would say that squinty and sniffy are very close to each other as there is an overlap. Show the teeth and the cheek muscles. Once you gave me the hint of 'surprise', I found it easier to distinguish between. Surprise was so much easier to do.

Researcher shows the difference between.

Do you think this will make any difference to how you would sing in the future. I would consider my facial expression in singing and speaking. Researcher asks 'why speaking?" "For persuasion".

As a non-singer the neutral position gives me more opportunity to focus on the singing but the addition of facial expression gave more complexity to the task. So it's harder for me to sing unless I am in neutral position.

Observations
Participant making a lot of physical effort to adopt facial postures. Raising eyebrows appeared to induce whole head lifting and shift in whole body posture.

Participant identifier: E Gender: Male Age:50-59
Level of experience in singing: Beginner singer, just started having lessons. Actor by trade.

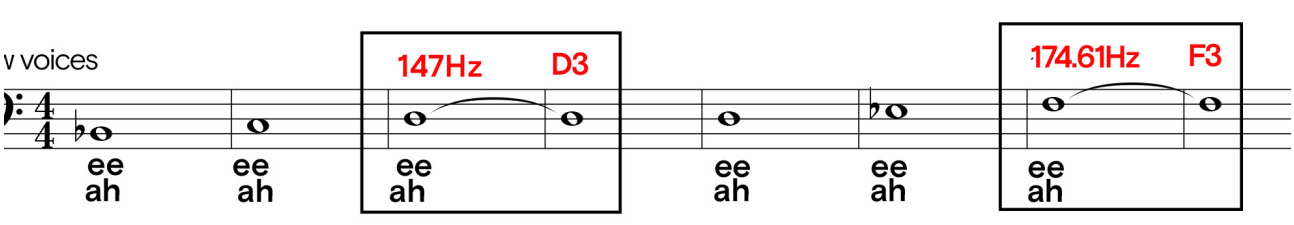
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200 cents = whole tone

IN-TUNE = mean pitch calculated over 1 second <50-cents off target note

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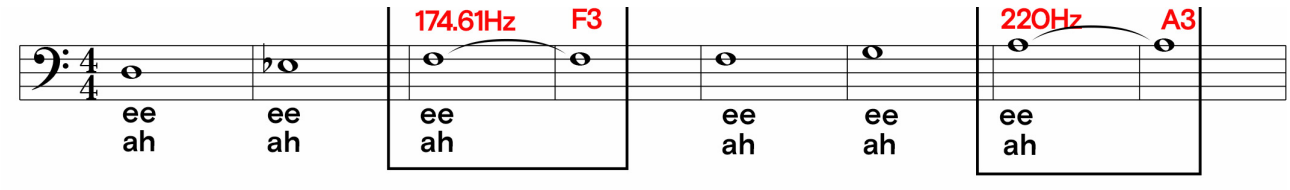
SHARP = mean pitch calculated over 1 second >50-cents above target

Exercise 1 - Vowels



1. (EE) Frequency & Target Pitch	147 D3	Cents		174.61Hz F3	Cents	
Neutral Face	**146.62** D3-3	-3	**IN-TUNE**	**175.05** F3+4	4	**IN-TUNE**
Squinty Face	**147.40** D3+7	7	**IN-TUNE**	**173.00** F3-16	-16	**IN-TUNE**
Sniff the Rose	**150.14** D3+39	39	**IN-TUNE**	**173.29** F3-13	-13	**IN-TUNE**

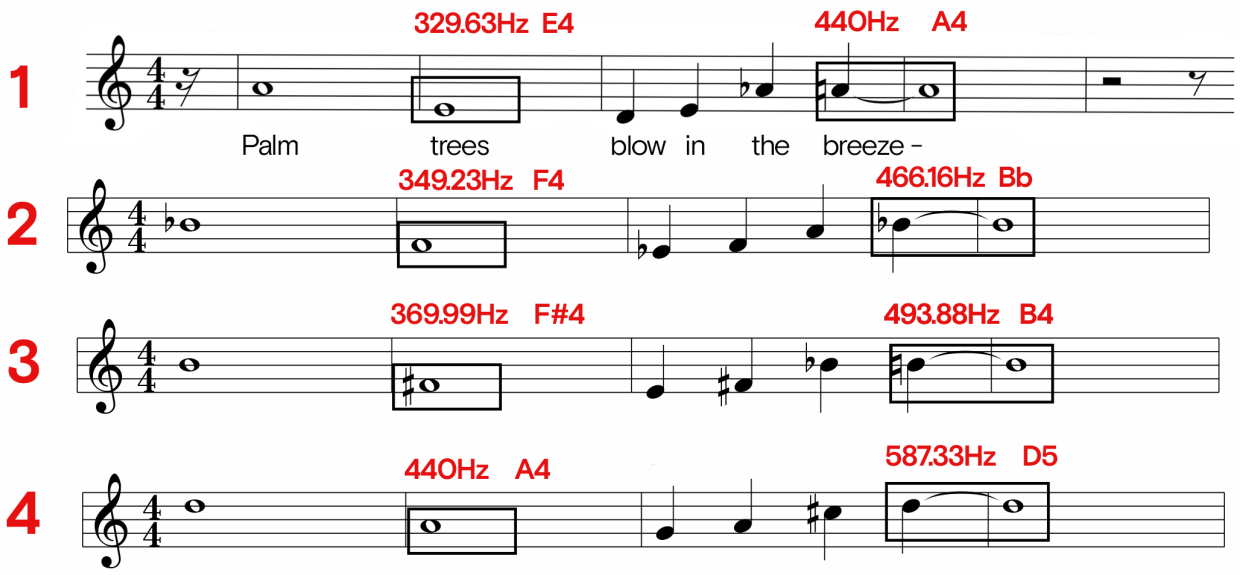
2. (AH) Frequency & Target Pitch	147 D3	Cents		174.61Hz F3	Cents	
Neutral Face	**149.00** D3+25	25	**IN-TUNE**	**174.53** F3-1	-1	**IN-TUNE**
Squinty Face	**151.71** D#3-49	51	**SHARP**	**175.17** F3+6	6	**IN-TUNE**
Sniff the Rose	**146.02** D3-10	-10	**IN-TUNE**	**174.37** F3-2	-2	**IN-TUNE**



3. (EE) Frequency & Target Pitch	174.61Hz. F3	Cents		220Hz. A3	Cents	
Neutral Face	**175.64** F3+10	10	IN-TUNE	**222.10**Hz. A3+16	16	IN-TUNE
Squinty Face	**177.16**Hz. F3+25	25	IN-TUNE	**221.07**Hz. A3+8	8	IN-TUNE
Sniff the Rose	**177.58** F3+29	29	IN-TUNE	**220.84**Hz A3+7	7	IN-TUNE

4. (AH) Frequency & Target Pitch	174.61Hz F3	Cents		220Hz. A3	Cents	
Neutral Face	**175.19**Hz F3+6	6	IN-TUNE	**220.26**Hz. A3+2	2	IN-TUNE
Squinty Face	**175.04**Hz F3+4	4	IN-TUNE	**220.36**Hz. A3+3	3	IN-TUNE
Sniff the Rose	**175.70**Hz F3+6	6	IN-TUNE	**220.31**Hz. A3+2	2	IN-TUNE

Palm Trees exercise



1. Frequency & Target Pitch	E3	Cents		A3	Cents	
Neutral Face	**167.08** E3+24	24	IN-TUNE	**224.92**Hz. A3+38	38	IN-TUNE
Squinty Face	**165.39**Hz E3+6	6	IN-TUNE	**224.08**Hz. A3+32	32	IN-TUNE

1. Frequency & Target Pitch	E3	Cents		A3	Cents	
Sniff the Rose	**168.70**Hz E3+40	40	IN-TUNE	**222.09**Hz. A3+16	16	IN-TUNE

Interview notes

2. Frequency & Target Pitch	F3	Cents		Bb3	Cents	
Neutral Face	**177.32**Hz F3+27	27	IN-TUNE	**235.83**Hz Bb3+20	20	IN-TUNE
Squinty Face	**176.90**Hz F3+23	23	IN-TUNE	**236.73**Hz. Bb3+27	27	IN-TUNE
Sniff the Rose	**177.16**Hz F3+25	25	IN-TUNE	**235.66**Hz. Bb3+19	19	IN-TUNE

3 open questions:

7. Open question seeks to gain feedback on whether any of the facial postures made the singing feel easier or harder and was there any change in tone. Were the postures difficult or easy to achieve and can they describe the sensations of each postures.
8. Participate asked about feedback on: Facial posture names, word descriptors of each and visual images.
9. Participant asked if there is anything about the experiment that could be improved or changed

STARTS

I felt there was difference. Perhaps doing it more times would have been more useful I think.

I found them all quite easy to do. There was difference.

Did you feel more power? Probably, I think sniffing the rose, it felt like Rogers and Hammerstein, like a performance. More performance element.

When you were going higher in your voice did you find any of the expressions easier to help you reach the notes? The squinty, may have helped a bit. Probably because I was focussed higher. I remember being told to raise my eyebrows once, I think it's that.

Do you think that you might experiment more with your face while you are singing?
I think a lot it, as an actor, you don't want to overthink things. But then, the confines of a role, you might sniff the rose to show emotion.

The words to the exercise about the palm trees was good at conjuring up images.

Sniff the rose felt more natural. The open face is about ‘giving out’. I didn’t really need the visual images.

Participant identifier: F Gender: Male Age:60-69
Level of experience in singing: Sings in a choir. Had lessons over 2 years. Keen amateur

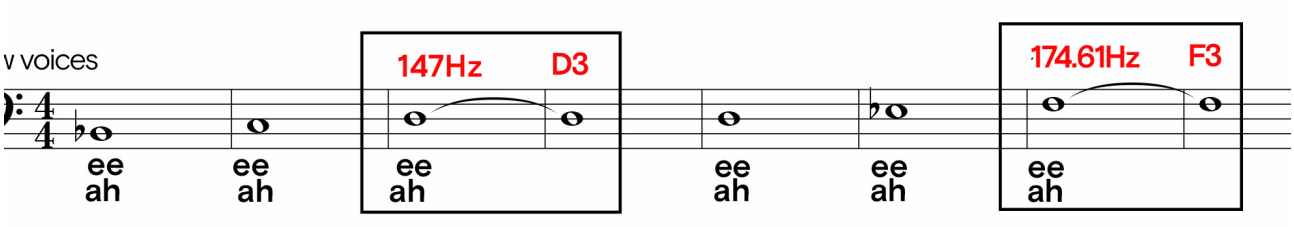
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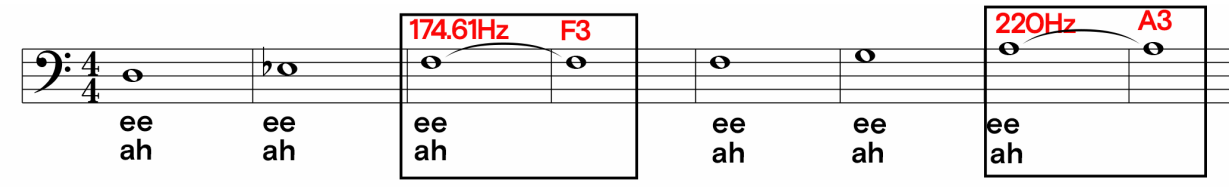
SHARP = mean pitch calculated over 1 second >50-cents above target

Exercise 1 - Vowels



1. (EE) Frequency & Target Pitch	147Hz D3	Cents		174.61Hz F3	Cents	
Neutral Face	**146.85** D3	0	**IN-TUNE**	**176.51** F3+9	9	**IN-TUNE**
Squinty Face	**144.90** D3-23	-23	**IN-TUNE**	**175.26** F3+6	6	**IN-TUNE**
Sniff the Rose	**145.44** D3-16	-16	**IN-TUNE**	**174.76** F3+1	1	**IN-TUNE**

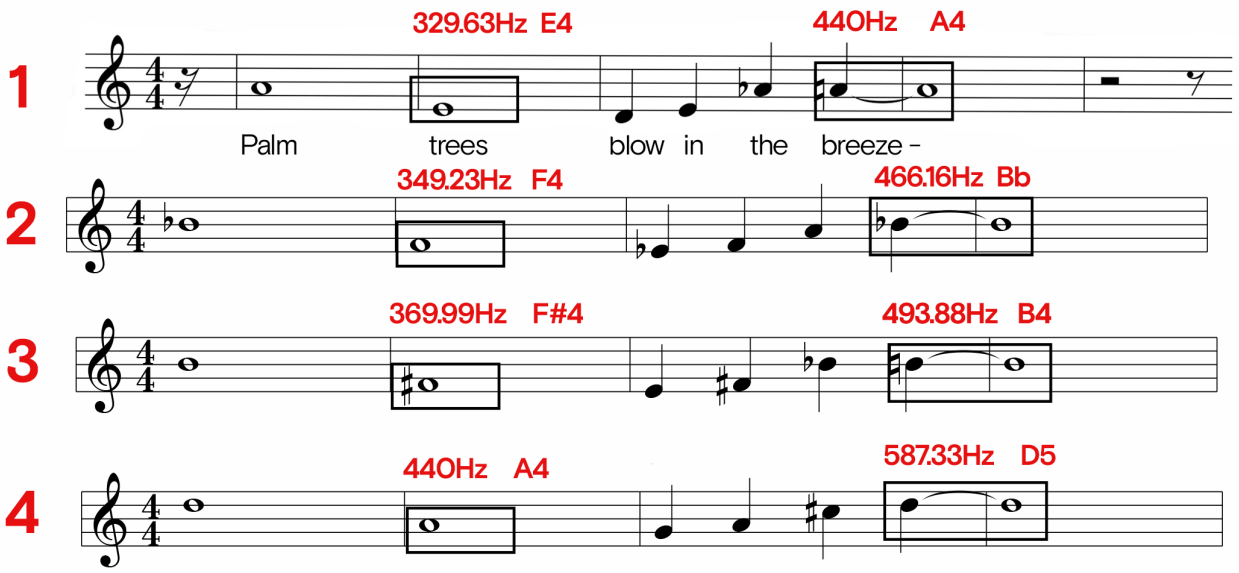
2. (AH) Frequency & Target Pitch	147Hz D3	Cents		174.61Hz F3	Cents	
Neutral Face	**144.87** D3-23	-23	**IN-TUNE**	**175.20** F3+6	6	**IN-TUNE**
Squinty Face	**145.98** D3-10	-10	**IN-TUNE**	**173.16** F3-14	-15	**IN-TUNE**
Sniff the Rose	**144.73** D3-25	-25	**IN-TUNE**	**175.66** F3+10	10	**IN-TUNE**



3. (EE) Frequency & Target Pitch	174.61Hz. F3	Cents		220Hz. A3	Cents	
Neutral Face	**175.63** F3+10	10	IN-TUNE	**217.66**Hz. A3-19	-19	IN-TUNE
Squinty Face	**178.44**Hz. F3+38	38	IN-TUNE	**218.68**Hz. A3-26	-26	IN-TUNE
Sniff the Rose	**176.29** F3+17	17	IN-TUNE	**220.04**Hz A3	0	IN-TUNE

4. (AH) Frequency & Target Pitch	174.61Hz F3	Cents		220Hz. A3	Cents	
Neutral Face	**175.95**Hz F3+13	13	IN-TUNE	**220.19**Hz. A3	0	IN-TUNE
Squinty Face	**257.40**Hz C4-28	672	IN-TUNE	**306.47**Hz. D#4-26	574	IN-TUNE
Sniff the Rose	**174.02**Hz F3-6	-6	IN-TUNE	**218.08**Hz. A3-15	-15	IN-TUNE

Palm Trees exercise



1. Frequency & Target Pitch	E3	Cents		A3	Cents	
Neutral Face	**158.91** D#3+37	-63	FLAT	**223.33**Hz. A3+18	18	IN-TUNE
Squinty Face	**164.38**Hz E3-5	-5	IN-TUNE	**220.42**Hz. G3+39	-161	FLAT

1. Frequency & Target Pitch	E3	Cents		A3	Cents	
Sniff the Rose	**161.42**Hz E3-36	-36	**IN-TUNE**	**221.87**Hz. A3+15	15	**IN-TUNE**

Interview notes

3 open questions:

10. Open question seeks to gain feedback on whether any of the facial postures made the singing feel easier or harder and was there any change in tone. Were the postures difficult or easy to achieve and can they describe the sensations of each postures.
11. Participate asked about feedback on: Facial posture names, word descriptors of each and visual images.
12. Participant asked if there is anything about the experiment that could be improved or changed

STARTS

Did you notice anything in particular about the quality of the sound, ease or difficulties with any of the postures

Neutral felt the easiest to apply other techniques as it felt lower in the in the body (summarising). Squinty I was much more mechanically using my tongue, my jaw, even my vocal cords more. I found it hard to sing that way

Sniffing the rose felt more dynamic. It felt like more power coming through. I didn't find it hard to sustain. Opening everything up, opened me up.

In terms of tonal output, neutral fine, squinty felt a bit tighter and closed, and sniffing the rose had more resonance.

I am used to neutral so things like looking forward rather than up made it easier.

Squinty was potentially easier to reach high notes than Sniffing.

Feedback about the experiment and tools:

The images helped. Neutral face, I liked the basset hound. Seeing singers like Tom Jones that I recognise helps know what it is you're being asked to do. Sniffing, the surprise idea helps with being in open. I was actually trying to sniff in preparation each time.

Overall it makes be less inclined to be squinty but more inclined to think about being more open. Eyes and nose. In some sense that's more about attitude.

(Researcher and participant do Sniff the Rose together). We both observe that the participant is pulling shoulders back and opening chest up while sniffing the rose.

Participant identifier: G Gender: Female Age:40-49
Level of experience in singing: Self- identifies as a total beginner. Professional viola player in elite orchestras.

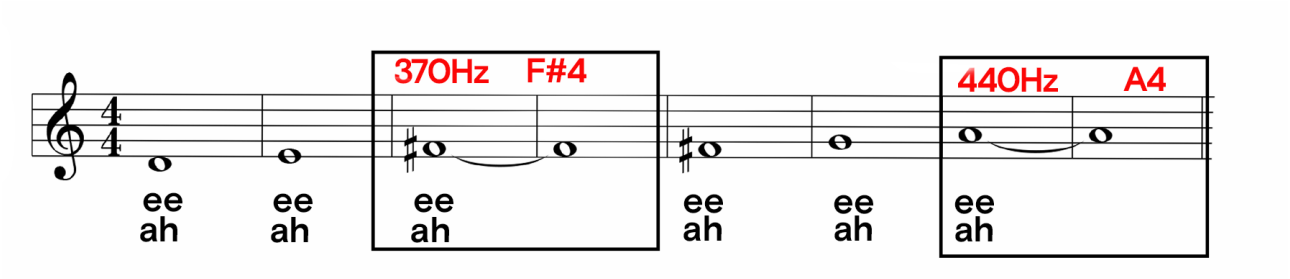
Results are illustrated in Hertz, musical pitch and musical cents
50 cents = quarter tone
100 cents = semitone
200 cents = whole tone

IN-TUNE = mean pitch calculated over 1 second <50-cents off target note

FLAT = mean pitch calculated over 1 second >50-cents below target

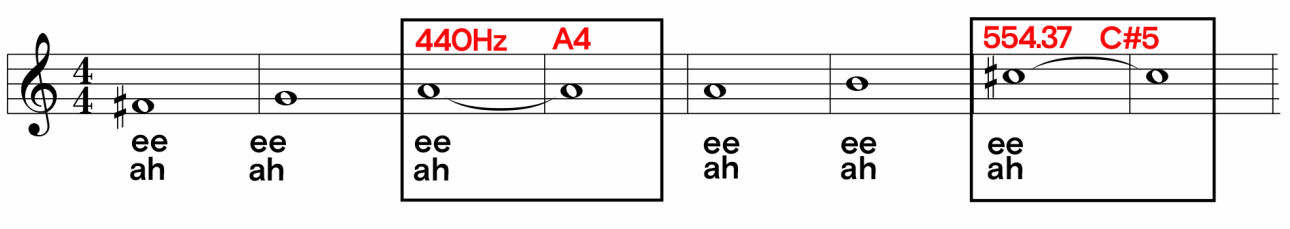
SHARP = mean pitch calculated over 1 second >50-cents above target

Exercise 1 - Vowels



1. (EE) Frequency & Target Pitch	370Hz F#4	Cents		440Hz A4	Cents	
Neutral Face	**368.36** F#4 -8	-8	**IN-TUNE**	**439.80** A4-1	-1	**IN-TUNE**
Squinty Face	**369.62** F#4-2	-2	**IN-TUNE**	**440.51** A4+2	17	**IN-TUNE**
Sniff the Rose	**373.22** F#4+15	15	**IN-TUNE**	**438.54** A4-6	-6	**IN-TUNE**

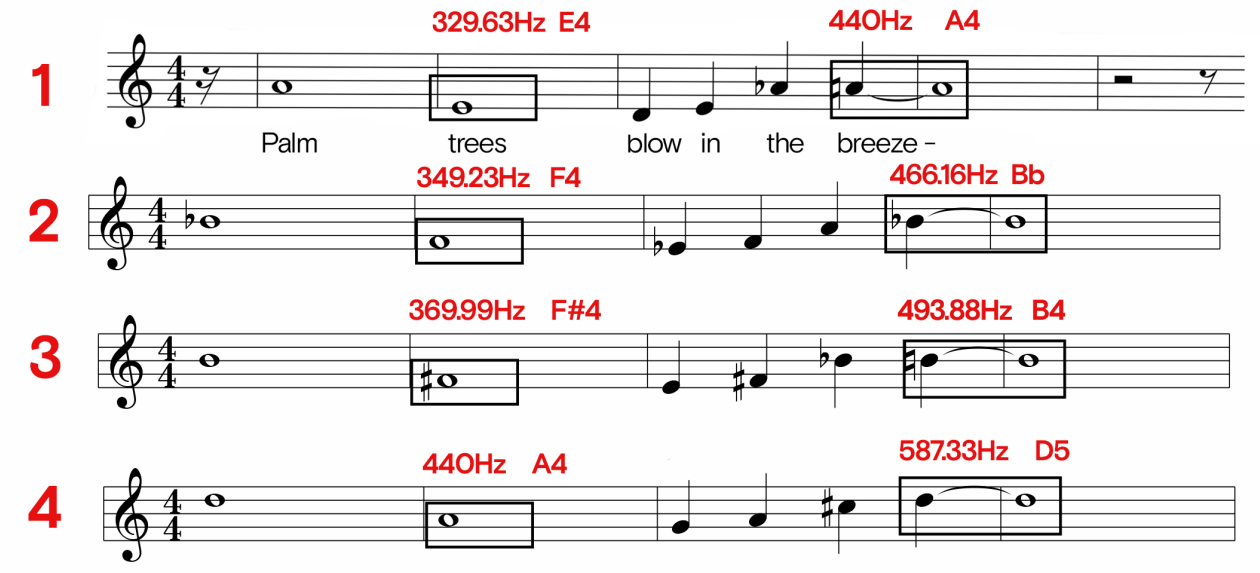
2. (AH) Frequency & Target Pitch	370Hz F#4	Cents		440Hz A4	Cents	
Neutral Face	**366.42** F#4 -17	-17	**IN-TUNE**	**437.62** A4 -9	5	**IN-TUNE**
Squinty Face	**367.46** F#4 -12	-12	**IN-TUNE**	**437.82** A4-9	-9	**IN-TUNE**
Sniff the Rose	**370.28** F#4+1	1	**IN-TUNE**	**439.49** A4-2	-2	**IN-TUNE**



3. (EE) Frequency & Target Pitch	440Hz. A4	Cents		554.37Hz. C#5	Cents	
Neutral Face	**440.77**Hz. A4+3	3	IN-TUNE	**550.67**Hz. C#5-12	-12	IN-TUNE
Squinty Face	**442.99**Hz. A4+12	12	IN-TUNE	**553.70**Hz. C#5-2	-2	IN-TUNE
Sniff the Rose	**442.12** A4+8	8	IN-TUNE	**556.41**Hz C#5+6	6	IN-TUNE

4. (AH) Frequency & Target Pitch	440Hz. A4	Cents		554.37Hz. C#5	Cents	
Neutral Face	**436.27**Hz Ab4-15	-15	IN-TUNE	**546.74**Hz. C#5-24	-24	IN-TUNE
Squinty Face	**435.68**Hz A4-17	-17	IN-TUNE	**550.73**Hz. C#5-11	-11	IN-TUNE
Sniff the Rose	**437.59**Hz A4-10	-10	IN-TUNE	**549.83**Hz. C#-14	-14	IN-TUNE

Palm Trees exercise



1. Frequency & Target Pitch	329.63Hz E4	Cents		440Hz. A4	Cents	
Neutral Face	**327.20**Hz E4-13	-13	IN-TUNE	**441.28**Hz. A4+5	5	IN-TUNE

1. Frequency & Target Pitch	329.63Hz E4	Cents		440Hz. A4	Cents	
Squinty Face	**329.54**Hz E4	0	IN-TUNE	**443.38**Hz. A4+13	13	IN-TUNE
Sniff the Rose	**326.21**Hz E4-18	-18	IN-TUNE	**440.94**Hz. A4+4	4	IN-TUNE

3. Frequency & Target Pitch	370Hz. F#4	Cents		493.88Hz B4	Cents	
Neutral Face	**369.57**Hz. F4-2	-2	IN-TUNE	**489.10**Hz. B4-17	-17	IN-TUNE
Squinty Face	**369.03** F#4-5	-15	IN-TUNE	**489.63**Hz. B4-15	-15	IN-TUNE
Sniff the Rose	**370.22**Hz. F#4-1	1	IN-TUNE	**493.82**Hz. B4	0	IN-TUNE

4. Frequency & Target Pitch	440Hz. A4	Cents		587.33Hz. D5	Cents	
Neutral Face	**429.91**Hz. A4-40	-40	IN-TUNE	**587.87**Hz. D5-+2	2	IN-TUNE
Squinty Face	**442.71**Hz. A4+11	11	IN-TUNE	**582.39**Hz. D5-15	-15	IN-TUNE
Sniff the Rose	**440.45**Hz. A4+2	2	IN-TUNE	**584.62**Hz. D5-8	-8	IN-TUNE

Interview notes

- Open question seeks to gain feedback on whether any of the facial postures made the singing feel easier or harder and was there any change in tone. Were the postures difficult or easy to achieve and can they describe the sensations of each postures.
- Participate asked about feedback on: Facial posture names, word descriptors of each and visual images.
- Participant asked if there is anything about the experiment that could be improved or changed

STARTS

Did you notice anything helpful, easier harder etc. in terms of the facial expressions?

The relaxed face was hard as the higher I go the more I changed my facial expression to squinty face. If you think it's higher you feel it higher.

Squinty face the sound changes. It's easier to go up with the squinty face. But the sound is nicer on Sniff the rose. The sound is rounder.

Was anything that changed the power or control?

Squinty face is probably easier to produce higher notes. I hear the note in my head before I play it. As I play an instrument. With the voice you can't count on it like an instrument so It must be hard to sing because you don't necessarily know.

Squinty face has a more piercing quality to sound. Sniffing the rose is rounder sound.

Researcher observes that when participant describes squinty they use hands to made a beak or point shape and sniffing has full hands shape.

Feed back on instructions:
It would have been helpful to see myself in the mirror. I am not sure that I always doing the sniff the rose correctly. I don't know if I flared my nostrils.

3. Frequency & Target Pitch	F#3	**Cents**		B3	**Cents**	
Neutral Face	**187.33**Hz. F#3+22	22	**IN-TUNE**	**250.78**Hz. B3+27	27	**IN-TUNE**
Squinty Face	**183.88** F#3-10	-10	**IN-TUNE**	**246.71**Hz. B3-2	-2	**IN-TUNE**
Sniff the Rose	**188.38**Hz. F#3+31	31	**IN-TUNE**	**255.12**Hz. C4-44	66	**SHARP**

4. Frequency & Target Pitch	A3	**Cents**		D4	**Cents**	
Neutral Face	**224.68**Hz. A3+36	36	**IN-TUNE**	**302.00**Hz. D4+48	48	**IN-TUNE**
Squinty Face	**218.93**Hz. A3-8	-8	**IN-TUNE**	**297.34**Hz. D4+22	22	**IN-TUNE**
Sniff the Rose	**219.89**Hz. A3-1	-1	**IN-TUNE**	**307.52**Hz. D#4-20	80	**SHARP**

The images are helpful. Although some of them look a bit mad. Pavarotti was useful. Sniff the rose is very open and feels like the sound can resonate. The other one (squinty) is very piercing.

The participant was very relaxed and leaning back in the chair unlike others

Participant identifier: H Gender: Female Age:30-39
Level of experience in singing: Absolute beginner. Currently having lessons within the practice and demonstrating very poor pitch control, particularly above about F4.

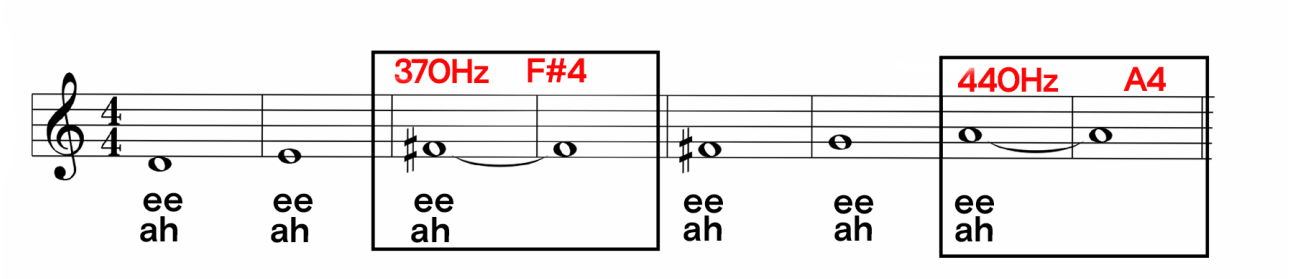
Results are illustrated in Hertz, musical pitch and musical cents
50 cents = quarter tone
100 cents = semitone
200 cents = whole tone

IN-TUNE = mean pitch calculated over 1 second <50-cents off target note

FLAT = mean pitch calculated over 1 second >50-cents below target

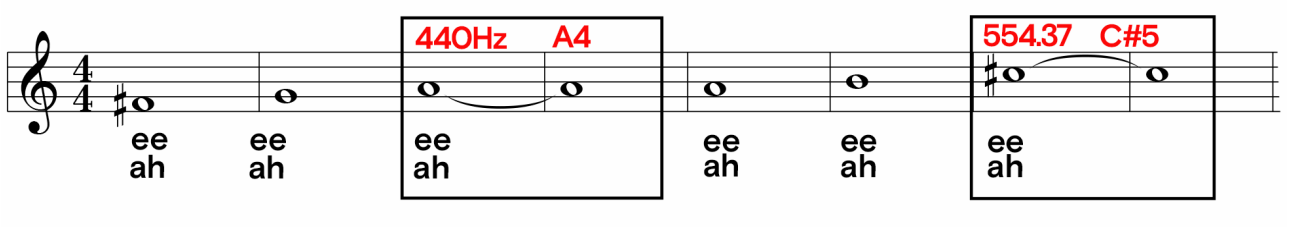
SHARP = mean pitch calculated over 1 second >50-cents above target

Exercise 1 - Vowels



1. (EE) Frequency & Target Pitch	370Hz F#4	Cents		440Hz A4	Cents	
Neutral Face	**363.85** F#4 -29	-29	**IN-TUNE**	**INVALID**		**INVALID**
Squinty Face	**355.34** F4+30	-70	**FLAT**	**538.51** C5+51	251	**SHARP**
Sniff the Rose	**376.57** F#4+30	30	**IN-TUNE**	**539.93** C#5-46	354	**SHARP**

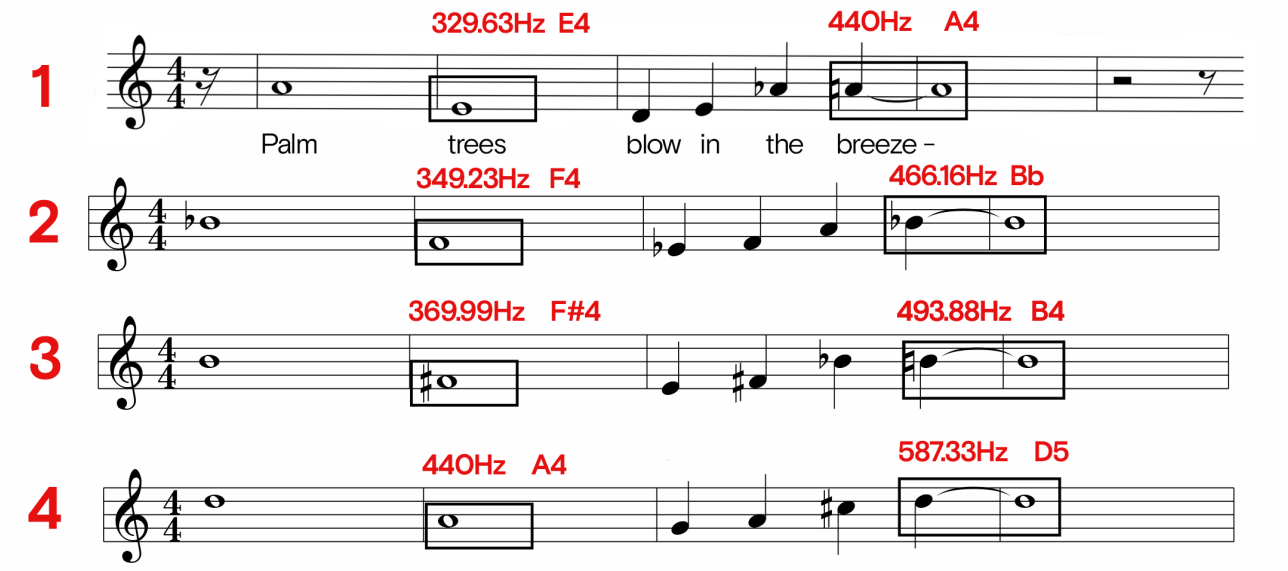
2. (AH) Frequency & Target Pitch	370Hz F#4	Cents		440Hz A4	Cents	
Neutral Face	**489.15** B4-17	483	**SHARP**	**609.70** D#5-35	365	**SHARP**
Squinty Face	**605.20** D#5-48	892	**SHARP**	**609.11** D#5-37	563	**SHARP**
Sniff the Rose	**595.28** D5+23	823	**SHARP**	**604.33** D5+49	549	**SHARP**



3. (EE) Frequency & Target Pitch	440Hz. A4	Cents		554.37Hz. C#5	Cents	
Neutral Face	**485.48**Hz. B4-30	170	**SHARP**	**589.82**Hz. D5+7	107	**SHARP**
Squinty Face	**603.99Hz**. D5+48	548	**SHARP**	**INVALID**		**INVALID**
Sniff the Rose	**595.21** D5+23	523	**SHARP**	**605.00Hz** D#5-49	151	**SHARP**

4. (AH) Frequency & Target Pitch	440Hz. A4	Cents		554.37Hz. C#5	Cents	
Neutral Face	**503.75**Hz B4+34	234	**SHARP**	**631.49**Hz. D#5+26	226	**SHARP**
Squinty Face	**570.55**Hz D#5+26	626	**SHARP**	**687.22**Hz. F5-28	372	**SHARP**
Sniff the Rose	**489.39**Hz B4-16	194	**SHARP**	**699.35**Hz. F5+2	402	**SHARP**

Palm Trees exercise



1. Frequency & Target Pitch	329.63Hz E4	Cents		440Hz. A4	Cents	
Neutral Face	**323.32**Hz E4-33	-33	**IN-TUNE**	**451.54**Hz. A4+45	45	**IN-TUNE**
Squinty Face	**363.04Hz** F#-33	167	**SHARP**	**491.67**Hz. B4-8	192	**IN-TUNE**
Sniff the Rose	**349.63**Hz F4+2	102	**SHARP**	**455.63**Hz. Bb-40	60	**SHARP**

- Open question seeks to gain feedback on whether any of the facial postures made the singing feel easier or harder and was there any change in tone. Were the postures difficult or easy to achieve and can they describe the sensations of each postures.
- Participate asked about feedback on: Facial posture names, word descriptors of each and visual images.
- Participant asked if there is anything about the experiment that could be improved or changed

STARTS

It was easier with neutral face, as this is more what I am used to. Squinty face was easier with higher notes. I think it helped with high notes. With the Rose on some notes it helped but not all the time. Sometimes, it felt it made things more difficult.

I think the experiment was very intuitive and easy to understand.

Observation

Observations: participant facial movements were extremely small and limited. As an observer it was difficult to see the differences between the postures.

Participant identifier: I Gender: Male Age:60-69
Level of experience in singing: Beginner singer, just started having lessons. Actor.

Results are illustrated in Hertz, musical pitch and musical cents

2. Frequency & Target Pitch	F3	**Cents**		A#3	**Cents**	
Neutral Face	**170.53**Hz F3-41	-41	**IN-TUNE**	**235.40**Hz A#3+17	17	**IN-TUNE**
Squinty Face	**168.54**Hz E3+39	-61	**FLAT**	**233.33**Hz. A#+2	2	**IN-TUNE**
Sniff the Rose	**173.66**Hz F3-9	-9	**IN-TUNE**	**235.09**Hz. A#3+15	15	**IN-TUNE**

3. Frequency & Target Pitch	F#3	**Cents**		B3	**Cents**	
Neutral Face	**183.73**Hz. F#3-12	-12	**IN-TUNE**	**247.30**Hz. B3+3	3	**IN-TUNE**
Squinty Face	**170.49** F3-41	-41	**IN-TUNE**	**233.15**Hz. A#3+1	-99	**FLAT**
Sniff the Rose	**178.72**Hz. F3+40	40	**IN-TUNE**	**245.75**Hz. B3-8	-8	**IN-TUNE**

50 cents = quarter tone

4. Frequency & Target Pitch	A3	**Cents**		D4	**Cents**	
Neutral Face	**222.40**Hz. A3+19	19	**IN-TUNE**	**300.90**Hz. D4+42	42	**IN-TUNE**
Squinty Face	**217.11**Hz. A3-23	-23	**IN-TUNE**	**298.61**Hz. D4+29	29	**IN-TUNE**
Sniff the Rose	**225.21**Hz. A3+41	41	**IN-TUNE**	**300.19**Hz. D4+38	38	**IN-TUNE**

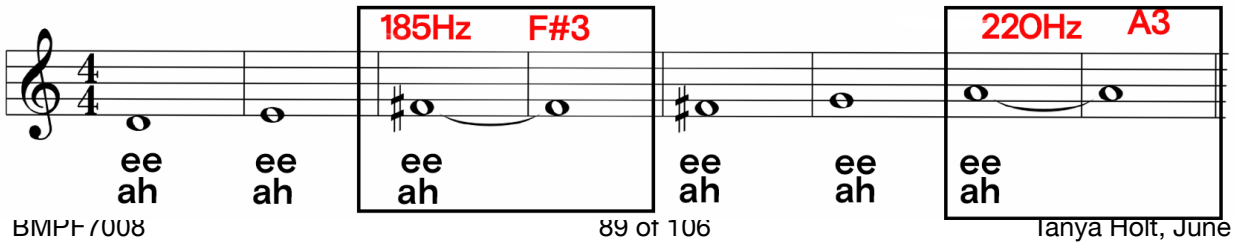
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200 cents = whole tone

IN-TUNE = mean pitch calculated over 1 second <50-cents off target note

FLAT = mean pitch calculated over 1 second >50-cents below target

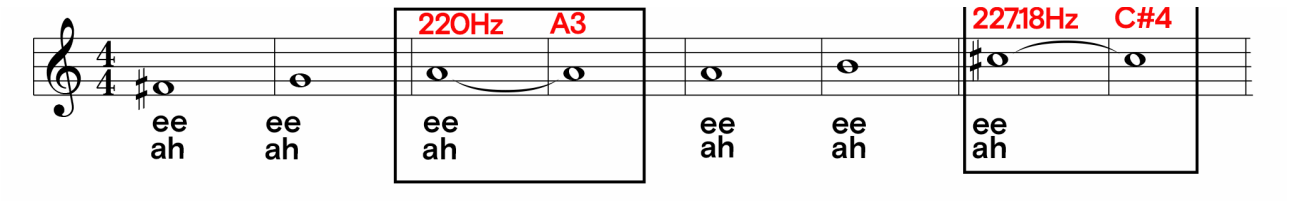
SHARP = mean pitch calculated over 1 second >50-cents above target

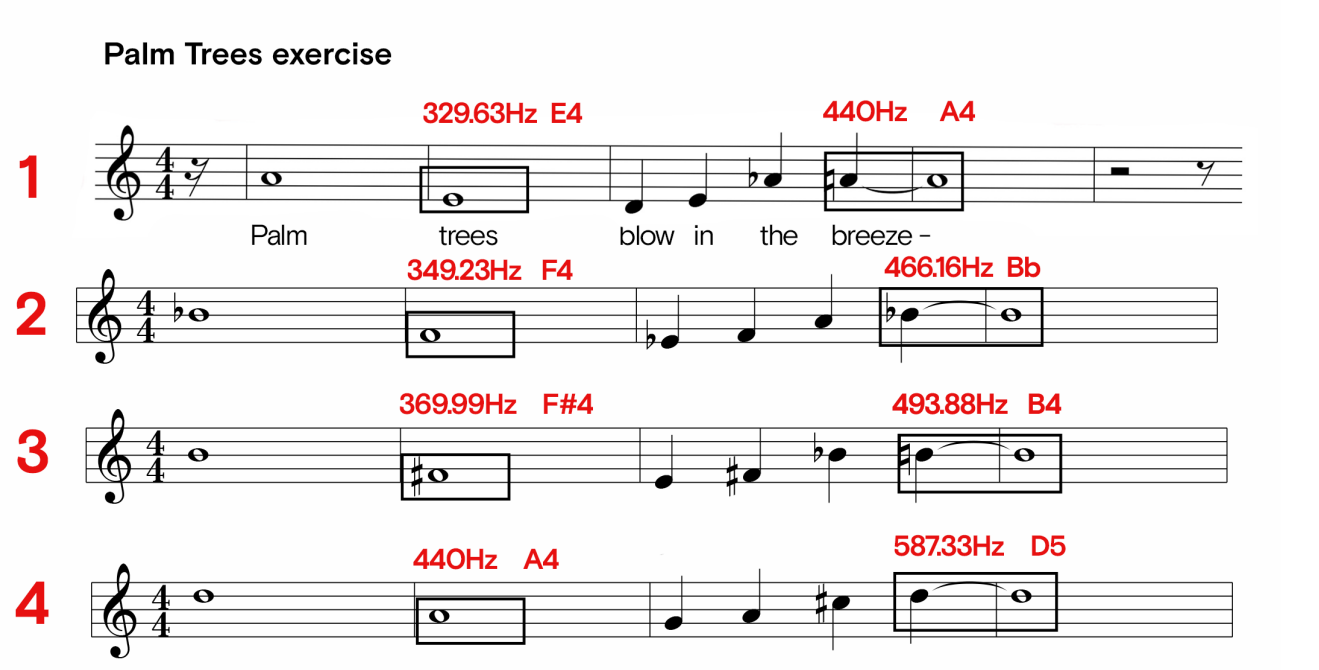
Exercise 1 - Vowels



1. (EE) Frequency & Target Pitch	185Hz F#3	Cents		220Hz A3	Cents	
Neutral Face	**183.17** F#3-17	-17	IN-TUNE	**222.66** A3+21	21	IN-TUNE
Squinty Face	**186.90** F#3+18	18	IN-TUNE	**222.42** A3+19	19	IN-TUNE
Sniff the Rose	**184.29** F#3-7	-7	IN-TUNE	**221.64** A3+13	13	IN-TUNE

2. (AH) Frequency & Target Pitch	185Hz F#	Cents		220Hz A3	Cents	
Neutral Face	**182.44** F#3-24	-24	IN-TUNE	**220.62** A3+5	5	IN-TUNE
Squinty Face	**182.63** F#3-22	-22	SHARP	**227.50** A#3-42	-42	IN-TUNE
Sniff the Rose	**180.80** F#3-40	-40	IN-TUNE	**220.11** A3+1	1	IN-TUNE





2. Frequency & Target Pitch	F3	**Cents**		A#3	**Cents**	
Neutral Face	**175.80**Hz F3+12	12	**IN-TUNE**	**230.02**Hz A#3-23	-23	**IN-TUNE**
Squinty Face	**174.41**Hz F3-2	-2	**IN-TUNE**	**229.53**Hz. A#3-27	-27	**IN-TUNE**
Sniff the Rose	**169.90**Hz F3-47	-47	**IN-TUNE**	**227.30**Hz. A#3-43	-43	**IN-TUNE**

4. Frequency & Target Pitch	A3	**Cents**		D4	**Cents**	
Neutral Face	**224.57**Hz. A3+36	36	**IN-TUNE**	**297.66**Hz. D4+23	23	**IN-TUNE**
Squinty Face	**228.13**Hz. A#3-37	92	**SHARP**	**299.08**Hz. D4+32	32	**IN-TUNE**
Sniff the Rose	**216.66**Hz. A3-26	-26	**IN-TUNE**	**297.90**Hz. D4+25	25	**IN-TUNE**

Interview notes

Interview times from 3-6- minutes.

3 open questions:

Open question seeks to gain feedback on whether any of the facial postures made the singing feel easier or harder and was there any change in tone. Were the postures difficult or easy to achieve and can they describe the sensations of each postures.
Participate asked about feedback on: Facial posture names, word descriptors of each and visual images.
Participant asked if there is anything about the experiment that could be improved or changed

STARTS

I was happy with the neutral face. I was a bit confused with the other faces. Didn't really know what to do and I don't think it impacted my singing. The Rose didn't feel right because I was concentrating too much on trying to do the face and the singing became secondary.

Why did pick neutral face as a description? What about 'dead pan'

I did lift my face up on neutral face on high notes. I think I did that with out realising. Even though I was trying to do the face, I think I definitely lifted my face. I know when you want to hit high notes you need to lift the face, like Tom Jones and Luciano they are lifting their faces to get the high notes.

It's difficult to hit high notes with a neutral face. I think, without a shadow of doubt I couldn't hit high notes without changing my face.

Feedback on the tools.

Neutral face reminds me of Charlie Chaplin, deadpan. The bloodhound always makes you think of sadness. The other two are quite confusing to do. I am not sure I know how to sniff the rose. What about a WOW face.

The experiment was very clear.

Participant identifier: J Gender: Female Age:18-29
Level of experience in singing: Keen amateur. Currently having lessons within the practice and is already aware of using their face for brightening tone.

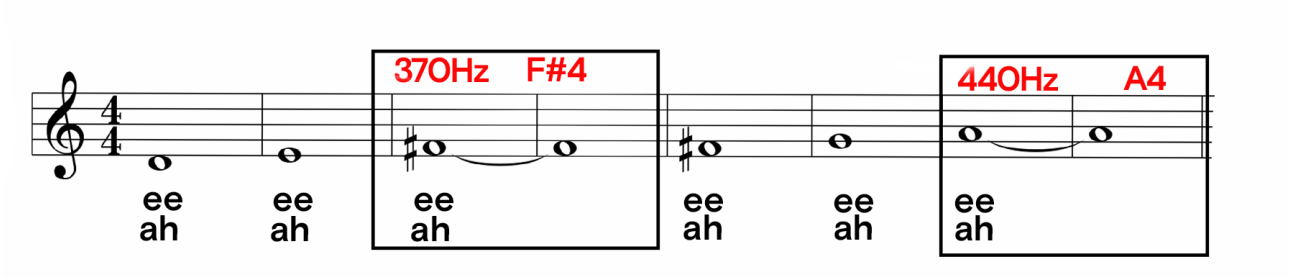
Results are illustrated in Hertz, musical pitch and musical cents
100 cents = semitone
50 cents = quarter tone
200 cents = whole tone

2. Frequency & Target Pitch	**349.23Hz** F4	**Cents**		**466.16Hz.** Bb4	**Cents**	
Neutral Face	**350.53**Hz F4+6	6	**IN-TUNE**	**466.49**Hz Bb4+1	1	**IN-TUNE**
Squinty Face	**351.40**Hz F4+11	11	**IN-TUNE**	**464.30**Hz. Bb4-7	-7	**IN-TUNE**
Sniff the Rose	**348.86**Hz F4-12	-2	**IN-TUNE**	**464.81**Hz. Bb4-5	-5	**IN-TUNE**

IN-TUNE = mean pitch calculated over 1 second <50-cents off target note

FLAT = mean pitch calculated over 1 second >50-cents below target

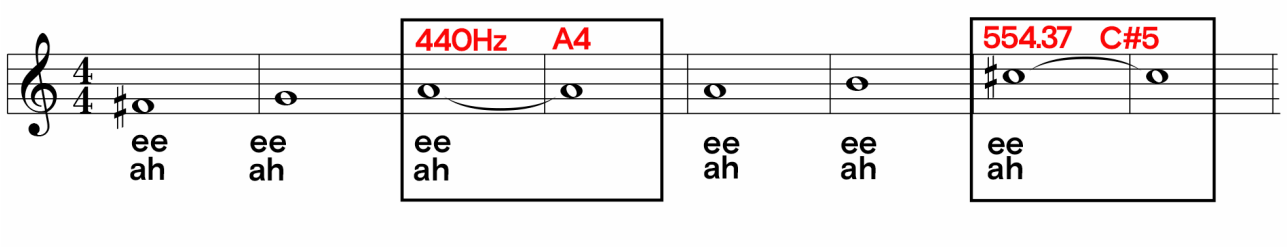
SHARP = mean pitch calculated over 1 second >50-cents above target



Exercise 1 - Vowels

1. (EE) Frequency & Target Pitch	**370Hz** F#4	**Cents**		**440Hz** A4	**Cents**	
Neutral Face	**368.30** F#4-8	-8	**IN-TUNE**	**441.04** A4+4	4	**IN-TUNE**
Squinty Face	**374.44** F#4+21	21	**IN-TUNE**	**439.53** A4-2	-2	**IN-TUNE**
Sniff the Rose	**378.47** F#4+39	39	**IN-TUNE**	**440.59** A4+2	2	**IN-TUNE**

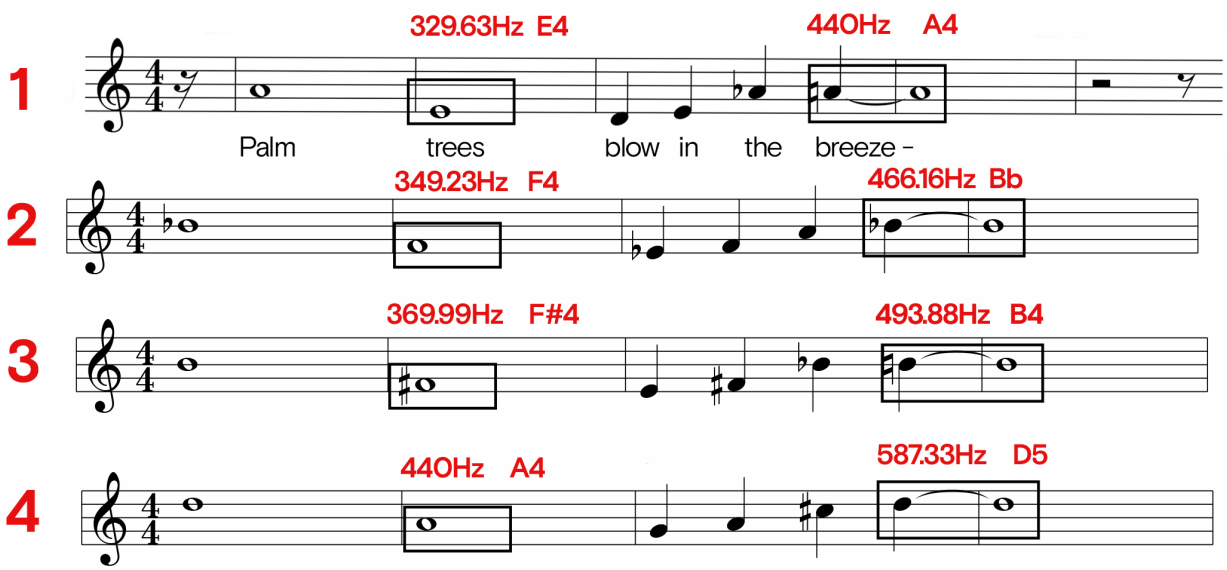
2. (AH) Frequency & Target Pitch	**370Hz** F#4	**Cents**		**440Hz** A4	**Cents**	
Neutral Face	**370.10** F#4	0	**IN-TUNE**	**437.82** A4 -9	-9	**IN-TUNE**
Squinty Face	**369.06** F#4 -4	-4	**IN-TUNE**	**440.70** A4+3	3	**IN-TUNE**
Sniff the Rose	**371.99** F#4+9	9	**IN-TUNE**	**438.81** A4-5	-5	**IN-TUNE**



3. (EE) Frequency & Target Pitch	440Hz. A4	Cents		554.37Hz. C#5	Cents	
Neutral Face	**438.41**Hz. A4-5	-5	IN-TUNE	**508.89Hz** C5-48	-52	FLAT
Squinty Face	**442.91Hz**. A4+11	11	IN-TUNE	**550.19**Hz. C#5-13	-13	IN-TUNE
Sniff the Rose	**443.71** A4+15	15	IN-TUNE	**542.66Hz** C#5-37	-37	IN-TUNE

4. (AH) Frequency & Target Pitch	440Hz. A4	Cents		554.37Hz. C#5	Cents	
Neutral Face	**441.23**Hz A4+5	5	IN-TUNE	**537.49**Hz. C5+46	-54	FLAT
Squinty Face	**443.80**Hz A4+15	15	IN-TUNE	**548.80**Hz. C#5-17	-17	IN-TUNE
Sniff the Rose	**440.52**Hz A4+2	2	IN-TUNE	**556.68**Hz. C#+7	7	IN-TUNE

Palm Trees exercise



1. Frequency & Target Pitch	**329.63Hz** E4	**Cents**		**440Hz.** A4	**Cents**	
Neutral Face	**330.14**Hz E4+3	3	**IN-TUNE**	**445.03**Hz. A4+20	20	**IN-TUNE**
Squinty Face	**328.60Hz** E4-5	-5	**IN-TUNE**	**444.65**Hz. A4+18	18	**IN-TUNE**
Sniff the Rose	**334.63**Hz E4+26	26	**IN-TUNE**	**444.74**Hz. A4+19	19	**IN-TUNE**

3. Frequency & Target Pitch	**370Hz.** F#4	**Cents**		**493.88Hz** B4	**Cents**	
Neutral Face	**368.16**Hz. F#4-9	-9	**IN-TUNE**	**484.67**Hz. B4-33	-33	**IN-TUNE**
Squinty Face	**379.83Hz** F#4+45	45	**IN-TUNE**	**496.88**Hz. B4+10	10	**IN-TUNE**
Sniff the Rose	**380.85**Hz. F#4+50	24	**IN-TUNE**	**492.60**Hz. B4-5	-5	**IN-TUNE**

4. Frequency & Target Pitch	**440Hz. A4**	**Cents**		**587.33Hz. D5**	**Cents**	
Neutral Face	**437.18**Hz. A4-11	-11	**IN-TUNE**	**449.99**Hz. D5+39	39	**IN-TUNE**
Squinty Face	**450.77**Hz. A4+42	42	**IN-TUNE**	**589.07**Hz. D5+5	5	**IN-TUNE**
Sniff the Rose	**452.61**Hz. A4+49	49	**IN-TUNE**	**591.56**Hz. D5+12	12	**IN-TUNE**

2. Frequency & Target Pitch	**349.23Hz** F4	**Cents**		**466.16Hz.** Bb4	**Cents**	
Neutral Face	**350.80**Hz F4+8	8	**IN-TUNE**	**463.35**Hz Bb4-10	-10	**IN-TUNE**
Squinty Face	**356.19**Hz F4+34	46	**IN-TUNE**	**473.78**Hz. Bb4+28	28	**IN-TUNE**
Sniff the Rose	**356.65**Hz F4+36	36	**IN-TUNE**	**470.74**Hz. Bb4+17	17	**IN-TUNE**

Interview notes

13. Open question seeks to gain feedback on whether any of the facial postures made the singing feel easier or harder and was there any change in tone. Were the postures difficult or easy to achieve and can they describe the sensations of each postures.
14. Participate asked about feedback on: Facial posture names, word descriptors of each and visual images.
15. Participant asked if there is anything about the experiment that could be improved or changed

STARTS

I found the neutral face hard to adopt the usual things in singing, like when you go high everything is lifted and it felt very restricting. It didn't feel like the quality of the sound was good especially going high.

Squinty face was the easiest and going higher that worked the best for me. Specially showing the teeth and lifting the cheekbones made it easier to access high notes. Sniffing the rose was hard to hold, specially the flared nostrils. Difficult to maintain. Compared to neutral face though, easier to access the high notes.

Breathing-wise sniff the rose gave me the most energy for the breath. Everything felt more open and that felt good.

I am a visual person and see the names and the descriptions were easy in helping me, especially the images of the faces.

I thought the whole thing was clear. It was good to go through it first.

Going forward I think using my face would help make certain notes easier to produce. It would be a good technique.

Participant sat upright in chair and displayed competence with producing different facial expressions. Occasional head lift on Sniff the rose

2. Frequency & Target Pitch	**349.23Hz** F4	**Cents**		**466.16Hz.** Bb4	**Cents**	
Neutral Face	**364.82**Hz F#4-24	76	**SHARP**	**458.95**Hz Bb4-27	-27	**IN-TUNE**
Squinty Face	**357.04**Hz F4+38	38	**IN-TUNE**	**499.61**Hz. B4+20	120	**SHARP**
Sniff the Rose	**394.33**Hz G4+10	210	**SHARP**	**472.98**Hz. Bb4+25	25	**IN-TUNE**

3. Frequency & Target Pitch	370Hz. F#4	Cents		493.88Hz B4	Cents	
Neutral Face	**433.70**Hz. A4-25	275	**SHARP**	**524.18**Hz. C5+3	103	**SHARP**
Squinty Face	**404.11** Ab4-47	153	**SHARP**	**526.13**Hz. C5+9	109	**SHARP**
Sniff the Rose	**385.41**Hz. G4-29	71	**SHARP**	**537.01**Hz. C5+49	149	**SHARP**

Participant identifier: K Gender: Female Age:50-59
Level of experience in singing: Hobby singer. Sings in choirs. Currently having lessons within the

4. Frequency & Target Pitch	440Hz. A4	Cents		587.33Hz. D5	Cents	
Neutral Face	**452.65**Hz. A4+49	49	**IN-TUNE**	**581.72**Hz. D5-17	-17	**IN-TUNE**
Squinty Face	**401.90**Hz. G4+43	-57	**FLAT**	**559.72**Hz. C#5+17	-83	**FLAT**
Sniff the Rose	**508.31**Hz. B4+50	150	**SHARP**	**607.57**Hz. D#5-41	-41	**IN-TUNE**

practice and is already aware of using their face for brightening tone.

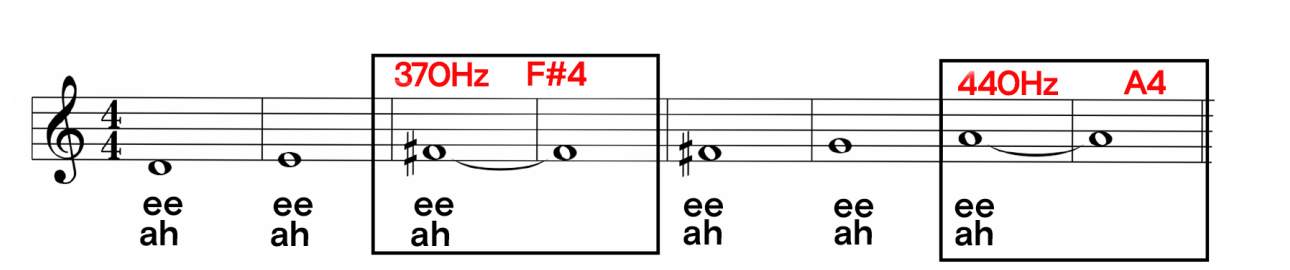
Results are illustrated in Hertz, musical pitch and musical cents
50 cents = quarter tone
100 cents = semitone
200 cents = whole tone

IN-TUNE = mean pitch calculated over 1 second <50-cents off target note

FLAT = mean pitch calculated over 1 second >50-cents below target

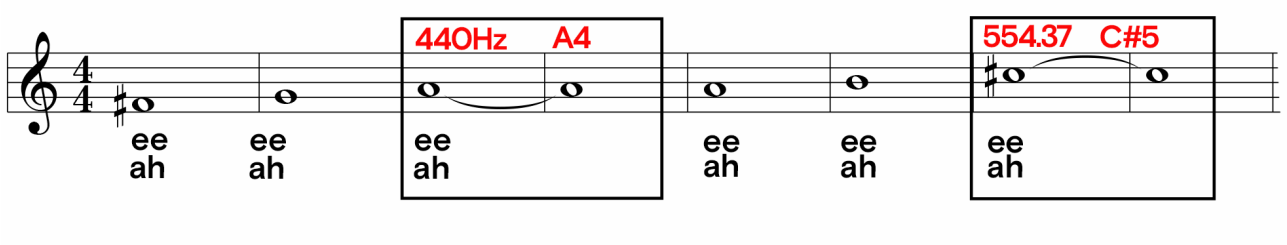
SHARP = mean pitch calculated over 1 second >50-cents above target

Exercise 1 - Vowels



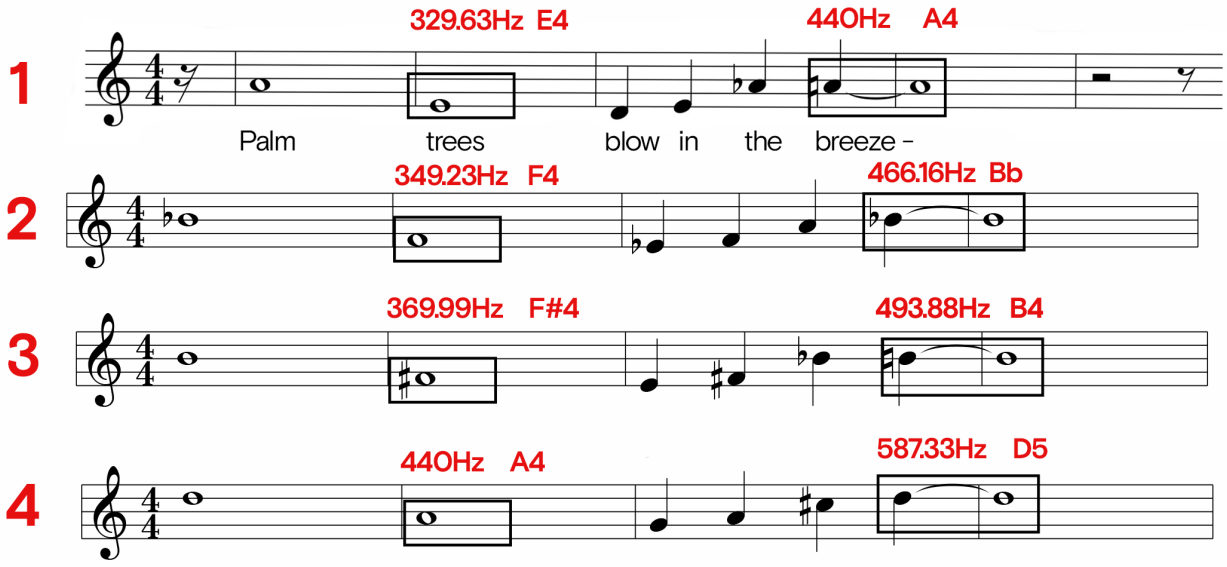
1. (EE) Frequency & Target Pitch	370Hz F#4	Cents		440Hz A4	Cents	
Neutral Face	**373.26** F#4 +15	15	**IN-TUNE**	**444.10** A4+16	16	**IN-TUNE**
Squinty Face	**374.74** F#4+22	22	**IN-TUNE**	**451.28** A4+44	44	**IN-TUNE**
Sniff the Rose	**375.51** F#4+26	26	**IN-TUNE**	**446.61** A4+26	26	**IN-TUNE**

2. (AH) Frequency & Target Pitch	370Hz F#4	Cents		440Hz A4	Cents	
Neutral Face	**374.90** F#4 +23	23	IN-TUNE	**441.73** A4 +7	7	IN-TUNE
Squinty Face	**377.11** F#4 +33	33	IN-TUNE	**447.93** A4-31	-31	IN-TUNE
Sniff the Rose	**379.65** F#4+45	45	IN-TUNE	**451.96** A4+46	46	IN-TUNE



3. (EE) Frequency & Target Pitch	440Hz. A4	Cents		554.37Hz. C#5	Cents	
Neutral Face	**446.90**Hz. A4+27	27	IN-TUNE	**561.00**Hz. C#5+21	21	IN-TUNE
Squinty Face	**450.54Hz**. A4+41	41	IN-TUNE	**569.67**Hz. C#5+47	47	IN-TUNE
Sniff the Rose	**452.95** A4+50	50	IN-TUNE	**569.05Hz** C#5+45	45	IN-TUNE

Palm Trees exercise



2024

4. (AH) Frequency & Target Pitch	440Hz. A4	Cents		554.37Hz. C#5	Cents	
Neutral Face	**444.75**Hz A4+19	19	IN-TUNE	**558.50**Hz. C#5+13	13	IN-TUNE
Squinty Face	**450.23**Hz A4+40	40	IN-TUNE	**563.77**Hz. C#5+29	29	IN-TUNE
Sniff the Rose	**449.72**Hz A4+38	38	IN-TUNE	**563.26**Hz. C#+28	28	IN-TUNE

1.
2.

1. Frequency & Target Pitch	329.63Hz E4	Cents		440Hz. A4	Cents	
Neutral Face	**332.92**Hz E4+17	17	IN-TUNE	**452.30**Hz. A4+48	20	IN-TUNE
Squinty Face	**338.10Hz** E4+44	44	IN-TUNE	**444.71**Hz. A4+18	14	IN-TUNE
Sniff the Rose	**340.12**Hz F4-46	54	SHARP	**454.31**Hz. Bb-45	55	SHARP

3. Frequency & Target Pitch	370Hz. F#4	Cents		493.88Hz B4	Cents	
Neutral Face	**371.13**Hz. F4+5	5	IN-TUNE	**499.69**Hz. B4+20	20	IN-TUNE
Squinty Face	**375.07** F#4+24	24	IN-TUNE	**505.41**Hz. B4+40	40	IN-TUNE
Sniff the Rose	**375.10**Hz. F#4+24	24	IN-TUNE	**504.56**Hz. B4+37	37	IN-TUNE

4. Frequency & Target Pitch	440Hz. A4	Cents		587.33Hz. D5	Cents	
Neutral Face	**440.09**Hz. A4	0	IN-TUNE	**594.67**Hz. D5+22	22	IN-TUNE
Squinty Face	**440.48**Hz. A4+2	2	IN-TUNE	**597.00**Hz. D5+28	28	IN-TUNE

3. (EE) Frequency & Target Pitch	220Hz. A3	Cents		227.18Hz. C#4	Cents	
Neutral Face	**227.40** A#3-43	57	SHARP	**279.78**Hz. C#4+16	16	IN-TUNE
Squinty Face	**221.30**Hz. A3+10	10	IN-TUNE	**277.95**Hz. C#4+5	5	IN-TUNE
Sniff the Rose	**222.87** A3+22	29	IN-TUNE	**280.17**Hz C#4+19	7	IN-TUNE

4. (AH) Frequency & Target Pitch	220Hz. A3	Cents		227.18Hz. C#4	Cents	
Neutral Face	**A3-3**HzF A3+6	6	IN-TUNE	**279.62**Hz. C#4+15	15	IN-TUNE
Squinty Face	**220.31**Hz A3+2	2	IN-TUNE	**279.68**Hz. C#4+16	16	IN-TUNE
Sniff the Rose	**219.95**Hz A3	0	IN-TUNE	**281.37**Hz. C#4+26	26	IN-TUNE

4. Frequency & Target Pitch	440Hz. A4	Cents		587.33Hz. D5	Cents	
Sniff the Rose	**446.41**Hz. A4+25	25	IN-TUNE	**604.75**Hz. D#5-49	51	SHARP

2. Frequency & Target Pitch	349.23Hz F4	Cents		466.16Hz. Bb4	Cents	
Neutral Face	**351.93**Hz F4+13	13	IN-TUNE	**470.34**Hz Bb4+15	15	IN-TUNE
Squinty Face	**358.59**Hz F4+46	46	IN-TUNE	**473.34**Hz. Bb4+26	26	IN-TUNE
Sniff the Rose	**357.33**Hz F4+40	15	IN-TUNE	**476.83**Hz. Bb4+39	39	IN-TUNE

Interview notes

STARTS

1. Frequency & Target Pitch	E3	Cents		A3	Cents	
Neutral Face	**140.99** C#3+30	-270	FLAT	**222.32**Hz. A3+18	18	IN-TUNE
Squinty Face	**160.13**Hz D#3+50	50	IN-TUNE	**222.41**Hz. A3+19	19	IN-TUNE
Sniff the Rose	**162.59**Hz E3-24	-24	IN-TUNE	**221.50**Hz. A3+12	12	IN-TUNE

Neutral face felt flat compared to the others and I didn't think the sound was very nice. Quite a flat tone. A physical sensation of flatness (rather than tuning). I didn't like the squinty face sound. It didn't feel particularly relaxed and calm as I did in the (Rose) one. Sniff the Rose, felt the nicest. More natural. The physical feeling for me and the sound felt easier and sounded better. Less of an effort that Squinty. The overall sound felt open and easier. (Participant demonstrates opening the shoulders and chest) Perhaps the physical nature of the other one, was harder, tighter and closed.

Did anything make hitting the high notes easier?

Definitely showing the teeth and opening the mouth. On sniff the rose, lifting the face and eyebrows helped.

On the neutral face, I think for me the keyword was 'relaxed'. I think the descriptors and words were very helpful. I didn't look at the faces (images) at all.

3. Frequency & Target Pitch	F#3	**Cents**		B3	**Cents**	
Neutral Face	**185.85**Hz. F#3+8	8	**IN-TUNE**	**249.72**Hz. B3+19	19	**IN-TUNE**
Squinty Face	**186.15** F#3+11	11	**IN-TUNE**	**252.12**Hz. B3+36	36	**IN-TUNE**
Sniff the Rose	**183.47**Hz. F#3-14	-14	**IN-TUNE**	**248.07**Hz. B3+8	8	**IN-TUNE**

4. Frequency & Target Pitch	A3	**Cents**		D4	**Cents**	
Neutral Face	**224.57**Hz. A3+36	36	**IN-TUNE**	**297.66**Hz. D4+23	23	**IN-TUNE**
Squinty Face	**228.13**Hz. A#3-37	92	**SHARP**	**299.08**Hz. D4+32	32	**IN-TUNE**
Sniff the Rose	**216.66**Hz. A3-26	-26	**IN-TUNE**	**297.90**Hz. D4+25	25	**IN-TUNE**

Everything was very clear. Giving the starting notes and beats to prepare was very helpful. I would definitely use my face more. I think doing the neutral face shows how much harder it is to sing than using my face.

Observations: participant physically opened shoulders on Sniff the Rose and possibly lifted their chin.

Appendix H: Dropbox link to audio exercises

https://www.dropbox.com/scl/fo/8b738konw0j6w03x55eg5/AMJWODCecaBXK0qRobmOVpE?rlkey=gv6vyu00v07lnei8viqnowvuy&st=zgrx5ej7&dl=0

Appendix I: Dropbox link to participant audio

https://www.dropbox.com/scl/fo/eova4xh9wr4383gukj03z/APPIKhicm21SRMvHbLJIPsM?rlkey=kxroz7vcmjx5yi68yc2clcfq7&st=6d1ft6du&dl=0

Appendix J: SPSS data summary

T-Test

Notes

Output Created		15-JUN-2024 20:12:06
Comments		
Input	Data	/Users/tanyaholt/Desktop/SPSS Files/All exercises - sums and ...
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	9
Missing Value Handling	Definition of Missing	User defined missing values are treated as missing.
	Cases Used	Statistics for each analysis are based on the cases with no missing or out-of-range data for any variable in the analysis.
Syntax		T-TEST PAIRS=neutral_face_all_exercises_mean neutral_face_all_exercises_mean Squinty_face_all_exercises_mean WITH Squinty_face_all_exercises_mean rose_all_exercises_mean rose_all_exercises_mean (PAIRED) /ES DISPLAY(TRUE) STANDARDIZER(SD) /CRITERIA=CI(.9500) /MISSING=ANALYSIS.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.00

[DataSet1] /Users/tanyaholt/Desktop/SPSS Files/All exercises - sums and means.sav

Page 1

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	neutral_face_all_exercises_mean	-131.8889	9	338.76972	112.92324
	Squinty_face_all_exercises_mean	76.8333	9	179.49808	59.83269
Pair 2	neutral_face_all_exercises_mean	-131.8889	9	338.76972	112.92324
	rose_all_exercises_mean	90.8333	9	142.82660	47.60887
Pair 3	Squinty_face_all_exercises_mean	76.8333	9	179.49808	59.83269
	rose_all_exercises_mean	90.8333	9	142.82660	47.60887

Paired Samples Correlations

		N	Correlation	Significance One-Sided p	Significance Two-Sided p
Pair 1	neutral_face_all_exercises_mean & Squinty_face_all_exercises_mean	9	.661	.026	.052
Pair 2	neutral_face_all_exercises_mean & rose_all_exercises_mean	9	.268	.243	.486
Pair 3	Squinty_face_all_exercises_mean & rose_all_exercises_mean	9	.063	.436	.871

Paired Samples Test

		Paired Differences			
		Mean	Std. Deviation	Std. Error Mean	95% Confidence ... Lower
Pair 1	neutral_face_all_exercises_mean - Squinty_face_all_exercises_mean	-208.72222	257.99420	85.99807	-407.03412
Pair 2	neutral_face_all_exercises_mean - rose_all_exercises_mean	-222.72222	330.56477	110.18826	-476.81680
Pair 3	Squinty_face_all_exercises_mean - rose_all_exercises_mean	-14.00000	222.20205	74.06735	-184.79961

Paired Samples Test

		Paired ... 95% Confidence Interval of the ... Upper	t	df	Significance One-Sided p
Pair 1	neutral_face_all_exercises_mean - Squinty_face_all_exercises_mean	-10.41033	-2.427	8	.021
Pair 2	neutral_face_all_exercises_mean - rose_all_exercises_mean	31.37236	-2.021	8	.039
Pair 3	Squinty_face_all_exercises_mean - rose_all_exercises_mean	156.79961	-.189	8	.427

Paired Samples Test

		Significance Two-Sided p
Pair 1	neutral_face_all_exercises_mean - Squinty_face_all_exercises_mean	.041
Pair 2	neutral_face_all_exercises_mean - rose_all_exercises_mean	.078
Pair 3	Squinty_face_all_exercises_mean - rose_all_exercises_mean	.855

Paired Samples Effect Sizes

			Standardizer[a]	Point Estimate
Pair 1	neutral_face_all_exercises_mean - Squinty_face_all_exercises_mean	Cohen's d	257.99420	-.809
		Hedges' correction	285.80176	-.730
Pair 2	neutral_face_all_exercises_mean - rose_all_exercises_mean	Cohen's d	330.56477	-.674
		Hedges' correction	366.19425	-.608
Pair 3	Squinty_face_all_exercises_mean - rose_all_exercises_mean	Cohen's d	222.20205	-.063
		Hedges' correction	246.15180	-.057

Paired Samples Effect Sizes

			95% Confidence Interval	
			Lower	Upper
Pair 1	neutral_face_all_exercises_mean - Squinty_face_all_exercises_mean	Cohen's d	-1.552	-.030
		Hedges' correction	-1.401	-.027
Pair 2	neutral_face_all_exercises_mean - rose_all_exercises_mean	Cohen's d	-1.387	.072
		Hedges' correction	-1.252	.065
Pair 3	Squinty_face_all_exercises_mean - rose_all_exercises_mean	Cohen's d	-.715	.593
		Hedges' correction	-.646	.535

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