

PROJECT PROPOSAL

INTEGRATING THE ALEXANDER TECHNIQUE INTO VOICE TRAINING: A PILOT STUDY ASSESSING THE IMPACT OF INDEPENDENT ONLINE LEARNING

CONTEXT AND JUSTIFICATION

The researcher's background includes over twenty years of international operatic performances. After attaining certification in the Alexander Technique (AT) her teaching practice has focused on in-person integration of AT principles into classical voice training. The current Covid-19 pandemic has altered the nature of this business. This project will be conducted to bridge practice and research by expanding this independent teaching studio's offerings to include a targeted online training programme for AT/voice integration.

Trained in the Carrington (1994) tradition, this researcher has never been encouraged to teach remotely, relying instead on the teacher's hands to give students a new experience (pp. 103-104). While developing this programme, it was necessary to consider alternate AT approaches including Barstow's teaching innovations (Connable, 2016), and Alexander's (2001) account of how he developed the technique independently. "Anyone can do what I do - but they would have had to do what I did" (Davies and Barlow, 2002, p. 318). Since Alexander's learning process reportedly took 10 years (Alexander, 1986, p. xiii) the fundamental question guiding this research is whether an online independent programme can be efficacious.

RESEARCH DESIGN

This eight-week mixed methods study seeks to assess the impact of AT/voice online teaching. A pragmatic approach employing an equal and parallel QUAN+QUAL mixed method research design (Fig. 1) will be used to provide “superior research findings and outcomes” (Johnson, Onwuegbuzie and Turner, 2007, p. 129). Adopting the axiological viewpoint that participant experience is paramount to any philosophical stance, specific ontological or epistemological positions will not be taken (Morgan, 2007, p. 67). This inquiry is influenced by participation action research, a meta-methodological approach integrating diverse methods and tools (Rowley, 2003), and grounded theory to organise, label and categorise the qualitative data (Crowther et al. 2017). Multiple cases may contribute credibility to the findings (Tashakkori and Teddlie, 1998, p. 70)

Qualitative and Quantitative Methods: Equal and Parallel, Fig. 1



A maximum of 7 participants were chosen using purposive sampling (Tashakkori and Teddlie, 1998, p. 76). Each had contacted the researcher through AT/voice workshops or local teachers, and completed a short questionnaire to assess motivation levels due to the level of independent study required (Appendix A). Quantitative data will be collected weekly through participant submitted recordings of specific singing tasks (Appendix B), and acoustically analysed by the researcher using VoceVista Video Pro (VVV), (Maas et al., 2020). The parameters under consideration for classical singing assessment using VVV are guided by Titze (2000), Miller (2008), and McCoy (2012). Qualitative data will include weekly learning journals, coded using a grounded theory coding process (Willig, 2013, p. 70). Initial and final semi-structured interviews to give results additional context (Gill et al. 2008). Data will be analysed and triangulated to find

a convergence of results or reveal different aspects of the question (Creswell, 2014, p. 178). The advantage of a mixed method approach is the ability to triangulate sources while providing richer descriptions (Merriam and Tisdell, 2016, p. 42). A timeline has been developed to facilitate a cohesive and organized learning experience for these independent learners (Appendix C).

INTENDED IMPACT

Due to the dearth of investigations into AT/voice integration, the proposed inquiry seeks to fill a research gap. Pioneering AT/voice studies have an interesting pedigree with first- generation teachers Jones and Barlow both having conducted research on singers. Barlow (2005) conducted singer experiments using a daily lesson framework (pp. 207-208). Results were interpreted in conjunction with participants' regular music teacher (Warrack, 2005), and were verified by external data such as improved competition results. Jones (1972) also utilised a traditional AT approach by manually adjusting a singer's head balance. These research frameworks are not currently possible due to pandemic contact restrictions, and the varied geographical locations of the participants. This proposed research seeks expand on existing studies by ascertaining if an independent learning environment might have some impact on singers. The researcher is unaware of any AT online research.

In preparation for this inquiry, the researcher expanded her knowledge of acoustics as well as her proficiency with current VVV testing software in order to conduct this research responsibly and produce valid and reliable results (Tashakkori and Teddlie, 1998, pp. 79-80).

Ultimately the researcher's goal is to expand beyond teaching individual lessons by creating an adaptable programme for both groups and individual applications. She also plans to write more comprehensively on AT/voice integration.

INSIDER/OUTSIDER RESEARCH AND ETHICS

The central focus of this research question seeks to assess the impact of online training on independent learning. The recorded nature of video content guiding participant learning infers that the research is somewhat removed from the learning process, with the researcher assuming a principally outside perspective. However, direct interactions including the proposed master classes would require the researcher to adopt an emic role. This participatory emic perspective allows the researcher to engage with subjects as a qualified guide while maintaining “the ethical high ground” (Ruane, 2005, p. 166). Mercer (2007) encourages researchers to consider etic/emic perspectives as points on a continuum (p. 13). This viewpoint is consistent with the varied approaches in this learning project, which is expected to shift between insider and outsider viewpoints. Ethics approval has been obtained for this research (Appendices D and E). Any emerging issues will be guided by the attached codes of ethics and conduct of the professional organisations to which the researcher belongs (Appendices F and G).

EXPECTED LEARNING OUTCOMES

This research project seeks to assess the impact of an online programme on independent learning. Both AT and voice lessons traditionally involve person-to-person interaction. Moving lessons online immediately mitigates in-person contact during a pandemic, as well reduces geographic and time constraints for students. Once this programme has been developed and tested it could be scaled to size to create partnerships with professional training programmes and university voice departments. Ultimately, an ongoing course could provide the foundation for an online AT/voice integration community.

PROJECT REPORT

INTEGRATING THE ALEXANDER TECHNIQUE INTO VOICE TRAINING: A PILOT STUDY ASSESSING THE IMPACT OF INDEPENDENT ONLINE LEARNING

Glossary of Abbreviations (Appendix H)

INTRODUCTION

The fundamental aim of this pilot study was to assess the impact of an online learning programme designed to integrate the Alexander Technique (AT) into classical voice training using multiple case studies. No existing studies measuring the effects of online AT/voice training were found, filling a research gap. The researcher is a private voice teacher certified in the Alexander Technique with over 20 years of international professional opera performance experience in principle roles.

Since both voice and AT lessons are traditionally conducted in person, the immediate concern of this study was to address training restrictions due to the Covid-19 pandemic. Participant progress was evaluated perceptually and acoustically by the researcher through VoceVista Video Pro (VVV), (Mass et al. 2020). These findings were triangulated with participants' reflection journals, which also served as a learning aid (Helding, 2014).

The goal of this online eight-week AT/voice integration programme is to mitigate chronic tension, improve coordination and reintegrate appropriate tonus for more optimal vocal performance. The researcher acknowledges that an eight-week pilot study is a brief period to institute both re-educative and skill building goals. However, time constraints limited this inaugural longitudinal study, which is still long enough to show some shifts (Ruane, 2005, p. 94). The secondary goals of this inquiry are to verify Jones (1972)

results claiming respiratory and resonatory improvements, and to propose future parameters for AT/voice inquiries. Acoustic measurements reflect current software capabilities (Maas et al. 2020), and incorporate stylistic concerns like vibrato and legato into the findings. The following hypotheses were identified.

Hypothesis #1: Respiratory noise will be reduced.

Hypothesis #2: Greater singing ease will be reflected as less spectral energy in the singer's formant range (SFR) between 2.3-4kHz, especially in female voices.

Hypothesis #3: Improved resonance will be reflected in the VFR.

Hypothesis #4: Reduction of chronic tension and improved coordination will be reflected acoustically with improved vibrato periodicity and a smoother legato.

LITERATURE REVIEW

The researcher's emerging pedagogical framework encompasses both physiology and acoustics which lie at the core of evidence-based voice pedagogy (EBVP), (Ragan et al, 2020, 22:00). The blending of these two areas guides the literature review for this inquiry. A quick overview of an AT approach contextualises the research, and a review of existing AT/voice research informs the researcher's motivation and methodology. Current classical voice parameters are summarised, and a brief primer in acoustics updates the existing inquiry and serves as a guide for potential future research.

ALEXANDER TECHNIQUE

AT takes a pragmatic approach to re-education by using everyday activities (Kleinman and Buckoke, 2013, pp. 127-178). AT/voice integration focuses on redirecting mental and physical energy (Alexander, 1918, p. 200), and relies on a singer's readiness to

challenge chronic habits (Heirich, 2005, pp. 1-4). This willingness typifies the “proper mental attitude” needed to learn (Alexander, 1918, p. 324). The goal is more efficient and less effortful singing (Heirich, 2005, p. 75; De Brunhoff, 2013, p. 26). Pettersen’s (2005) classical singing respiratory studies show that a reduction of certain muscular tension does not affect vocal function (p. 274) challenging any singer’s predilection to preserve all tension as essential.

Most first generation AT teachers believed that a hands-on component was necessary to facilitate new kinesthetic experiences and advance student awareness (Davies and Barlow, 2002, p. 222; Carrington, 1994, p. 99). Since this is presently impossible an alternate AT teaching method derived from Barstow’s lineage was investigated (Conable, 2016). Considered an integrative AT practice, Barstow’s tradition neither eschews nor stipulates putting hands on students (Madden, 2018, p. 80). Core AT principles remain constant including an indirect approach to specific vocal concerns (Alexander, 2001, pp. 27-28). This contrasts with the traditional explicit feedback given by voice teachers (Helding, 2020, pp. 128-136). Unequivocal instruction conflicts with Alexander’s suggestion to avoid *end-gaining*, by which he means rushing to complete a task unsatisfactorily due to compromised coordination (Alexander, 1918, p. 224).

INTEGRATING AT AND VOICE

There is a paucity of studies related specifically to the effects of AT on the voice, especially those incorporating quantitative data. Conventional AT studies have centered around common health issues, notably the alleviation of back pain (Woodman and Moore, 2011; Little et al. 2008). One of the central questions of this research is to ascertain if AT lessons can enhance vocal function, not merely mitigate pain. Klein, Bayard and Wolf (2014) reviewed 12 controlled AT/musician trials and determined that results claiming enhanced function were largely inconclusive, although improvements to performance anxiety were indicated (p. 10). While some of the inquiries reviewed

included singers, subjects were often either novices (Engelhart, 1989), or did not address vocal concerns (Valentine et al. 1995).

Singer-centric studies assessing AT benefits are scarce. The two most notable include those conducted by prominent first-generation AT teachers Barlow and Jones. The first was a study conducted at the Royal College of Music in 1956 structured around a traditional lesson framework (Barlow, 2005, pp. 207-208). Physical measurements, photographs, and qualitative teacher feedback were collected. Body measurements are too variable over time, and even Barlow (2005) thought that photographic evidence can be misleading (p. 207). A predominately emic inquiry with imperfect data, it is unsurprising that Barlow's research is considered substantially biased (Klein, Bayard and Wolf, 2014, p. 7). Although impartial experts indirectly contributed to these findings through adjudication, reflecting a disproportionate improvement of competition results (Barlow, 2005, p. 210).

Subsequently, Jones' (1972) research assessing the immediate effects of modified singer head balance, reported two notable findings. Spectrogram results supported claims of reduced audible inhalation (p. 212) and improved resonance confirmed both by the subject and unspecified musicians as "increased richness of the overtones" (pp. 213-214). Alleviating intrusive respiratory noise is an area of routine AT interest (Alexander, 1918, p. 325), as well as pedagogic concern (Bunch Dayme, 2005, p. 49). Conclusions related to enhanced resonance can now be verified, updated and expanded by independent researchers armed with advancements in voice science (Miller, 2008; Titze, 2000; Sundberg, 1987) using acoustic analysis software such as VVV (Maas et al. 2020).

Lloyd's (1986) mixed method approach mirrored Barlow's 1956 study, with all of the same biases. A teacher in training, Lloyd was not AT certified at this time calling into question her expertise to conduct this research (Yin, 1989, p. 65). What is germane to the current research is Lloyd's use of multiple case studies to understand multifaceted phenomena (Yin, 1989, p. 140). Since learning and re-education is an unpredictable and individual process that can only be inferred (Helding, 2020, pp. 100-101)

triangulating various data sources from multiple cases studies add credibility to the results (Tashakkori and Teddlie, 1998, p. 70).

DEVELOPING A PRACTICAL VOCAL PROFILE

There is a prevailing thought in vocal pedagogy espoused by Miller (1986) that physical freedom leads to proper muscular tonus (p. 206), which produces an even and efficient vibrato (p. 187). Nix et al. (2016) postulate that vibrato is directly regulated by singers through “muscle conditioning and respiratory coordination” (p. 756.e41). Given the physiological nature of this inquiry, it is logical to include vibrato measurements as a novel area of AT/voice research. Although it must be acknowledged that long-term longitudinal studies conclude vibrato training takes years (Mürbe et al, 2007, p. 683; Mitchell and Kenny, 2010, p. 427).

Vibrato rate, measured in cycles per second or Hertz (Hz) (McCoy, 2012, p. 18) has a contemporary target range of 4.5-6.5Hz (Titze, 2000, p. 325). Evidence suggests that rates may be affected by gender, with women having higher rates than men (Guzman et al. 2012, 675.e8).

Vibrato extent, defined as the frequency excursion from a central pitch (Doscher, 1988, p. 158) is affected by complex issues and therefore difficult to categorise. Extent has been identified as highly variable even among early music specialists who strive for a straight-tone (Hawkes et al, 1987, p. 156). Extent can change with note duration (Bretos and Sundberg, 2003, p. 42), increased amplitude (Guzman et al. 2012, p. 675.e9), and varies with stylistic and vocal demands (Johnson-Read et al. 2015, p. 634.e15). Gender may play a role as female opera singers have been found to have a wider extent (Manfredi et al. 2015, p. 517.e1), which Anand et al. (2012) deemed as perceptually more acceptable than when present in male voices (p. 820.e24). Notwithstanding these mitigating factors 100-200 cents is the contemporary accepted classical vibrato extent range (Titze, 2000, p. 325).

Vibrato has been implicated as an active contributor to a legato line (Doscher, 1988, p. 157). Continuity in the sound, perpetuated by an even periodic vibrato rate matched with a suitable vibrato extent, defines a classically sung legato (McCoy, 2012, p. 61). Functionally complicit in the attainment of an even vibrato is steady subglottal pressure (Stark, 1999, p. 115). This even pressure leads to an efficient vocal balance described as “flow phonation” (Sundberg, 1987, p. 172). These classical vocal characteristics serve as the benchmark for this research.

ACOUSTICS REVIEW

Vocal resonance is characterised by predictable and simultaneous overtones called harmonics formed by the vocal tract (McCoy, 2012, p. 21). These harmonics can be viewed as spectral energy in a long-term average spectrum (LTAS), which has been divided into two distinct frequency ranges to assess spectral balance. The first is the vowel formant range (VFR) between 0-2kHz, and the second is the SFR between 2-4kHz (Omori et al. 1996; Manfredi et al. 2015). Omori et al. (1996) state that greater energy in the 2-4kHz region denotes a classical ring (p. 232). Mitchell and Kenny (2004) object saying SFR energy does not accurately depict timbre (p. 99), and should be triangulated with perception to assess the suitability of the vocal quality (p. 117). The current inquiry adjusts these discrete ranges preferring 0-2.3kHz and 2.3-4kHz to reflect a higher effective SFR (Miller, 2008, p. 120), even though female SFR values are even higher starting around 2.6kHz (Weiss, Brown and Morris, 2001, p. 459).

The spectral balance between the VFR and SFR correlates to the Italian classical ideal of *chiaroscuro*, a balance between bright and dark tone colours (Miller, 2008, p. 111). Lowering the vocal formants (VFs) may also contribute to this timbre by creating a spectral distance between the formant region peaks (Titze, Maxfield and Walker, 2017, p. 382.e10). Miller (2008) suggests that *chiaroscuro* equilibrium might be achieved either through second formant (F_2) tuning in the VFR (pp. 113-114), or through the presence of a singer’s formant cluster in the SFR (p. 120). The phenomenon of clustering formants, seen as enhanced energy in higher frequencies, is an acoustic

strategy predominantly used by male classical singers when singing over an orchestra (Sundberg, 1987, p. 118). Classical singing in general shows heightened energy in the SFR when compared to other styles like jazz (Manfredi et al. 2015). Increased energy in the SFR may also be the product of pressed phonation (Titze, 2000, p. 275). Miller (2008) notes that pressed phonation may be mitigated by more efficient VF tuning to boost the voice with less effort (p. 65). Efficient formant tuning affects vowel clarity, assists resonance, aids practical functions like passaggio navigation, and perceptually defines musical timbre and style (Miller, 2008, pp. 21-22, 72). Vowels are defined by the first formant (F_1) and F_2 , (McCoy, 2012, p. 40). Sopranos overwhelmingly rely on the fundamental (f_o) to boost their sound, often coupling the first harmonic and first formant (f_o/F_1) (Sundberg, 1987, p.127). Narrower formant bandwidths are more efficient because there is less deterioration in the sound (Miller, 2008, p. 110). Although bandwidth is not currently measured by VVV, narrowing can be discerned in the LTAS. When assessing bandwidth, a predetermined distance from the peak, such as 10dB, is used (McCoy, 2012, p. 40).

Blending perceptual terms with quantitative measures such as loudness and amplitude requires some context. Decibels (dB) are measured on a logarithmic scale where small numbers can produce outsized effects. Miller (2008) notes that a harmonic becomes dominant when it exceeds another by 5dB (p. 113). McCoy (2012) states that an increase in 6-10dB is required to perceptually double the sound (p. 21). This is supported by Stevens' (1955) equation of perceptual loudness which he identifies as doubling every 10dB (p. 821).

METHODOLOGY

This research adopts a mixed method pragmatic design with a focus on the human experience (Morgan, 2007, p. 67), influenced by participant action research (Rowley, 2003, p. 132), and employing a multiple case study (CS) approach (Yin, 1989, p. 46). Tashakkori and Teddlie (1998) argue that case studies provide an accurate before and

after account (p. 88), which is essential in a longitudinal study. The pragmatic interchange of social and numerical data led to a richer explanation of phenomena (Mitchell, 2018, p. 103).

ETHICS

Ethics approval was granted through the University of Wales Trinity Saint David, Wales Academy for Professional Practice and Applied Research. In addition, the researcher was bound by codes of conduct as a member of two professional teaching organisations. These are all found in the appendices. All participants signed a consent form (Appendix I), and were informed that they could withdraw at any time. Throughout every stage of this process, the researcher was careful to honour the ethical principles of respect for persons, beneficence and justice outlined by the Department of Health, Education and Welfare (1979). The programme was modified for participants with discomfort, injuries or movement constraints. Everyone consented to the use of their recorded images during the presentation portion of this research.

PARTICIPANTS

Potential participants contacted the researcher after AT/voice webinars in the six months preceding the research period. A purposive sample (Tashakkori and Teddlie, 1998, p. 76) of potential classical singing participants were pre-screened for intrinsic motivation and asked to commit to daily independent learning. Five participants of the original seven invited to participate are included in this study. One participant withdrew in the third week citing health reasons. Another became a hospice caregiver for a family member interrupting her participation. Participants came from diverse geographical locations spanning from southern Louisiana to Tel Aviv. The average participant age in this study was 32, and the average training was 12 years, with seven spent studying classical music (Fig. 1).

Fig. 1: Participant Data

Case Study	Age	Voice Type	Years of Training (classical)	Singing Specialty	AT experience
CS1	25	Soprano	10 (10)	Opera: Bel canto, Mozart	A masterclass or two
CS2	25	Soprano	15 (9)	Opera	None
CS3	35	Mezzo	12 (2)	Jazz, and baroque solo	A little work with an AT teacher, several AT workshops
CS4	33	Tenor	15 (7)	Musical theatre	Minimal
CS5	43	Baritone	8 (8)	Baroque solo, renaissance choral, 20th century art song	A small amount of AT reading, and YouTube videos
Mean	32		12 (7)		

PROGRAMME

A series of 17 instructional videos were designed for this course (Capalbo, 2020a). These videos provided a background in AT theory and introduced traditional AT procedures (Appendix J). Each procedure in the AT framework was then applied to vocal exercises summarised in Appendix K. Video content was released semi-weekly and enhanced with live online weekly master classes where the participants were invited to sing and interact with the researcher. Materials influencing the development of this programme are found in the bibliography (Appendix L).

VALIDITY AND DATA COLLECTION

This longitudinal mixed method study utilises both qualitative and quantitative data collected weekly. Tashakkori and Teddlie (1998) state that validity and reliability are the two most important issues pertaining to mixed method data (pp. 79-80). Validity, assuring the measurement of appropriate data, guided the researcher to define a practical vocal profile assessable using VVV, while remaining relevant to AT/voice integration. Reliable, error-free data were ensured through sample retesting (Tashakkori and Teddlie, 1998, p. 85). The researcher made every effort to mitigate research biases through the use of multiple data sources (Merriam and Tisdell, p. 12). In addition, the verification and expansion of existing findings (Jones, 1972) enhanced this study's validity (Tashakkori and Teddlie, 1998, p. 83). The qualitative research ideal of trustworthiness was pursued in terms of an eight-week prolonged engagement, triangulation of data sources, negative case analysis, and thick description of participants' reflection journals, with all original materials stored for future verification (Tashakkori and Teddlie, pp. 90-92).

METHODS

The specific tools utilized to capture data in the VVV programme include.

- **Spectrum (LTAS) Analysis** - Amplitude (dB)
- **Vibrato Analysis** - Vibrato rate (Hz) and vibrato extent (cents)
- **Spectrographic Analysis** - Stylistic assessments (legato, vibrato periodicity, and phonation type)

Results from these acoustic data were then applied to the vocal profile (Fig. 2).

Fig. 2: Acoustic Measurements Applied to the Vocal Profile

Method	Acoustic Measurements and Assessments Week 1 versus Week 8 Changes
Respiratory Noise	
Spectrum (LTAS) Amplitude measurements triangulated with aural assessment.	▪ Measurement of audible aperiodic inhalatory noise ○ Peak to peak comparison (dB)
Balance of Spectral Energy	
Spectrum (LTAS) Amplitude measurements triangulated with visual and aural assessments	▪ Caro mio ben, 9 bar sample ○ Peak to peak comparison between regions (dB), (0-2.3kHz, 2.3-4kHz)
Formant Tuning	
Spectrum (LTAS) Visually and aurally assessed.	▪ Excerpted initial [a] from <i>Caro</i> ○ Efficient VF strategy (0-2.3kHz)
Vibrato Rate and Extent	
Vibrato Analyser (LTAS) Measurements provided from highlighted sections	▪ Caro mio ben, 9 bar sample ○ Vibrato rate 4.5-6.5Hz; extent (100-200 cents)
Legato	
Spectrogram Visually and aurally assessed. Triangulated with aural assessment.	▪ Excerpted selection including the text “Caro mio ben” ○ Vibrato periodicity and continuity in the signal.

INSIDER RESEARCH

The researcher led a cohort of five independent learners through a programme related to her areas of expertise (Costley, 2010, p. 6). This online course challenged the established face-to-face teaching role, allowing the researcher to function more as a guide, serving both as an observer and participant on the etic/emic continuum (Cohen, Manion and Morrison, 2007, p. 179).

The programme was structured around the researcher's training and previous research on this topic (Capalbo, 2020b). Emerging themes were extracted from participant reflection journals (Willig, 2013, p. 72), which helped the researcher to clarify video content. In addition, guidance was explicitly modified as required due to disease, discomfort, and independently sustained injuries.

The online weekly master class was the most emic element of this research. Although the researcher did not function explicitly as a voice teacher in this inquiry, some participants expressed an interest in supplementary vocal input. The decision to make instructional shifts were based on her interactions with specific participants. The ultimate goal of tension release and restoration of coordinative function to facilitate vocal ease remained constant.

FINDINGS

Jones' (1972) two main acoustic findings related to respiration and resonance are verified, clarified and expanded in this inquiry. Additional assessments related to style are investigated.

RESPIRATION

Jones' previous study found some evidence of reduced audible respiratory noise. His evidence consisted of a faint spectrographic image (p. 212) with no measurements attached.

Audible levels of respiration were measured at the same point in the song *Caro mio ben* (Fig. 3). The highest weekly respiratory peak was identified and measured in the spectrum using LTAS. Results showed a reduction of respiratory noise in all participants' LTAS peaks from the first to the eighth week (Fig. 4). The mean decline was 6.8dB of aperiodic inhalatory sound. These numbers could be considered significant when you consider that 6dB doubles amplitude.

Fig. 3: Respiration Selection

Measured inhalation,
all participants

The image displays a musical score for the song "Caro mio ben". The top staff is labeled "CANTO" and begins with a piano (*p*) dynamic marking. The lyrics "Ca - ro mio ben, cre - di - mi al - men, sen - za di te lan - guisce il" are written below the staff. An orange arrow points to a specific note in the melody, with the text "Measured inhalation, all participants" written above it. The bottom staff shows the piano accompaniment, starting with a piano (*p*) and "dolce" marking.

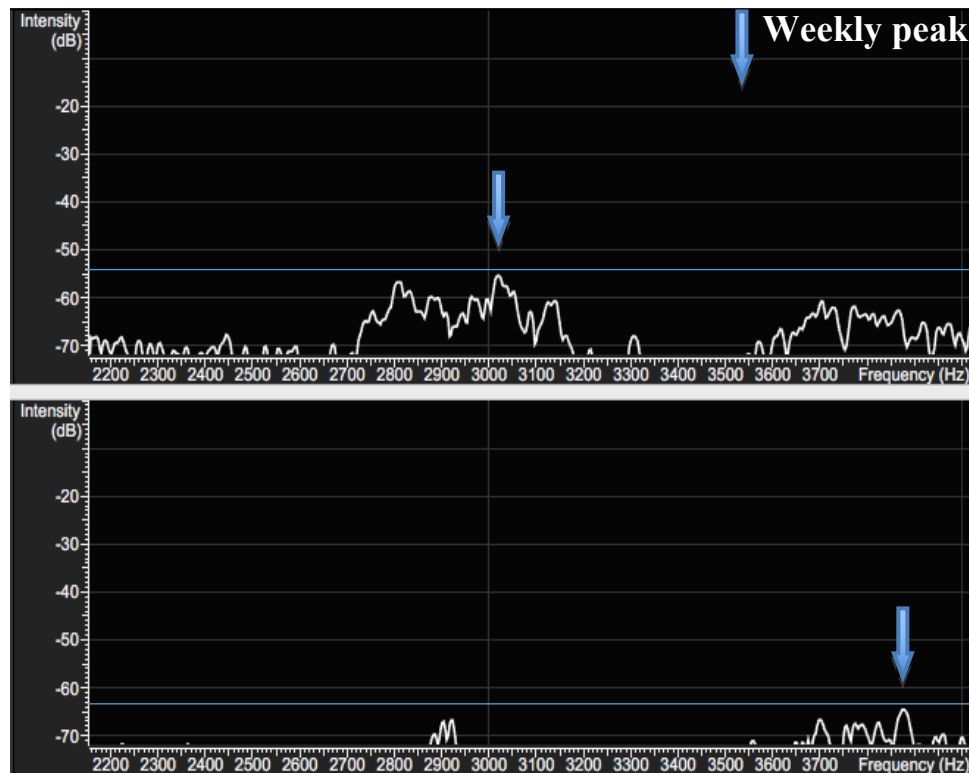
Fig. 4: Decreased Respiratory Noise

Case Study	Change in peak dB inhalatory noise from week 1 to week 8
CS1	-10dB
CS2	-5dB
CS3	-6dB
CS4	-6dB
CS5	-7dB
Mean Reduction	-6.8dB

Change in peak to peak LTAS respiratory noise

Participant respiratory data revealed pronounced decreases in CS1's respiratory noise (Fig. 5). Identifying as a noisy breather she found herself reevaluating, "how often I over breath, which actually can cause tension for me". This level of self-reflection indicates that CS1's dramatic reduction may have been assisted through this programme by providing new tools and focusing her awareness on a problem she recognised on some level she wanted to fix. Her results illustrate typical participant findings, showing not only a peak reduction over eight weeks, but an overall decline in aperiodic respiratory noise throughout the entire spectrum. Full LTAS respiratory results are found in Appendix M.

Fig. 5: LTAS, Greatest Respiratory Noise Reduction

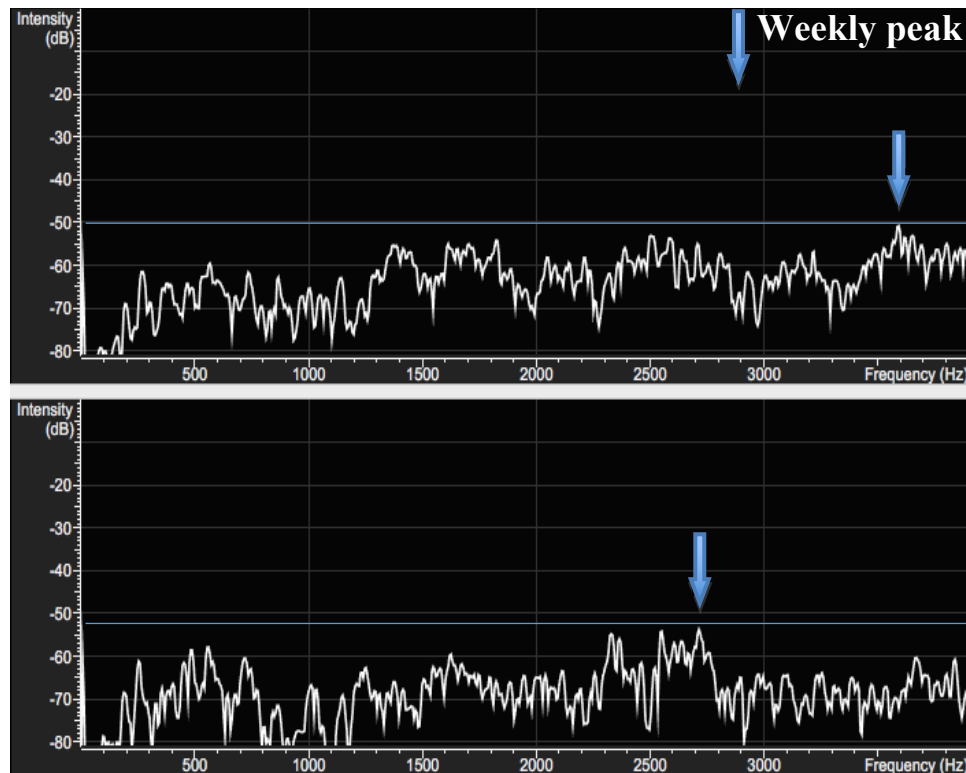


CS1: LTAS of aperiodic respiratory noise

Week 1, top – Week 8, bottom

Before leaving the topic of respiration, it is interesting to consider the results from a singer who tended to sing with pressed phonation, discussed in depth later. CS5 had notably higher levels of respiratory noise throughout his LTAS range both weeks (Fig. 6). This likely indicates underlying tensions throughout the vocal apparatus even though an overall net decrease in peak inhalatory noise was observed. Based on the information provided during master classes, the researcher believes that there is a strong possibility that CS5 uses an audible inhalation to cue ensemble members. This pattern has manifested as a tensional habit that remains present even when it is not necessary to signal others.

Fig. 6: LTAS, Respiratory Noise Reduction with Tensional Patterns



CS5: LTAS of aperiodic respiratory noise

Week 1, top – Week 8, bottom

RESONANCE

Jones identified enhanced resonance as his other significant research outcome. Due to advances in technology and voice science, this claim can now be parsed more critically.

SPECTRAL ENERGY

Nine bars of *Caro mio ben*, were measured using LTAS. Singing effort was inferred from the spectral energy peaks between the VFR (0-2.3kHz) and SFR (2.3-4kHz). For the purposes of this programme, lower effort in the SFR during phonation was viewed as easier and more efficient as long as an appropriate timbre was maintained. Since singers are not projecting over an orchestra during this task, enhanced amplitude in the SFR region is not required. However, boosts in the SFR may be present as a feature of

vocal timbre. Spectral energy measurements are found in Fig. 7. The final column indicates how the decibel level changed over the research period.

Fig. 7: Spectral Energy Measurements, *Caro mio ben* (nine bars)

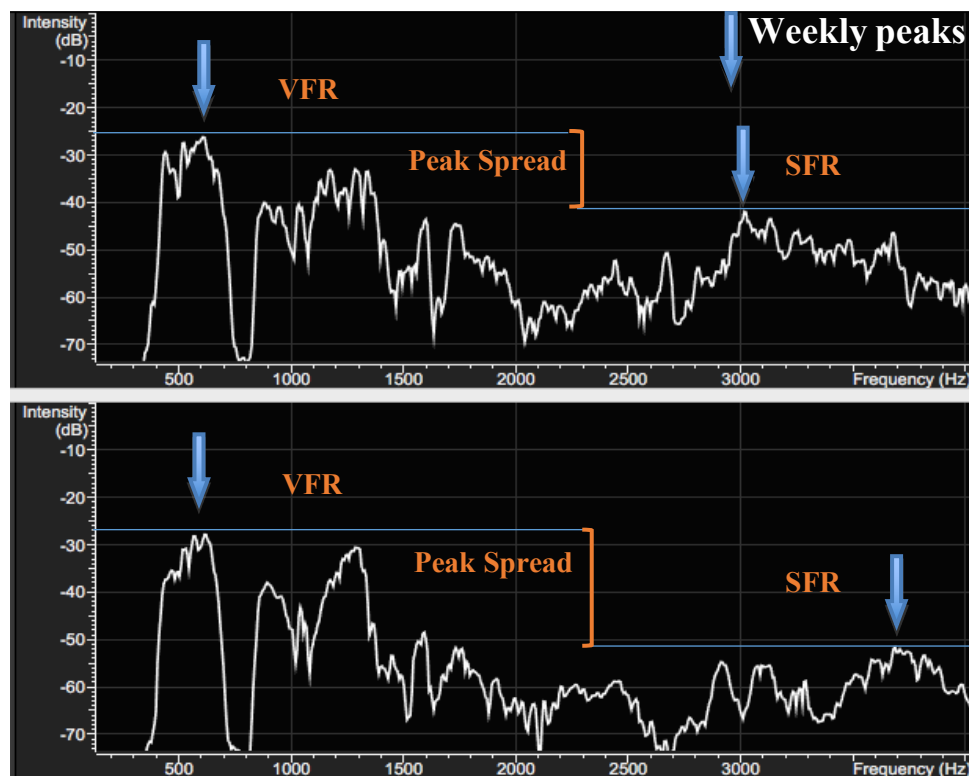
Case Study	Peak Spread 0-2.3kHz and 2.3-4kHz	Peak Spread 0-2.3kHz and 2.3-4kHz	Week 1 – Week 8 change in peak spread
	Week 1	Week 8	
CS1	-16.0dB	-23.5dB	-7.5dB
CS2	-29.0dB	-32.5dB	-4.0dB
CS3	-10.5dB	-18.0dB	0.0dB
CS4	-11.5dB	-14.0dB	-2.5dB
CS5	-14.0dB	-13.5dB	+0.5dB
Mean			-2.7dB

Amplitude Peak to Peak Spread

Week 1 and Week 8

There was a modest mean reduction of 2.7dB in spectral energy in the SFR over eight weeks. There was a reduction in SFR amplitude for three of the participants (CS1, CS2, CS4) indicating that their phonation was easier and more efficient. The mean reduction for 60% of the cohort with expected results was -4.7dB. Unsurprisingly the sopranos (CS1 and CS2) had the two highest reductions. This is likely due in part to the acoustic nature of higher frequencies. Sopranos can rely on f_o in the VFR to boost their sound rather than energy in the SFR. The most dramatic reduction is found in Fig. 8 below.

Fig. 8

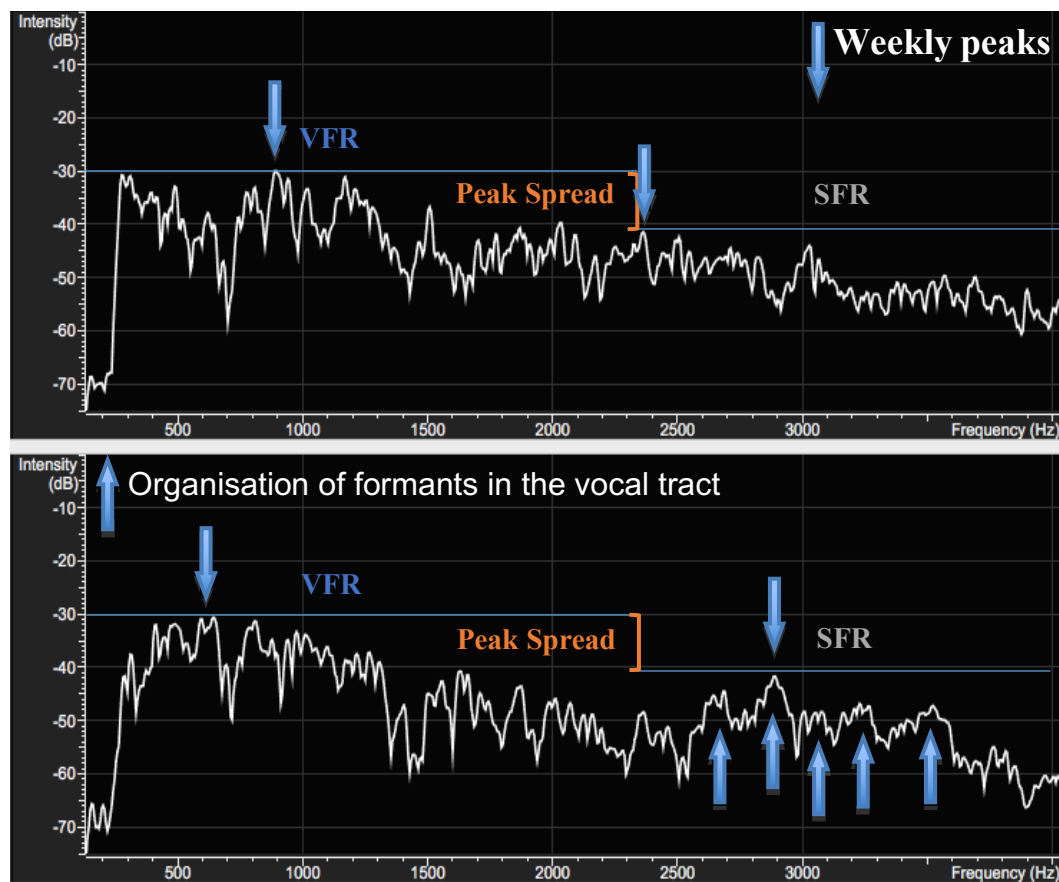


CS1: LTAS of *Caro mio ben* (9 bars)

Week 1, top – Week 8, bottom

CS3's results were interesting because although there is no reduction in dB levels, her energy patterns in the LTAS show quite a shift over the weeks (Fig. 9). Stronger and clearer emerging formants seem to be developing in the SFR of this singer who trained originally in jazz. The researcher posits that this developing pattern may indicate more stability in her classical vocal tract position, although this research area is still emerging (Manfredi, et al, 2015). To maintain this new vocal tract coordination CS3 may have used greater effort. Effort may diminish as she becomes more skilled in this style. Perceptually, the researcher confirmed an emerging classical ring by the eighth week in the song task. This pattern reveals an interesting trend. However, the enhanced SFR does not dominate f_0 , which is 11dB below the VFR peak. It remains at appropriate, although energetic, levels for this task.

Fig. 9

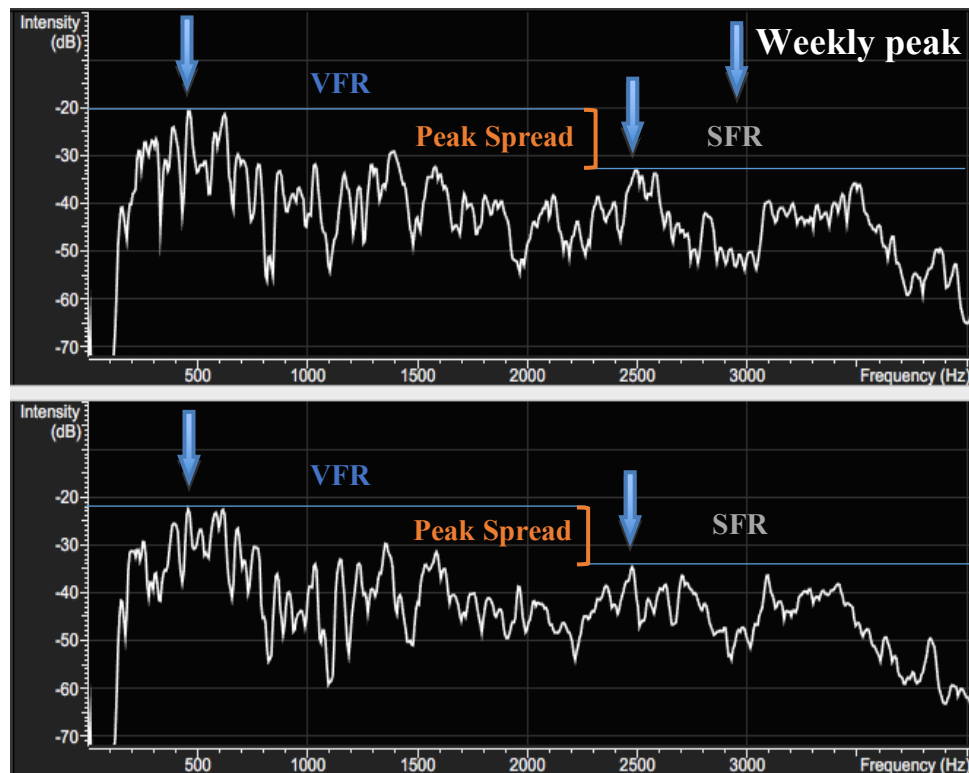


CS3: LTAS of *Caro mio ben* (9 bars)

Week 1, top – Week 8, bottom

CS5's spectral energy results represent a clear outlier demonstrating a slight increase in SFR amplitude by the final week (Fig. 10). A mitigating factor may be an illness during week one, causing him to sing more cautiously. While heightened energy might indicate enhanced ring, as seen with CS3, an increased amplitude may also represent pressed phonation. Perceptually CS5's sound is dull and pressed with a clearly constrained vibrato. The researcher compared his eighth week result with all previous weeks to confirm that these results are consistent, and not merely a negative performance shift on the final week. All participant LTAS spectral energy images are found in Appendix N.

Fig. 10

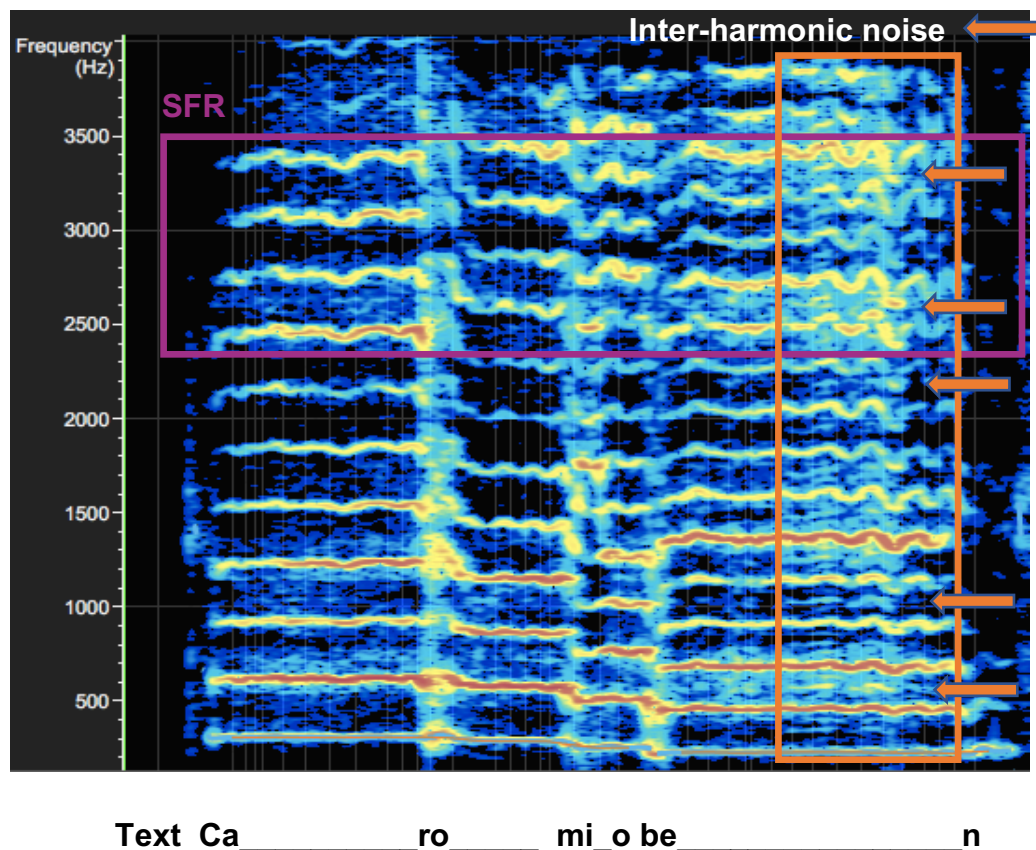


CS5: LTAS of *Caro mio ben* (9 bars)

Week 1, top – Week 8, bottom

This researcher agrees with previous research findings that sound quality cannot be assessed by relying solely on the LTAS for this cohort consisting of teachers and aspiring singers. To be responsibly evaluated this data must also be assessed perceptually. CS5's previous results revealed pressed phonation when triangulated with perception. This researcher does not make claims of pressed phonation lightly. This pressing tendency is illustrated in a spectrogram sample from CS5 (Fig. 11). The boxed **SFR** indicates that the energy is boosted, illustrated by the brighter yellow colour. However, the sound contains aperiodic inter-harmonic noise on the sustained note *ben* that should not be present because the harmonic series is regular and predictable. This visual representation illustrates what the researcher heard as habitually constrained vibrato atypical of the classical style, as well as pressed phonation with an almost rattle-like noise at times.

Fig. 11: Pressed phonation



CS5: week 8, *Caro mio ben*

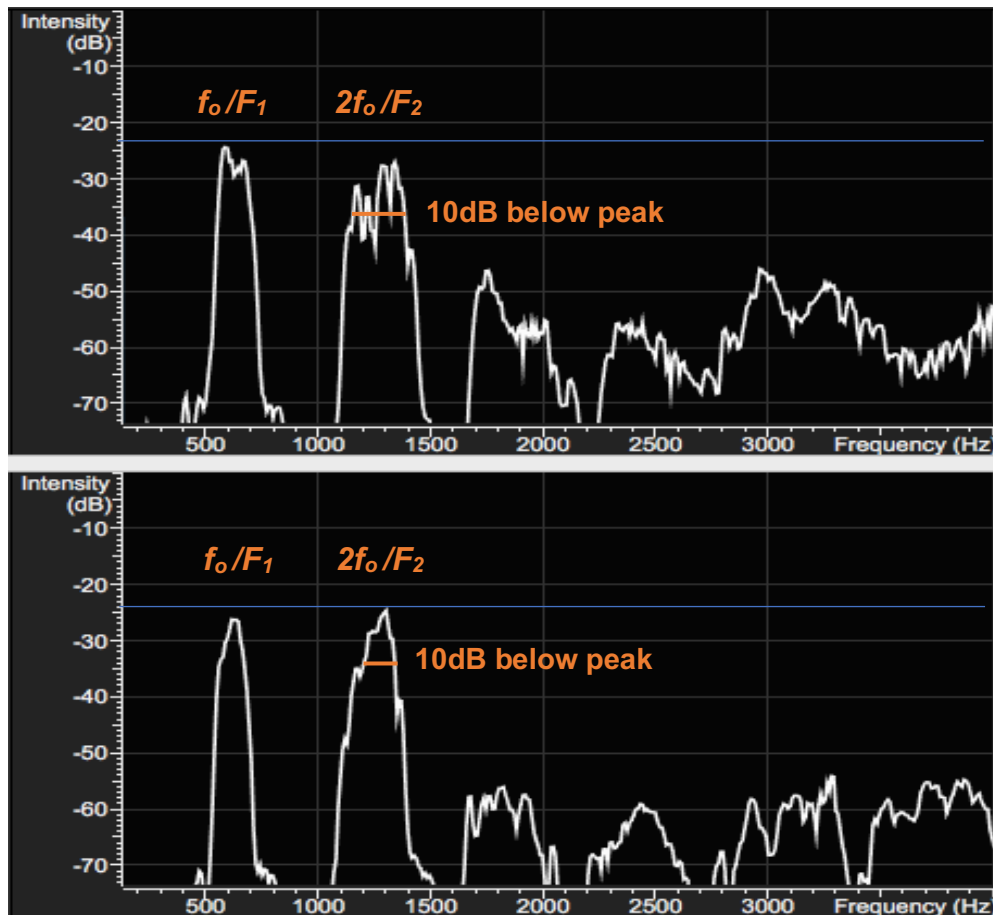
This spectrogram represents an updated version of Jones' (1972) data (p. 213), which clearly illustrates that heightened harmonics do not necessarily equate to an improved and appropriate resonance or timbre.

VOWEL FORMANTS (VFs)

Any attenuated levels in the SFR, due to vocal ease, must be balanced by a clearer VF strategy in the lower part of the spectrum for resonance equilibrium. An excerpted [a] from the first word *Caro* was used to evaluate VFs. Tuning strategies are assessed on isolated vowels since each has an individual acoustic profile. The relationship of F_1 to F_2

defines vowel clarity, colour and style in the 0-2.3kHz region. There were no explicit vowel instructions given during this research.

Fig. 12

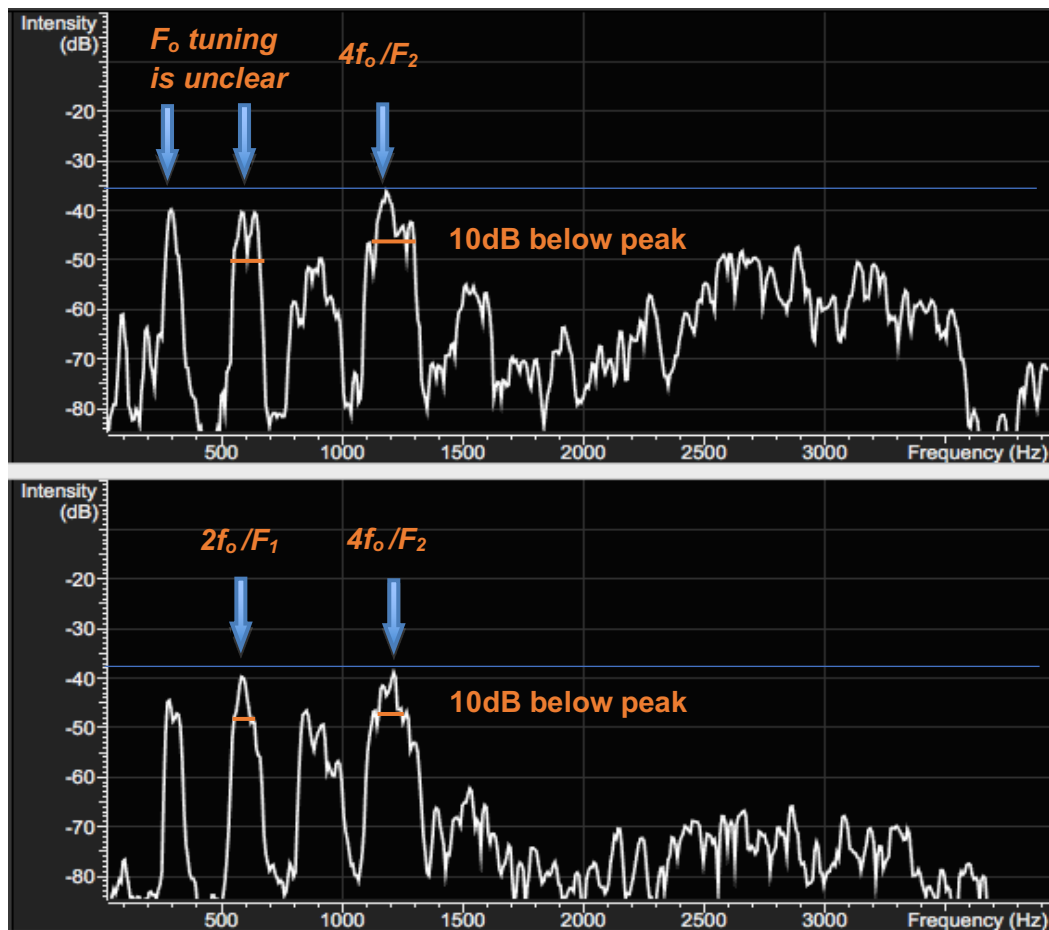


CS1: LTAS of [a] from C̄aro, E5-flat

Week 1, top – Week 8, bottom

Overall a narrowing in formant bandwidths was found in week eight indicating a more precise formant tuning strategy aligning $2f_0$ and F_2 in female voices (Fig. 12). Narrowing the F_2 bandwidth effectively lowers that formant creating more distance between the VFR and SFR peaks. This corroborates an emerging theory previously mentioned that spectral distance supports a chiaroscuro timbre or a balance between light and dark. Data consistently revealed narrower VFs for all participants.

Fig. 13



CS4: LTAS of [ɑ] from *Caro*, E4-flat

Week 1, top – Week 8, bottom

Since men sing an octave lower, their spectrum results differ (Fig. 14). Evidence of more precise formant tuning is seen in Fig. 13. The battle between f_0 and $2f_0$ to dominate F_1 in week one resolve into a clearer resonance strategy with $2f_0$ boosted about 5dB higher than f_0 to track F_1 in week eight. CS5's [ɑ] also showed narrower bandwidths, with a boosted $4f_0/F_2$ relationship, although the $2f_0/F_1$ coupling dominates his LTAS. Full LTAS data are found in Appendix O.

Further studies are required to confirm the implication of vocal ease on spectral balance, although there is evidence of a more precise VF tuning strategy, in conjunction with less energy in the SFR.

QUALITATIVE EVIDENCE OF VOCAL EASE

One of the principal goals of this AT/voice integration programme was to attain greater vocal ease. This was reflected in the participant's journals.

During my voice lesson today, I noticed that I was much more connected than usual. I have been focusing quite a bit on my head neck back relationship while I sing and bringing that into my lesson helped me make some great sounds. Carrying my connection from my high notes (that have always been easy) down to my middle and low voice which have been a struggle for me. They are becoming easier. (CS2)

I noticed while singing today I felt much more stability in the sound and less jaw shaking, and my arms and upper chest are much more relaxed. I did not experience much fatigue. High notes were easier to reach. I could sustain the soft sound more easily and sing the diminuendo which is usually a problem for me. (CS3)

Based on the preponderance of evidence, this researcher concludes that when excess tension was released participants sang with less effort. This was reflected in the balance of spectral energy between the VFR and SFR and their journals. When new resonance patterns emerged, comparable levels of vocal effort were used to stabilise the new vocal coordination.

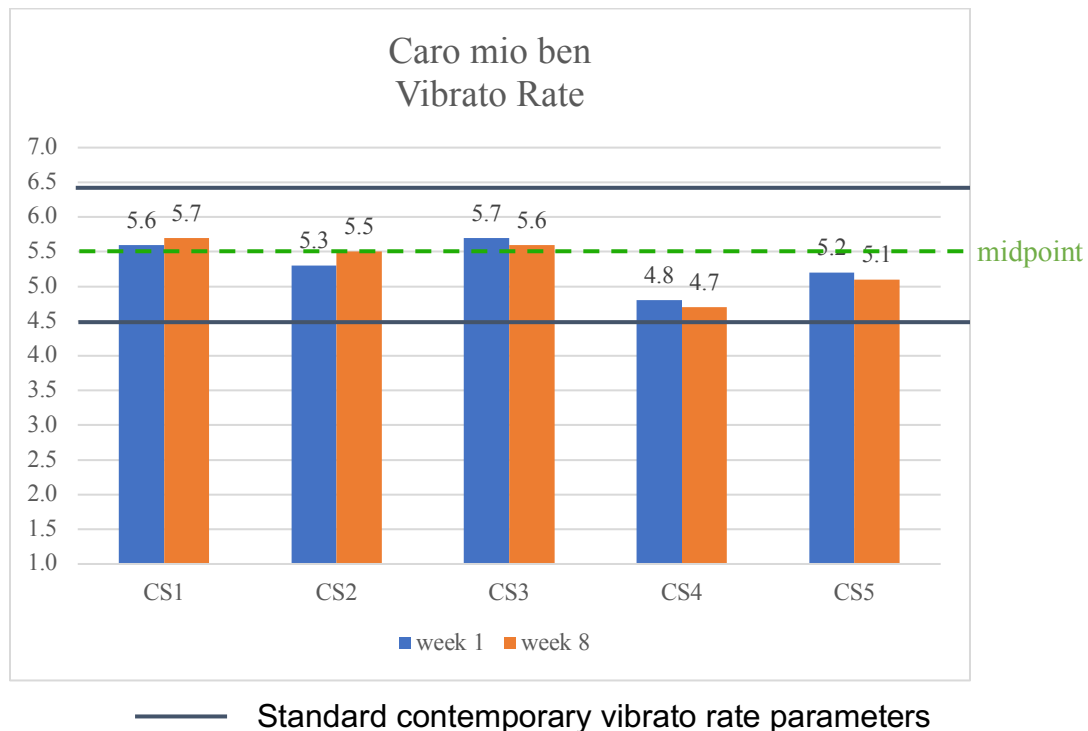
Conversely, if habitual tensional singing patterns were preserved, there was no measurable change in the LTAS or perceptual differences in the singing. Alexander's warning against students with a rigid viewpoint was at times personified in CS5's journal where he suggested that some of the exercises were for "remedial" or "over-trained"

singers, and therefore irrelevant to him. The easiest sounding sample from CS5 occurred in the first week and was likely due to more cautious singing during an illness.

VIBRATO

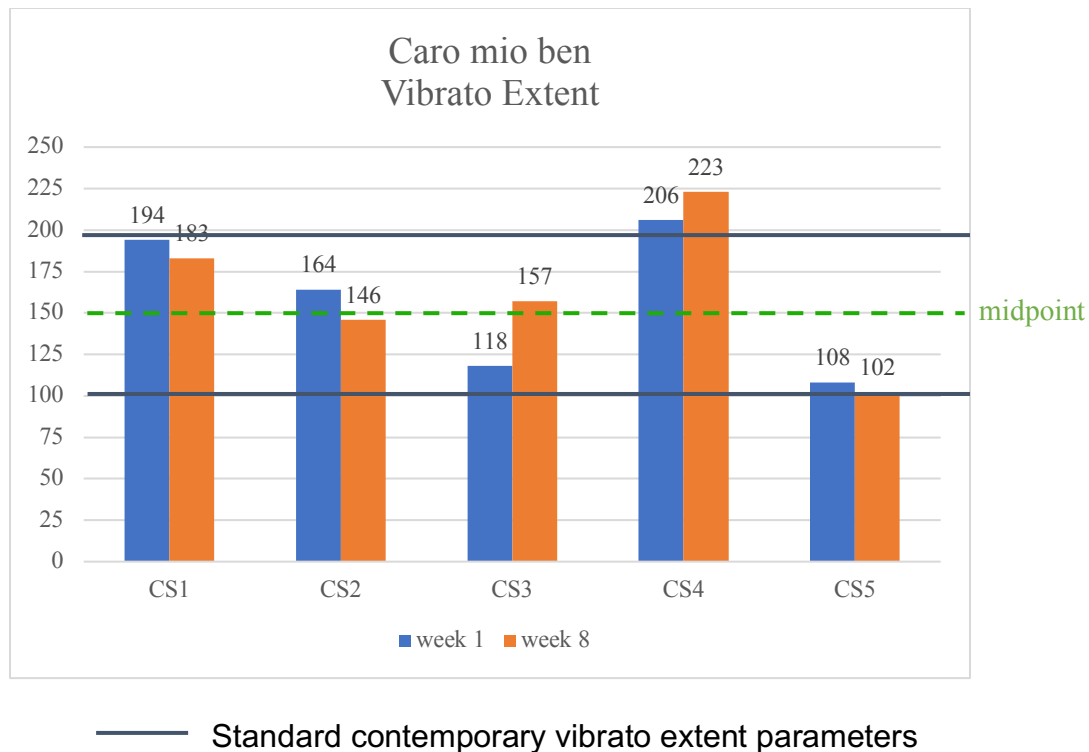
The vibrato rate results in the nine-bar song task (Fig. 14) showed that the entire cohort fit into the standard parameters. The women's data (CS1, CS2 and CS3) showed modest changes that stayed close to the midpoint of the expected rate over the eight weeks. The vibrato rates for both men (CS4, CS5) decreased moving slightly away from the midpoint, but as discussed earlier men's vibrato rates tend to be smaller.

Fig. 14



The vibrato extent results also showed dissimilarities between the genders as expected (Fig. 15). The women's extent all moved toward to the midpoint of the expected range over eight weeks with an average shift of 22 cents. Conversely, the extent in both male participants moved in opposite directions toward, or over, the accepted range limits.

Fig. 15



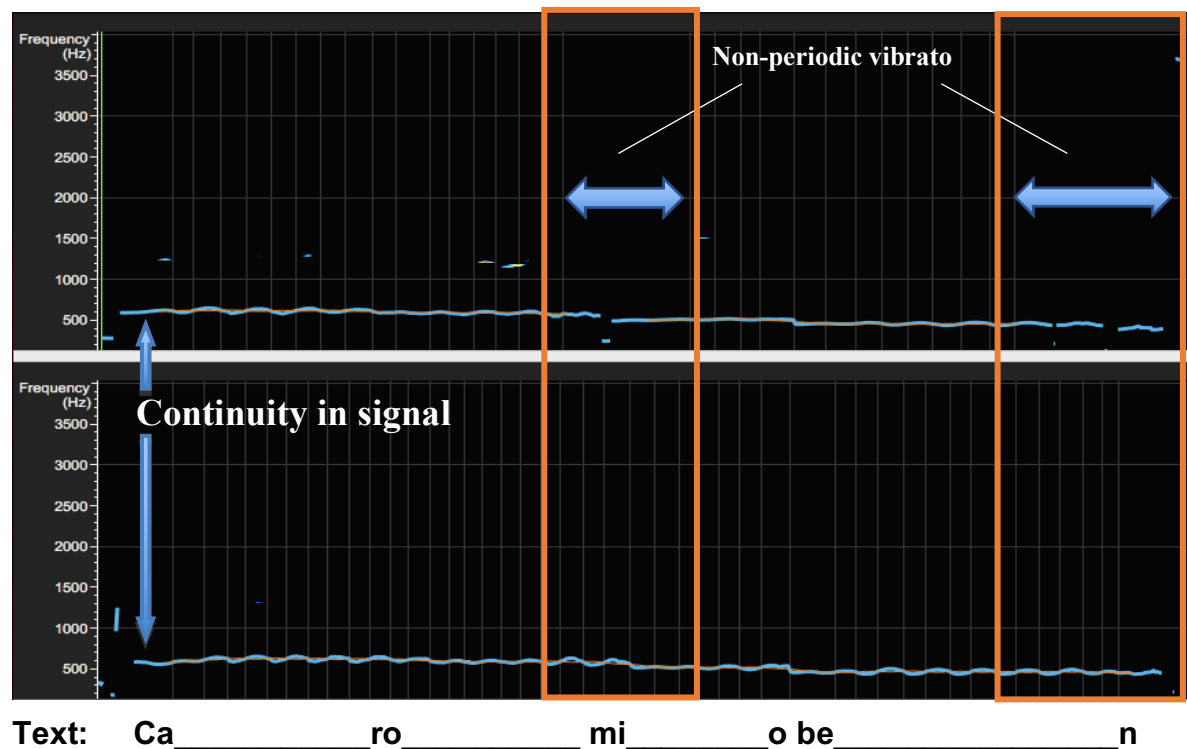
The researcher acknowledges that the issues affecting vibrato extent are multi-faceted, and vibrato can take time to change. However, for the purposes of this research, she found that both male singers tended to stay close to their habitual vibrato pattern over this period, with no spontaneous adjustments toward the accepted midpoint.

Throughout this inquiry CS4 consistently demonstrated an extremely variable and high vibrato extent. His data indicate that his voice tended toward a wobble, confirmed perceptually by the researcher. On the opposite end of the spectrum, CS5 preferred to sing with a straighter tone. This was represented in his acoustic data as well as in his journal. He wrote, “I have a concern that my exploration of AT is helping release tensions that are allowing a bigger voice”. His reluctance to release his voice from vibrato constraints was a recurring theme. His overall results reflected an uncommonly low vibrato extent for the identified benchmark of this research.

LEGATO

Legato is foundational to the classical singing style, and reliant on a periodic vibrato. Signal continuity was analysed in the phrase *Caro mio ben*. Many minor performance shifts were observed over eight weeks. Only one participant demonstrated a clear pattern of overall legato improvement in signal continuity and vibrato periodicity between over this period (Fig. 16).

Fig. 16: Legato, Fundamental Continuity and Vibrato Regularity



CS3: Spectrogram of *Caro mio ben*

Week 1, top – Week 8, bottom

The energy in the spectrogram (Fig. 16) has been attenuated to see f_0 more clearly. The faint vertical lines represent vibrato cycles, which are more periodic and therefore more stylistically correct for classical singing in week eight. Note the straightened vibrato in the onset of *mio*, and the offset of *ben* in week one versus greater periodicity in week

eight. The consonants are also clearly more connected in week eight especially the [m] of *mio* and [n] of *ben*.

Other indications of legato awareness were found in the journals and were specifically connected to the benefits of working with the HotBoaC procedure.

I feel like the pulling on the chair helps me with phrasing. While singing a long phrase, the pulling helps to keep it legato. It almost feels like an ebb and flow through whatever piece I am working on. (CS2)

[HotBofC] made me more aware of my legato, and because it was external, it was easier notice. There were times when plosives were interrupting the legato too much. (CS5)

During the final masterclass the researcher took a more emic approach with CS2 and CS4 expressly asking for legato for the first time. This video data is presented in the lecture portion of this research.

CASE STUDY OBSERVATIONS

Some subjects expressed confusion initially as they grappled independently with the material, which is not uncommon in the AT learning process. There was a marked sense of acceptance and greater insight by week seven. “I think this week I had a breakthrough. I really felt like I was grasping the material.” (CS4) Many of the physical observations made below are best presented through moving images. Therefore, the lecture presentation contributes to these research findings.

CS1, a voice teacher and church singer, was the most independent participant as she was unable to attend most master classes. She relied on the video material and three check-up meetings with the researcher. In the video clips submitted, the researcher

noticed that CS1 had a more casual approach to singing posture and wondered if she was too relaxed. This lack of muscular tonus was reflected in her journal:

I find that sometimes sitting up straight in a chair or on the floor is very tiring if held for longer than 2-3 minutes. I believe this may be because my postural muscles, particularly the muscles running along my spine are weak and not used enough.

During these meetings CS1 displayed a curiosity and understanding of AT procedure mechanics. Her head, neck and back coordination improved through her diligent work. These images are presented in the lecture.

CS2, a music therapist and aspiring opera singer, displayed common tensional issues in the master classes through extraneous head and neck movement. Tension in her tongue and jaw, customary hotspots for her, seemed to diminish somewhat over time. Since AT is a mind/body practice, it is interesting to note her reflections on her mental state after sustaining a work injury.

Today was a rough day at work and there were a lot of restraints that needed to be done. It is hard for me to stay out of the middle of things sometimes. I'm not sure if this is right, but I felt when I was letting other staff members take over the crises, I was kind of omniserving what was going on. It was an interesting concept.

The researcher believes that the ability to detach and not react emotionally relates directly to the issues of performance anxiety and stress. This is a widely touted AT benefit only briefly mentioned in this paper, although it bears further investigation. CS2's singing tensional changes, and legato improvements between weeks one and eight will be presented in the lecture.

CS3, a teacher and jazz singer with 2 years of classical training, has a background in Estill training and yoga. This participant was very dedicated to the process as evidenced by her frequent journal entries and perfect master class attendance. She began this process with notable tension in her arms, torso and face. Her journal reflects both the mind and body aspects of AT/voice integration.

It was my third encounter with AT and the most profound one. I have an even greater understanding of the importance of the body's condition, muscle tonus, posture, quality and [comfortable] sound production. My insights include: better body awareness overall, and specifically while singing. I believe I have built the foundation for more awareness while approaching the singing process. Generally, I can say my body feels better after this course.
(Lightly edited for grammar and spelling. The participant is a non-native English speaker.)

CS3's sound was transformed over eight weeks in the song task, with a more reliable classical ring and legato. Her singing tensions were remarkably reduced by week eight. Before and after videos will be shown in the lecture presentation.

CS4, a full time PhD student and music teacher, identifies as a musical theatre singer although his formal training was classical. Diagnosed with a degenerative ailment affecting the spine, he initially displayed excessive arm and head movements. These improved over time. His reflections indicate how he adapted this programme to his personal circumstances and his focus on mindfulness benefits.

I can feel my muscles engage even more as I slowly move from position to position. But I do feel more stabilization and less fatigue. The semi supine pose has been very helpful when used in conjunction with one of my therapy tools (a back stretcher). I feel it release and unlock the lower part of my back. Doing the routine has been very helpful in centering myself before singing.

His legato improvements will be shown during the presentation.

CS5, a voice teacher who sings semi-professionally, identifies as an early music specialist. This participant's results support respiratory and VF strategy findings. However, CS5 seems to have preconceived notions as to how much he is willing to change. Often presenting material for his upcoming Trinity qualification LTCL recital in the master class, he seemed locked in a performance rather than a learning mode. He remained reluctant to make changes even as he noted the observation of others, in this case, a trained musician and his accompanist.

[My partner] perceived that my sound was 'easier' and 'more natural' when I chose more stillness [and] it sounded fuller and easier than my sound before these workshops...I just feel louder, and I don't automatically want that.

The researcher suspected this participant's aim was primarily to extract information, while remaining disengaged from the process of change. Nevertheless, after eight weeks, using indirect means that he was "starting to grind with", there was ultimately improvement in CS5's habitual head tilting and nodding. His attentional focus also improved when performing material of his own choosing. The performance lecture will demonstrate these changes.

DISCUSSION AND REFLECTION

Evidence from this research supported Jones' (1972) findings of reduced respiratory noise and shifts in resonance, although this research parsed resonatory changes more precisely. Attenuated energy in the SFR relating to greater ease was found in 60% of participants, while the remaining two subjects were either new to classical singing or sang in an atypically constrained style. A clearer VF strategy typified by narrower bandwidths (Miller, 2008) was evident in all participant spectrum data. Overall there was a shift in spectral balance toward greater ease evidenced by less effort displayed in 60% of participants' SFRs and more precision in all VFRs.

Data related to elements intersecting function and style, like vibrato, were inconclusive supporting the claim that vibrato may take time to develop (Mürbe et al, 2007; Mitchell

and Kenny, 2010). Similarly, legato must likely be reinforced by explicit unequivocal instruction similar to conventional voice lessons, after better coordinative function has been established.

Results may have been affected by the assigned repertoire that did not motivate participants to sing their best, even though a standard assessment was required. There was a pervasive feeling in many of the submitted video files of just getting the vocal tasks *out of the way*, without embracing the process. The absence of cueing before testing may have also negatively affected results. Cueing was difficult to institute because participants were responsible for their own recording and submission. Future inquiries may benefit from instituting a cueing protocol with data collected directly by the researcher, even remotely.

CONCLUSION

The Alexander Technique is an iterative re-educative process. After completing this programme, participants showed a greater understanding of AT principles and became more adept with the procedures. Additionally, the evidence supports the claim that participants started to recognize and confront their habitual tensions, which impacted their respiration and singing.

Four hypotheses were proposed at the beginning of this research.

Hypothesis #1: Respiratory noise will be reduced.

This was found to be true with a mean reduction of 6.8dB. This means that noise was approximately halved.

Hypothesis #2: Greater singing ease will be reflected as less spectral energy in the SFR between 2.3-4kHz, especially in female voices.

This was substantiated in the results of both sopranos (CS1 and CS2) with more modest results for the tenor (CS4). The mean reduction in the SFR for those three

participants was 4.7dB. The mezzo soprano (CS3) showed no change but her SFR revealed a burgeoning development with more precisely tuned formants indicative of the classical style. The researcher posits that CS3 likely used more energy to stabilize this new alignment than she will require in the future. CS5 was an outlier, with no direct data or patterns to support this hypothesis. However, his data results do not necessarily disprove this theory, since this researcher doesn't believe that CS5 was engaged in the pursuit of greater vocal ease. This was reflected in his comments and the consistently constrained singing style he chose.

Hypothesis #3: Improved resonance will be reflected in the VFR.

This was demonstrated to be true to a degree in all cases as VF tuning became more precise exemplified by narrower formant bandwidths.

Hypothesis #4: Reduction of chronic tension and improved coordination will be reflected acoustically with improved vibrato periodicity and a smoother legato.

Specific concerns, like legato, tended to improve only with explicit intervention. The women's vibrato rate results trended toward the centre of standard ranges with a more convincing mean vibrato extent shift of 22 cents over eight weeks. Men's results tended to stay tethered to their habit at the extremes of the accepted range. A longer longitudinal study is needed to validate claims regarding spontaneous improvements related to stylistic issues.

FUTURE ACTIONS

This research was launched to solve an immediate teaching challenge related to contact restrictions. Going forward there are a number of teaching applications for a programme of this type.

- Reinforcement between private or group lessons
- University level music courses, lectures or workshops
- Young artist training workshops
- Independent online training programmes

Future inquiries involving a more typical cohort, with a conventional classical vibrato rate and extent, would allow for the implementation of vibrato jitter research. More typical data may also provide generalisable results for vibrato, an important classical vocal characteristic, which is theorised to develop naturally over time (Sundberg, 1987). Expanded AT/voice research beyond the acoustic realm may include psychophysical benefits related to cognitive tension, experienced as performance anxiety, and measured through tools like the Kenny Music Performance Anxiety Inventory (Kenny, 2016).

The knowledge and experience derived from this workplace learning programme synchronises with the emerging American EBVP movement focusing on acoustics and physiology (Ragan et al. 2020). The researcher is motivated to continue clarifying her pedagogical philosophy and formalising her teaching methodology through the development of additional voice exercises instituting AT fundamentals. She will pursue publishing the results of this study to contribute to AT/voice scholarship and expand on Jones' (1972) pioneering research.