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## Research Methods in WBL Module

Post Graduate Certificate in Professional Practice

# **“Assessing the efficacy of using spectrographic software in training Musical Theatre singers”**

Jamie Read – April 2018, London

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## **Abstract**

Following on from a previous literature review which sought to define the key Musical Theatre voice qualities of Belt, Legit and Mix (Read, 2018), this small scale research project set out to assess the efficacy of using the Voiceprint Plus V6 spectrographic software in helping Musical Theatre students to accurately configure the voice for Belting and Legit qualities. This study contains a review of the available literature, and a short study in which a cohort of 10 students were given the opportunity to take part

in one-to-one coaching sessions using Voiceprint Plus V6 and then feedback through a focus group session. Previous studies have focussed on the benefits of visual aids in signing in general, or specifically in the area of pitching, but nothing to date has looked at the specific voice quality needs of Musical Theatre singers, even though there are clear acoustic and spectrographic differences that can be shown by using Voiceprint Plus V6, most especially in Power Spectrum mode.

The results have shown a very positive response to the visual aid that Voiceprint Plus V6 provided, with students keen to replicate the experience in future and reporting a greater understanding of the harmonic properties of the voice qualities that they are training towards after using the software. Students also reported that they found the visual image of their voice affirming of their existing technique, and were more accurate in their understanding of the key differences between Belting and Legit qualities. This positive response is also supported by the literature review, which finds that visual learning helps both teachers and learners in the voice studio and confirms the underlying harmonic differences between Belting and Legit qualities that this study is based on.

## **Introduction**

Musical Theatre (MT) is a wide-ranging and under-researched area of singing, both in terms of our understanding of vocal function and also pedagogy. The author has worked in the field as both a performer and pedagogue for 20 years, and through first-hand experience can confirm that an MT performer is expected to sing in a great many styles including, most notably, the qualities known as Belt and Legit (Bourne and Kenny, 2015; Edwin, 2009, Green et al, 2013, LoVetri 2002).

In a previous literature review, the researcher attempted to gain greater clarity on the physiological and acoustic differences between these two qualities, and establish a pedagogical approach to teaching them (Read, 2018). This research established that, acoustically, one of the key strategies employed by MT singers when changing rapidly from one voice quality to another is formant tuning, caused by changing the shape of the vocal tract (Bestebreurtje & Schutte, 2000; Echternach et al, 2014; Björkner, 2006).

Being well-acquainted with the Voiceprint Plus V6 software from previous experience, the researcher decided to experiment with this tool, to establish the efficacy of using it to help MT singers-in-training to gain a better understanding of this formant tuning strategy in their own voice, by enabling them to see the harmonics of their voice in real time whilst in lessons. It was the researcher's hypothesis that being able to see the differences in resonance, the students might be able to increase the speed and accuracy of their learning.

The software itself (Voiceprint Plus V6, published by Estill Voice International LLC) has 3 pre-configured modes: Spectrogram, SPL<sup>1</sup>, and Power Spectrum. It allows the student/teacher to record up to 30 seconds of sound at a time which can then be played back, and it is possible to switch between modes at any point to demonstrate a particular point that a student may need to work on. Voiceprint Plus V6 also allows the student/teacher to put two spectrograms on the screen at the same time to compare them, although this function was not used during the current research project.

Since one of the key differences between Legit and Belt is the tuning of the first formant to the first and second harmonics respectively (Bourne & Garnier, 2012; Sundberg et al 1992), the researcher chose to concentrate on using Voiceprint Plus V6 in Power

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<sup>1</sup> Sound Pressure Level

Spectrum mode, as this gives the student and teacher the clearest and easiest view of the vocal tract resonances. Figure one shows an example of the Power Spectrum view, with the first formant clearly tuned to the second harmonic typical of the Belt quality (Titze & Worley, 2009).

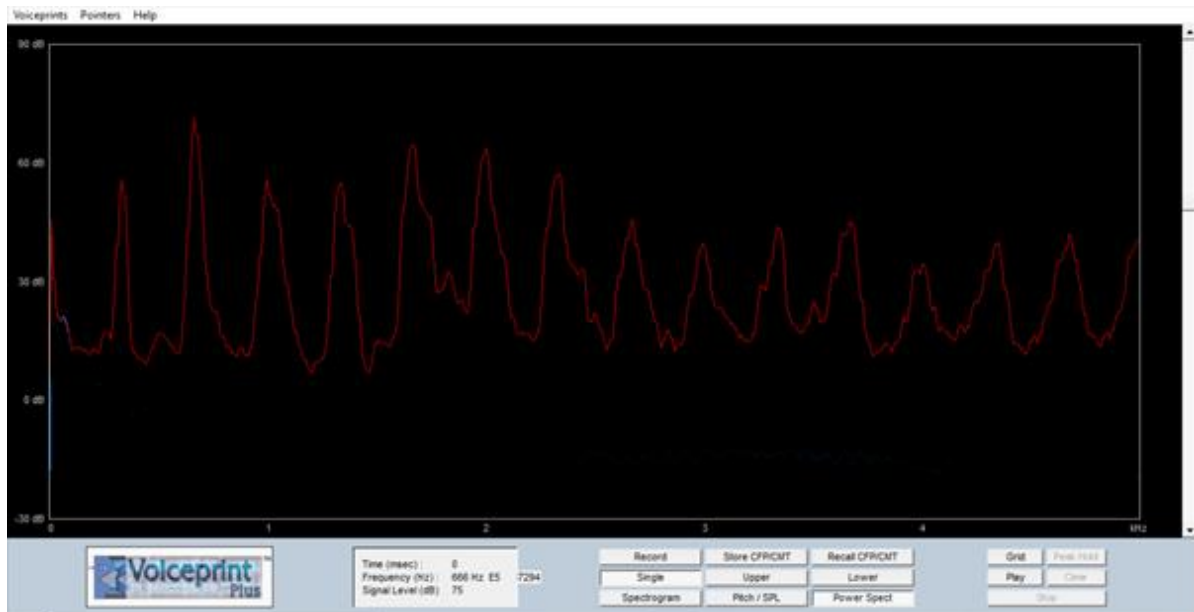


Figure One – Voiceprint Plus V6 in Power Spectrum Mode, showing a Belt quality formant pattern with clearly elevated second harmonic. NB the red line represents the peak frequencies achieved in a 4 second extract of belting.

The main research question, which emerged from the previous research, is:

Can MT students learn to differentiate between, and accurately reproduce, the two key voice qualities of Musical Theatre (being Belt and Legit) more efficiently by using spectrographic software alongside their regular training?

The application of this research is important for both the researcher and his community of practice within the MT genre, since the demands on young Musical Theatre singers are ever-increasing (Green et al, 2015; Edwin, 2009) and pedagogical practice must evolve to stay ahead of these developments (Roll, 2015).

## Literature Review

At the present time, there does not appear to be any literature dealing with spectrographic software (or indeed, any visual aids) being used specifically with MT training. However, since MT is such a wide-ranging genre and requires a great variance of vocal qualities (Edwin, 2008; Bourne & Garnier, 2012; Echternach et al, 2014) it seems to the researcher to be an ideal area for development.

In the earlier research report carried out by the researcher and mentioned previously, one of the key areas that came to light as a difference between Belt and Legit qualities is that of formant tuning strategies, employed by both classical and CCM singers (Björkner, 2006; Bestebreurtje, 1999; Titze, 2016). Once again, this area lends itself ideally to using spectrographic software as a teaching aid and felt ripe for further study. Previous studies have looked at the degree to which singers are able to control these formants and the perceptual effects for the listener, since the timbre of the sound (or voice quality) is directly affected by the harmonics generated in the vocal tract (Titze et al, 2016). It was shown that mouth shape also played a part in this process, with wider mouth shapes creating a 'megaphone' shaped vocal tract and narrower mouth shapes creating a, 'inverted megaphone' shape (Titze, 2016; Titze et al, 2016)

Whilst there is no research specific to the MT genre, there are some previous studies detailing the use of spectrograph usage in singing training. Howard et al (2004) found very positive results trialling the use of a software package known as WinSingad with a cohort of the same size as this study (eight students). It was noted by T1 – one of two teachers using the software in the Howard et al study – that it was of benefit to be able to freeze the screen and give immediate feedback to the student about what they were seeing. It was also noted that, whilst visual aid software is useful for giving quick

feedback to students, it cannot be a replacement for a well-qualified and experienced singing teacher (Howard et al, 2004). These two points were also found to be the case by the researcher, during the trial coaching and focus group sessions.

Four other pieces of visual feedback software for singers are also reviewed by Hoppe et al (2006), namely Singad, Sing and See, Albert and Winsingad. In this case, both quantitative and qualitative data were reviewed by the authors, and once again the 'time lag' often experienced between a student performing a song and then receiving feedback from the teacher was flagged as being a problem that real-time visual feedback was able to address (Hoppe et al, 2006). The study also brings up the important point that self-monitoring using visual feedback is common to other areas of voice use, such as second language acquisition.

Similar results were found by Wilson (2006) in her thesis, which explored real-time feedback in relation to pitching for singers. Students working on one of two experimental groups showed a marked improvement in their development over those in a control group, who were not given access to the computerised visual aid.

From the researcher's perspective, one of the shortcomings of the previous studies reviewed in this article is that they only deal with software that assists with pitching rather than voice quality. However, some previous studies looking at automated software programmes have made attempts at defining the spectral analysis of voice quality in objective terms. It has been noted that the particular dimensions of the vocal tract and the resonant properties of the tissues in the vocal tract are variable, and so there are likely to be anomalies in the acoustics of the sound produced (Forczmanski, 2015).

The previous training and skill of the subjects is also important in understanding the likely result. In a comparative study of 37 singers and 20 non-singers, Omori et al (1995) noted that the sung power ratio (SPR) had a direct correlation in the perception of a 'ringing' sound in the voice of the singers, often termed the singer's formant (Sundberg et al 1992).

An important factor to consider in the study design was that of Knowledge of Results, or KR, the importance of which in learning a new vocal task is explored by Steinhauer & Grayhack (1999). This study showed an unexpected result; that the ability to acquire and retain a new vocal motor skill in fact went down as the frequency of KR went up, indicating that students who have a preconception of what they 'ought' to do in fact do not learn the new task accurately or quickly. The issue of KR was also raised in the context of vocal learning and visual aids by Howard et al (2004), and so the researcher was careful in the design of the study to make sure that students did not have any prior knowledge of what they might be looking for in a Power Spectrum image of Legit and Belt voice qualities. It was also stressed to volunteer students in this study that there was no 'wrong' and that all results would help to shape the data.

In order to understand and analyse the images on Voiceprint, it is also necessary to make reference to so-called Linear Source Filter theory (Sundberg, 1987; Kent, 1993). This theory is a standard model for understanding the acoustics of the vocal tract, and proposes that the sound energy produced by the vocal folds (the sound source) is passed through a frequency dependent filter, in the form of the vocal tract. The properties of the vocal tract, such as the length and width of the tube, will in turn change the acoustic properties of the sound energy as it passes through the filter (Kent, 1993). It has been established that Belt quality is produced with a high larynx, narrow vocal tract and a wide mouth shape (Estill, 1988; Echternach, 2014; Lovetri et

al, 1998) which lead to the tuning of the first formant to the second vocal harmonic, producing a “missing fundamental” (Titze, 2016). By contrast, operatic singing – which is closely related to the Legit voice quality with a strong fundamental frequency (Edwin, 2009) – is produced with a lowered larynx, a wide pharyngeal space and, often, a more closed mouth space (Estill, 1988; Björkner, 2006; Lovetri et al, 1998).

Voiceprint Plus V6 was chosen by the researcher, as it is a piece of software he is very familiar with. It is used in Spectrograph mode to conduct Estill Voice International certification examinations (Fantini et al, 2017) and, since the researcher is an Estill CMT<sup>2</sup> he has been working with the software in its various versions since 2009.

## **Methodology**

The methods for this research report and small-scale study are qualitative and spring directly from the literature review which summarised current research in the fields of Musical Theatre Voice, and spectrographic software and visual aids in singing tuition.

From this review, evidence emerged to show that visual feedback during singing lessons had a positive effect for learners (Hoppe et al, 2006; Howard et al, 2004; Wilson, 2006). It also became clear that the harmonics of a given timbre are very important in shaping the listener’s perception of voice quality (Kent, 1993; Titze, 2016; Titze et al, 2016; Forczmanski, 2015) and that both Belt and Legit qualities have a clear harmonic pattern (Titze, 2016; Bourne & Garnier, 2012; Sundberg et al 1992) that a singer is able to control (Björkner, 2006; Lovetri et al, 1998).

In the design of this study, this researcher noted the experiences of Steinhauer & Grayhack (2000) in the role of knowledge of results prior to learning a vocal motor

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<sup>2</sup> Certified Master Teacher

task, and also considered both the limitations and advantages of being a teacher-researcher within the field of action research (Borg, 2013; Xerri, 2018). These experiences show that prior knowledge of a task can in fact lead to a decline in the ability of the student to accurately learn and recall a new vocal motor task, and also point out the potential biases that the researcher/teacher/student relationship may lead to, especially in the use of focus groups as a method of qualitative data collection. In order to mitigate these potential effects, the researcher did not share the task or expectations with the volunteer students ahead of time. Time was also spent explaining to the volunteer students ahead of the focus group session, that all opinions were valid and that there were no right or wrong responses to the questions. The open-ended questions and semi-structured nature of the focus group also allowed students to speak freely and engage with the topic and, in the conducting of the session, the researcher ensured that all participants were given the chance to speak and offer their views.

Through the paradigm of Social Constructivism, the researcher has undertaken so-called Insider Research (Robson, 2002) within the field of expertise of MT, being well-placed to do so as an established practitioner in the field of voice pedagogy and an expert practitioner in Musical Theatre. As Director of the Faculty for Voice at a leading vocational MT programme in the UK<sup>3</sup>, the researcher is able to truly work as an 'insider' and place the research question and results firmly within his practice.

In the field of voice pedagogy Social Constructivism is an ideal paradigm, allowing the researcher to get a sense of the social reality of a problem and to seek consensus, if not outright objective 'truth' (Berger and Luckmann, 1966). Opinion is often divided on

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<sup>3</sup> READ College [www.readcollege.org](http://www.readcollege.org)

what constitutes particular vocal qualities and whether or not they are aesthetically acceptable (Edwin, 2003), and so a collaborative process of action research will be applied by the researcher (Lomax, 2002). This allows the researcher to work within a community of practice to assimilate their views and understanding into both research and teaching practice (Moon, 2009). Such a process is especially useful in an educational setting, since it has been noted to help to improve both outcomes for learners as well as facilitating professional development and empowerment for pedagogues (Hine, 2013).

In the context of this small-scale study, the researcher recruited a cohort of 10 vocational MT students, all aged between 18 and 21 years (mean age 19.1 years). The students are all currently studying on full-time courses under the researcher's tutelage and were familiar to varying degrees with the two voice qualities being researched.

Of the ten students who volunteered, eight were female and two were male, which is representative of the gender distribution on the MT courses from which they were recruited. The cohort was chosen at random from a list of fourteen potential volunteers, all of whom met the age and ability criteria to take part in the study. From the initial ten, eight students completed the study: one student withdrew as she was not able to attend the required focus group; and one withdrew due to health reasons after falling ill during the time period during which the study was carried out. The two volunteers who withdrew are therefore discounted from the data, and the study proceeded with a cohort of eight. The cohort signed consent forms and were given information sheets prior to starting the study, and they also completed an online questionnaire to establish their prior understanding and training.

All volunteer students were required to attend a one-to-one coaching session with the researcher, which was audio recorded for the study. All coaching sessions had the same content for each of the volunteer students, which comprised of:

- An explanation of the project, and that they could not do things 'wrong'.
- An overview of Voiceprint Plus V6 (in Power Spectrum mode), explaining what they could see on the screen whilst the researcher demonstrated. They were not told what to expect or what to try and achieve in advance of taking a turn of Voiceprint themselves.
- Students were then asked to attempt a Legit quality on the vowel /i/ at two frequencies – first a lower frequency and then a higher. For female students these frequencies were C4 (261Hz) and C5 (523Hz) and for male students the frequencies were E3 (165Hz) and E4 (330Hz). These frequencies were recorded as images on Voiceprint (appendix A), and the formant on the first harmonic was pointed out to the volunteer students relative to the lower decibel level of the second harmonic. Students were then asked to look at Voiceprint in real time as they sang these frequencies again, trying to 'play with the sound' and see what changes they were able to make to this image.
- Finally, students were asked to produce a Belt quality using the syllable /wei/ on the higher of the two frequencies only, since belting usually only takes place in this region of the voice (Kayes & Welch, 2016; DeLeo Leborgne et al, 2009). The tuning of the first formant away from the first harmonic and towards the second was then pointed out to the volunteer students, and when deemed necessary by the researcher, they were given the opportunity to create a more 'brassy' belt and see how large they could make the frequency peak on the second harmonic.

After completing the coaching phase, all volunteer students then attended a focus group led by the researcher, which was audio recorded for this study. The focus group used semi-structured, open-ended questions and created an opportunity for volunteer students to trigger questions and responses from one another as well as being steered by the researcher's questions (Burns, 2010; Xerri, 2018). Information collected from the focus group was transcribed to provided qualitative data that was analysed for emergent themes.

### **Research Results and Data**

This is a qualitative study, and data has been collected in two key ways.

Firstly, Voiceprint images were saved for each of the 8 volunteer students who took part, along with accompanying audio recordings. Whilst the Voiceprint images may at first appear a quantitative data source, it is important to note that there is always an amount of interpretation in reading the displays and in the guidance given to volunteer students in working with the displays. Indeed, Howard et al (2004) viewed such ambiguity in reading spectrographic data as a positive experiential learning experience for students.

Secondly, volunteer students were required to attend a focus group after completing the coaching phase of the study. The researcher used open-ended questions in the form of a semi-structured group interview, to elicit thoughts and feelings about the use of Voiceprint Plus V6 in lessons. The focus group was recorded, with the researcher making notes during the session as well. The recordings were then analysed and partially transcribed, so that the researcher was able to look at emergent themes and ideas within the data. Results were coded to allow the researcher to explore the frequency of themes and draw qualitative conclusions regarding the efficacy of the use

of Voiceprint Plus V6 in training MT students. All volunteer students were asked to complete a questionnaire to build a picture of their previous training and experience. The data collected in this questionnaire can be found in Table 1.

This data is important in providing a frame of reference for the responses of the volunteer students to the training that they received, since the materials of learning and teaching are often different than one another, and what a student takes from a lesson may not be what the teacher expects, depending on their previous experiences and understanding of the subject matter (Moon, 2009).

Question			
How would you currently rate yourself in terms of experience of singing in the Legit style?	Some Experience: 62.5%	Little Experience: 37.5%	(Very Experienced / No Experience: 0%)
How would you currently rate yourself in terms of experience of singing in the Belt style?	Very Experienced: 33.33%	Some Experience: 66.67%	(Little Experience / No Experience: 0%)
Are you able to describe the difference between these two styles in terms of the singer's vocal set up?	Yes: 83.33%	No: 16.67%	
If yes, please do so in your own words	5 respondents answered this question, with 100% of them talking accurately in physiological terms such as "Belting has thick vocal folds" and "Legit is head voice dominated and produces an operatic sound"		
How would you currently rate your skill in singing in the Legit style?	Somewhat skilled: 100%	(Highly Skilled / Skilled / Unskilled: 0%)	
How would you currently rate your skill in singing in the Belt style?	Skilled: 50%	Somewhat Skilled: 50%	
Have you previously had vocal training in the Musical Theatre genre?	Yes: 66.67%	No: 33.33%	
If yes, how many years of training have you had?	Range: 7 months – 8 years	Mean: 3.25 years	
To the best of your recollection, have you ever previously used the computer software "Voiceprint Plus" in your vocal training?	(Yes: 0%)	No: 100%	

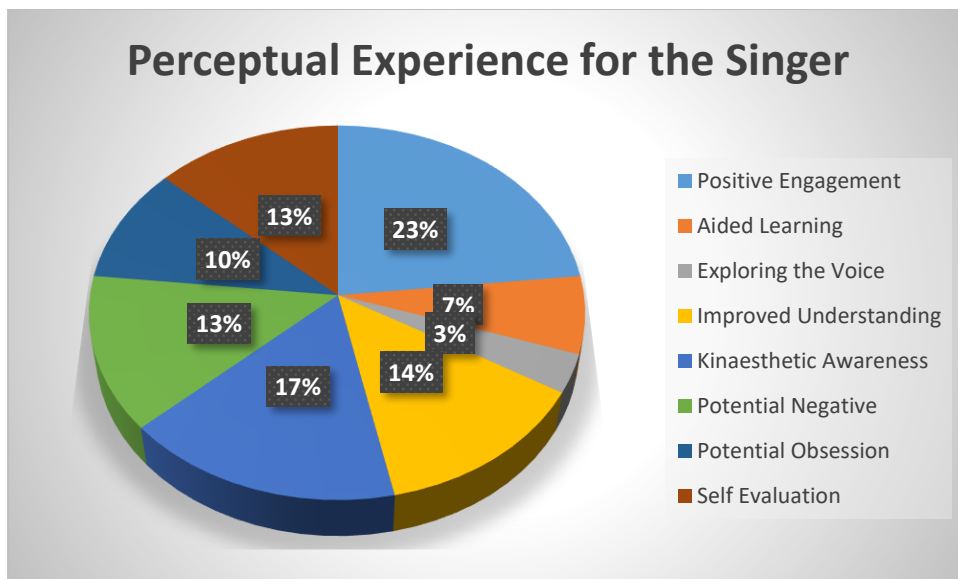
**Table 1 – Questionnaire results from volunteer students**

From this data, we can see that a majority of volunteer students had some experience of both Legit and Belt qualities prior to the study, and also that a majority (83.33%) of them felt confident in describing the differences between these qualities. It is therefore possible to extrapolate that, whilst the volunteer students did not have prior knowledge of the task that they were undertaking, they had enough experience and understanding of the subject matter to benefit from the experience and make useful comments and judgments thereon. The questionnaire also clarifies that none of the volunteer students had previous experience working with Voiceprint Plus V6, which would negate concerns about data being adversely affected by Knowledge of Results (Steinhauer & Grayhack, 2000).

Data collected from the focus group was initially categorised into four themes:

- Perceptual Experience for the Singer
- Engagement with the Tool
- Learning Experiences and Outcomes
- Voice Quality Understanding

Within these categories, data was coded to allow the researcher to understand the nuances of the answers that the volunteer students gave, and to attempt to extrapolate meaning from them in the context of the research question. It was also important for the researcher, in his role as Director of the Faculty for Voice, to be able to apply the research to practice and understand it in a vocational setting.



**Figure 2 – Qualitative Data results for Perceptual Experience for the Singer**

Figure two shows the breakdown of data codes within the theme of ‘Perceptual Experience for the Singer’. The largest segment of data was for the ‘Positive Engagement’ (PE), which accounted for 23% of the feedback received. Data coded as PE showed an interest from the student in the experience, and often included reflections on why the student had found the experience positive. Phrases included “I like being able to see your own voice”, “Can’t always hear, so good to be able to see stuff” and “Not just feel it [as you can see the voice]”.

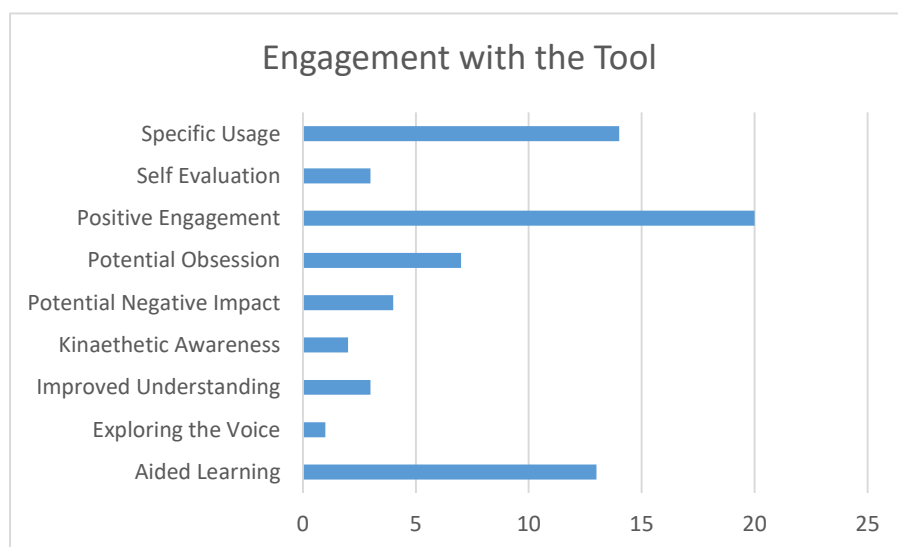
The next largest segment is for Kinaesthetic Awareness (KA) with students showing an improved sense of what they were doing in the vocal tract thanks to the visual feedback. KA included comments such as “Nice to match what you can feel with what you can see” and “[Creates] Muscle memory, similar to using a mirror in dance”.

It is important to recognise the two less-favourable categories in the data segments for this theme, which are ‘Potential Negative’ (PN) and ‘Potential Obsession’ (PO). Data coded as PN and PO were given when the researcher asked the focus group “Can you think of any negatives that might arise from using Voiceprint in lessons?”

and so was deliberately elicited to make sure that volunteer students did not only volunteer what they felt they were supposed to say. It is of note that, when members of the focus group were initially asked “How did you find the experience of using Voiceprint in lessons?” no negative feedback was given.

The 10% attributed to PO is an interesting segment, as students commented that they felt the tool could become too engaging in some ways, and lead to singers fixating on the spectrograph and not paying enough attention to artistry and kinaesthetic feedback. This data was put in a separate code than any other potentially negative feedback since it emerged as a recurring theme that several members of the focus group raised. Comments for PO included “[Fine] as long as you remember you’re trying to get to a place where you can just do it” and “It could play on your perception of how your voice is”.

In total, 77% of the data collected in this theme was positive, and the 23% of data that was negative was deliberately requested by the researcher to ensure a balanced view.



**Figure 3 – Qualitative Data results for Engagement with the Tool**

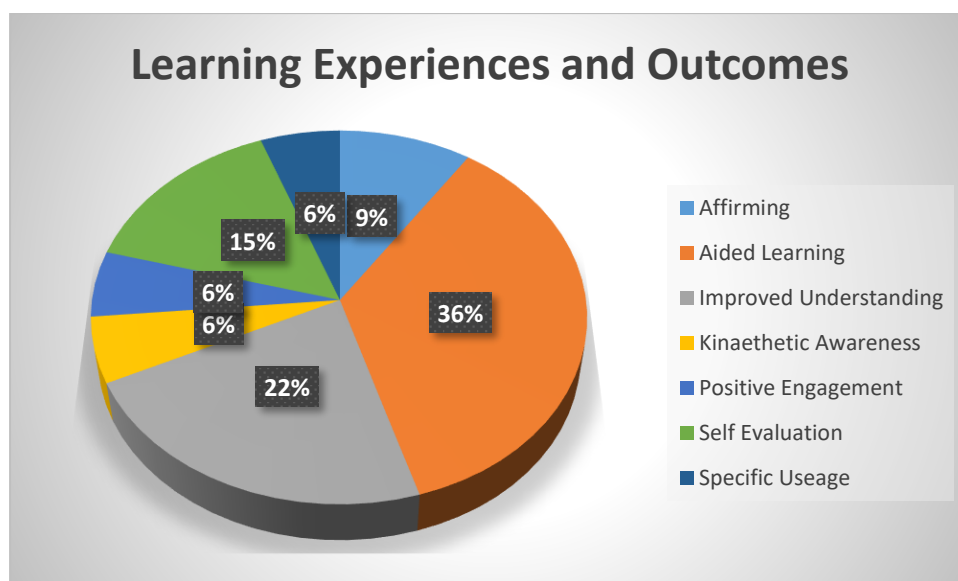
Figure 3 shows an overview of data collected that formed the theme of ‘Engagement with the Tool’, and summarised more specific experiences that volunteer students

reported. Similar coding was used for this theme with the addition of Specific Usage (SU), which is made up of 14 phrases or comments that suggested Voiceprint Plus V6 would be useful for learning in specific circumstances. These included comments such as “Really useful for initial understanding, but shouldn’t be used for every song”, “Would be great for private practice”, and “Really good to track progress”.

Data for the code PE can be seen to be the highest in this area of research:

“If I'd had that [Voiceprint] at the start of my course, I think I'd be shocked at the change in my voice”

Once again, data received when eliciting negative as well as positive comments, includes the coding of PO including the specific feedback “Could become an obsession” and “Sound should be most important, don't get hung up on the print”.



**Figure 4 – Qualitative Data results for Learning Experiences and Outcomes**

In figure four, we can see data collected that fell into the theme of Learning Experiences and Outcomes. This theme emerged from the learning outcomes and objectives initially set by the researcher, as well as comments pertaining to these from the participants. ‘Improved Understanding’ (IU), referring to the understanding of

harmonics in the voice, and Aided Learning (AL), with students referring to a positive learning experience, formed over half of the responses in this area. Data collected for this theme included the following:

“I felt like I had an idea of different vocal qualities [after using Voiceprint]” (IU)

“She was able to change her voice and quality and get it [harmonic peak] lower” (IU)

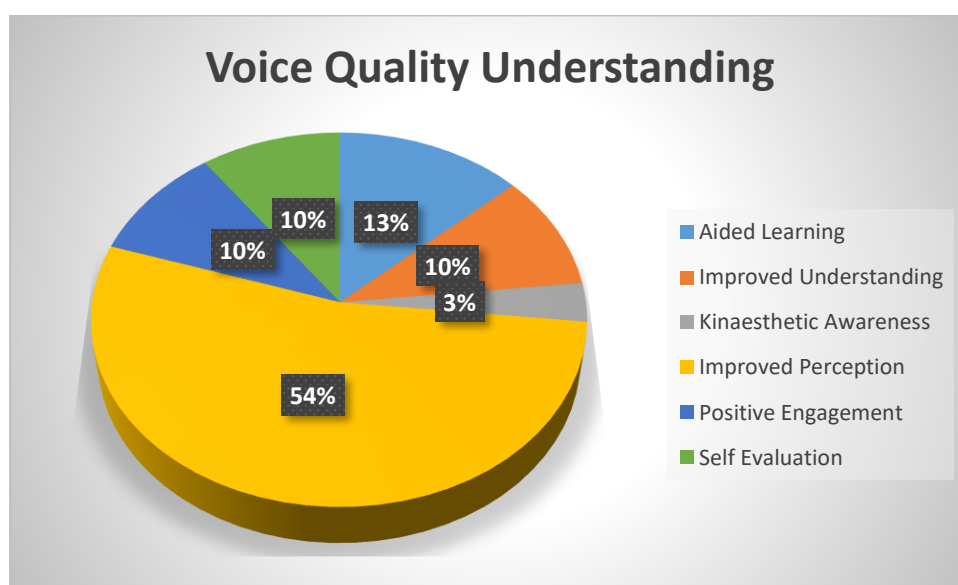
“When different teachers tell me 'place your voice here' I now know they're meaning something else” (IU)

“I know what it is that I'm doing rather than just guessing” (AL)

“It was nice to see further into the voice, like a microscope” (AL)

“You can learn how to sing without it, but it has advantages [in learning]” (AL)

9% of the responses showed that the students found Voiceprint affirming (AF) and 15% of responses showed Self Evaluation (SE) such as “I was assuming things [about my voice] in my head that weren't true” and “When we've got to a point where we know what we're doing that's when we can make artistic choices”



**Figure 5 – Qualitative Data results for Voice Quality Understanding**

Finally, figure 5 illustrates data collected and themed as 'Voice Quality Understanding'. Comments in this data included more specific comments as to Belt and Legit qualities and the experiences of the students in working on the qualities with Voiceprint.

Improved Perception (IP) accounted for over half of these responses, with students able to reflect that "[Legit is] softer and gentler" whereas "Belting is like MT Broadway".

13% of responses were coded AL with phrases used including "Would be great to use to get legit and belt" and "I didn't realise they [voice qualities] were that different"

The open ended questions used to guide the focus group can be found in Appendix C of this study.

There were enquiries from students about further functions on Voiceprint, such as help with pitching. Whilst these are functions that the software has, and the enquiries showed a positive engagement with the tool, the researcher notes that this area is outside the remit of this study and that work on pitching with computerised visual aids has already been undertaken by Hoppe et al (2006) amongst others.

One area of concern that arose for the volunteer students was the potential for over-reliance on the tool, and also the fact that one would not have access to it when "actually singing", i.e. in performance. This area is important to reflect on, and several students commented that they would be worried about the act of singing becoming too subjective, with the Voiceprint image propagating a 'right and wrong' approach to an artistic endeavour.

From a pedagogical standpoint, feedback from the cohort on learning experiences and outcomes was very helpful. If one is to address the efficacy of using this system as a part of voice training, and indeed it if the theory is to be applied in practice, then understanding the learner's responses to this theme are critical.

On this point, it was also very interesting for the researcher, who has been working with the students in this cohort for between 7-19 months, to observe the engagement and interest in the students that the use of Voiceprint created. Students who had felt under-confident in their singing now felt affirmed in their understanding and technique, and expressed this within the coaching sessions and the focus group. Voiceprint also showed itself an excellent teaching tool for the researcher, who found explaining the concepts around harmonics and formants much simpler and clearer when using the software as a visual aid.

Many comments in this section of the data gave voice to the sense that Voiceprint would make an excellent starting point and accompaniment to training the voice, but that it should not be a principal learning tool and that there is no replacement for good vocational teaching practice. Once again this is borne out through the researcher's own experience, as well as in the comments in the focus group. Whilst any tool or methodology may provide useful building blocks for teachers, it is important to bear in mind that all learners are individuals and bring different experiences to their learning, as well as taking different things from it (Moon, 2009).

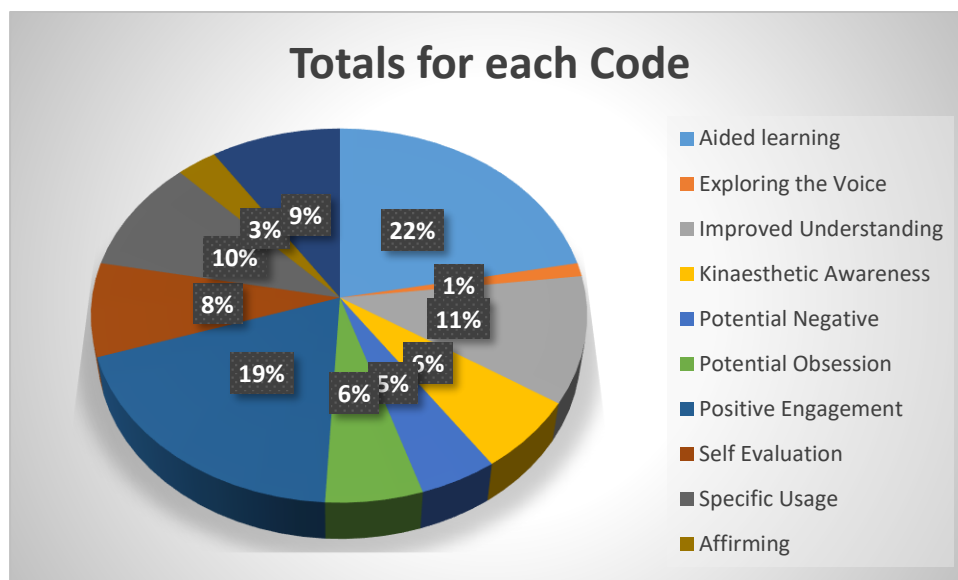
Of the 24 Voiceprint images saved during this study (3 per volunteer student: Lower octave legit, higher octave legit and higher octave belt), 23 fell in to the formant patterns that had been expected from the literature review and previous research. Student number 8, a male singer, had several attempts at the lower octave Legit quality, but on all occasions the first formant appeared tuned towards the second harmonic with a low fundamental frequency value, as one would expect to see in the Belt quality (Titze, 2016). This anomaly will be reflected on in more detail in the Analysis section of this research, but it is worth noting that this student is more

comfortable singing in the contemporary style and so may well configure his vocal tract to a belt sound habitually.

### Analysis of Findings

Data from the coaching sessions and focus group was organised into four main themes detailed earlier in this study, and then coded to assist the researcher in interpreting the responses of the participants.

Figure 6 shows overall totals for each code used by the researcher:



**Figure 6 – Totals for each Code used by the researcher**

Here we can see that the codes AL and PE are the largest data segments accounting for 41% of the data, with codes expressing possible negative aspect of Voiceprint – PN and PO – accounting for only 11% of the total qualitative data recorded.

From this data analysis it is clear that, in line with previous studies into visual feedback for pitching, the use of Voiceprint Plus V6 was beneficial to the students who took part in the study. As well as being able to ascertain different voice qualities with a greater

accuracy, students felt more assured in their technique, and an increased sense of kinaesthetic awareness coming along with the visual aid.

Patterns within the data showed a high level of engagement with the visual aid tool, with 10% of the data showing reflections by students on specific applications of the tool. Learning was improved overall, with students able to recognise the differences between the voice qualities of Belt and Legit more easily and feel a greater sense of control in shaping the vocal tract to achieve these voice qualities.

A large number of responses within the data suggested that students would like to engage with Voiceprint Plus V6 at the start of their training to help them understand the voice qualities that they are working towards, but it was also felt that over-reliance on the technology without adequate teaching and supervision would be problematic. Several responses recorded the view that students might become obsessive and overly focussed on achieving a so-called 'perfect' Voiceprint image, rather than focusing on the auditory and kinaesthetic sensations of singing. This makes an important point pedagogically, reinforcing the position that a learning tool such as Voiceprint Plus V6 should be seen as a teaching aid rather than the basis of a teaching methodology.

Several students, who identified as visual learners during the focus group, confirmed that being able to see the harmonics in front of them in real time, and also in playback, helped them to achieve the sound that they were looking for, and those in later stages of training expressed the feeling that they would have benefitted from having access to the system earlier on in their course.

From a pedagogical standpoint, the data also sought to address learning outcomes with the volunteer students. The researcher delivered the same coaching session with

each volunteer student to ensure a similar experience, and to try and ascertain if the use of spectrographic software in a singing lesson both useful and economical for the teacher. Key learning outcomes addressed were: Basic understanding of harmonics in the context of singing; Recognition of differences between two different voice qualities; Control over the voice quality being used. Based on a positive experience of using Voiceprint Plus V6, which has a very simple user interface and is easy to use, the researcher found that all desired outcomes were met. Students were quickly able to understand the basic principles of harmonics as the researcher demonstrated different vowels and voice qualities on Voiceprint. Students were readily able to identify the different placement of the first formant between Belt and Legit qualities, and then were able to show control over the formant placement but exploring the voice quality with the Power Spectrum display running in real time in front of them.

Data that fed into the theme of learning experiences and outcomes included feedback from students expressing surprise and interest in the particular harmonic values of their own voice. This led to questions and a greater curiosity as to the make-up of their Voiceprint image, which in turn gave greater clarity to the qualities that they were attempting.

Overall, 89% of data collected showed positive aspects of the experience of working with Voiceprint Plus V6.

One interesting anomaly that arose in the data was the formant tuning of student number 8 in the cohort, a male singer most familiar with the contemporary Belt sound. In the limited time available during this study, this student appeared to be tuning the first formant to the second harmonic when attempting Legit quality in the lower Octave. This propensity may be due to habitual muscular patterns in the vocal tract, but also

tends towards some previous research on the male operatic voice, which suggests that formant tuning patterns can be different in male operatic tenors (Titze, 2009). There has also been research into the MT voice quality known as Mix, which suggests that some singers will show harmonic patterns in Mix that are closer to Legit and some will show patterns closer to Belt, even though there are elements of both present (Lovetri et al, 1998; Kayes & Welch, 2016). It may well be the case that student 8 was in a so-called Mix setup, and therefore elements of the Voiceprint image reflected Legit quality whilst the tuning of the first formant was nonetheless more similar to Belt.

## **Conclusions**

This study was initiated in response to practical experience by the researcher, and was conducted with the researcher in the role of action-researcher (Hine, 2013). Through a review of the literature it has been established that real-time visual aids are useful tools for singers and teachers in the studio although evidence was only available for issues of pitching.

After working with MT students for 20 years, the researcher could see a potential application of existing technology in new ways, to assist in the delivery of voice training specific to this genre.

By conducting a small-scale initial study, the researcher is able to present evidence that using spectrographic software to help MT students switch between voice qualities is a positive experience for the learner and assists in forming a greater understanding of the qualities and a better kinaesthetic awareness of how to create them.

The study design allowed the researcher to collect qualitative data on the thoughts and feelings of students during a coaching experience working with Voiceprint Plus V6. Attention was given to KR (Knowledge of Results), and students answered a

questionnaire to give details of their previous training experiences. Phrases used in the focus group (coded SU) often pointed to the software being useful as an initial tool and an ongoing progress monitor, and so for a future study to develop this research, it may well be appropriate to work with students early in their training before they have developed a full knowledge of the voice qualities, Legit and Belt.

In the process of putting this research into practice, the researcher will be able to respond to the points raised in the focus group, such as ensuring that Voiceprint is used as a teaching aid within a broader curriculum rather than as a sole focus within teaching practice. Attention must also be given to the potential negative side-effects raised in this study, such as attempting to make singing a 'right-or-wrong' exercises without due focus on artistic endeavour and individuality. Several volunteer students raised the concern of they themselves becoming overly focused on achieving a 'perfect Voiceprint', and so here again consideration must be given to the pedagogical approach of the voice teacher and an understanding of the frame of reference that each student brings to their training (Moon, 2009).

As an example of experiential learning in a higher education setting, it is also interesting to reflect on the experiences for both students and researcher using the Experiential Learning Cycle (Kolb & Kolb, 2005).

In step 1, the concrete experience is reflected upon. For the researcher and students alike, in this case the concrete experience is experiencing a coaching session using Voiceprint Plus V6 to see and explore voice qualities already familiar to them.

Step 2 asks the learner and researcher to undertake reflective observation based on the experience. Certainly the data collected during the focus group allowed students to reflect on the experience, giving voice to both positive and negative aspects of the

experiment, and also making suggestions for the application of the tool. At this moment the researcher must also reflect, not just on the experience of using the tool in lessons, but also on the students' experiences in the lessons. Taking on board suggested applications and negative comments is as important here as listening to the majority of positive feedback. Listening to the members of the focus group, and reflecting on past experiences, it is clear that Voiceprint will be useful at the start of students training and as one way of monitoring progress, but that it may well become a distraction if over used and should not form the basis of vocal technique training.

This leads into the abstract conceptualisation of the work, and learning from the experiences. Much of this has been addressed in this study already, and links to the application of this research to practice. Planning and consideration will be given to the inclusion of Voiceprint as part of the vocal tech curriculum at READ College, based on the experiences of this study.

Finally, Kolb encourages active experimentation. In this sense, it may prove to be useful to conduct a longer-term study in this area with a larger cohort, to underpin the results of this small-scale study and to continue to develop pedagogical practice in the ever-changing and developing genre of Musical Theatre.

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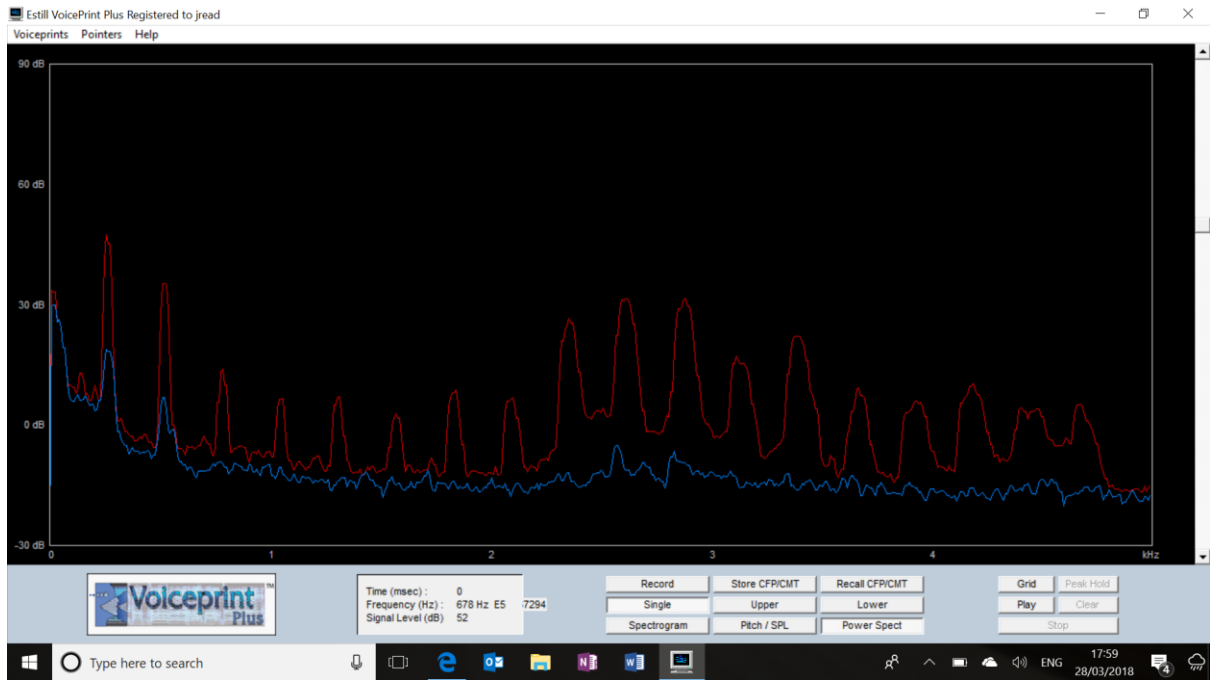
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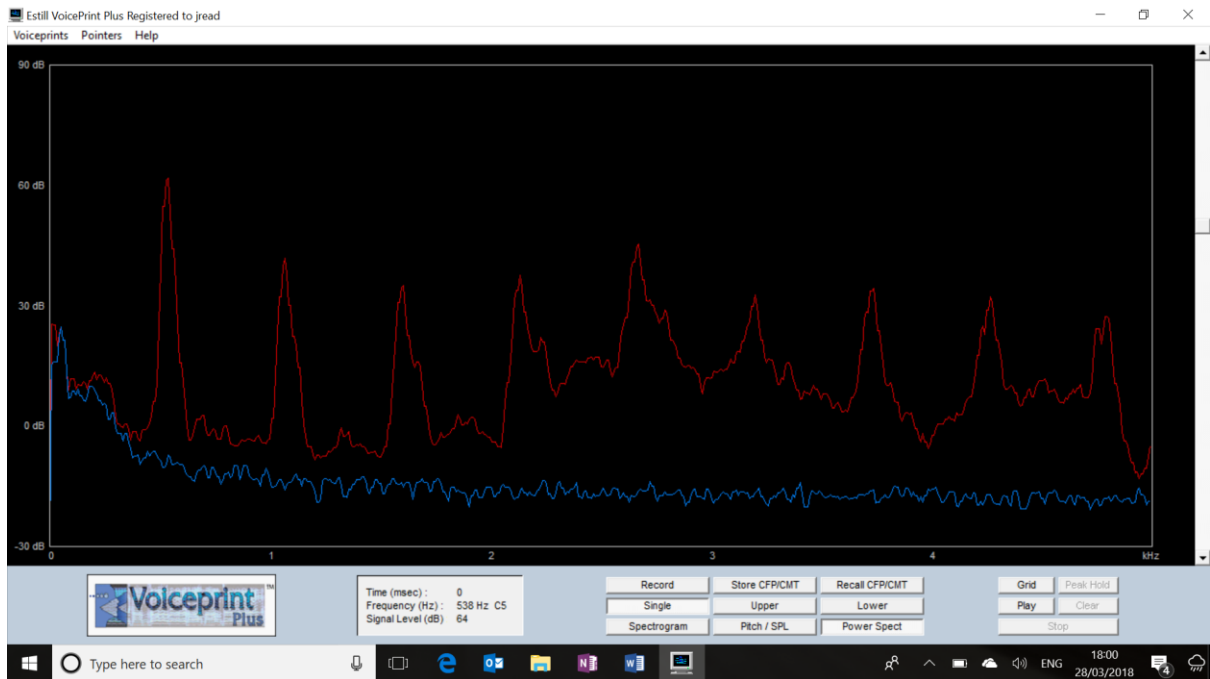
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## Appendix A – Voiceprint Images from Coaching Phase

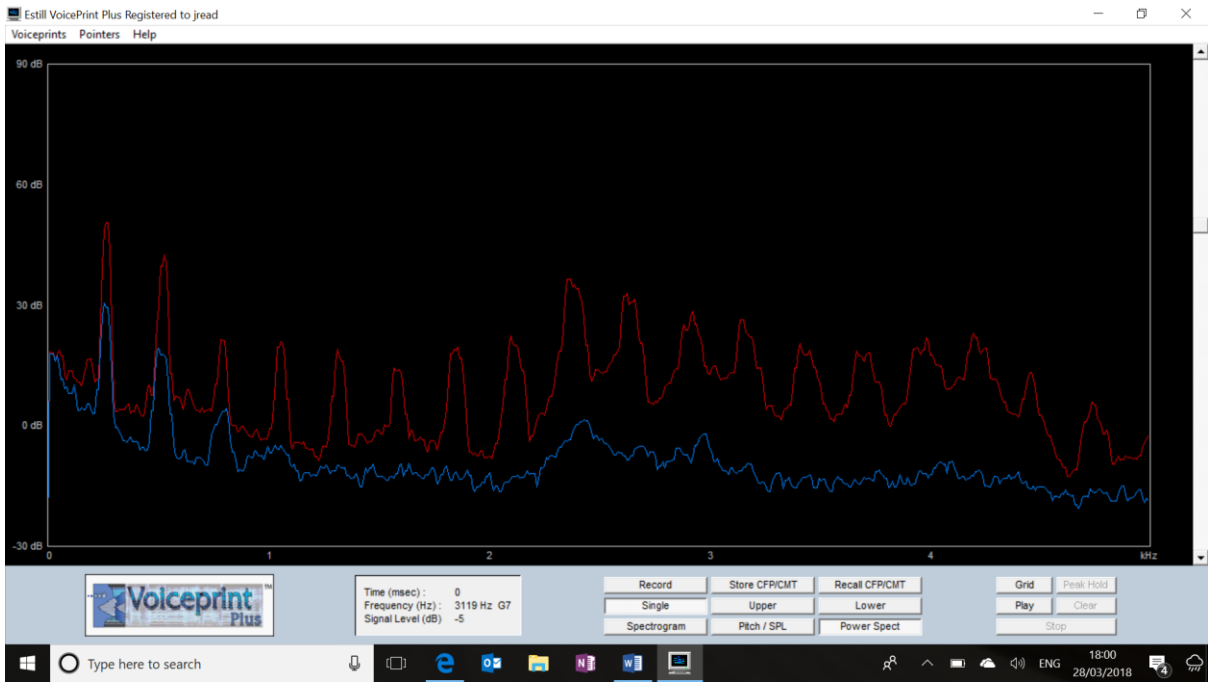
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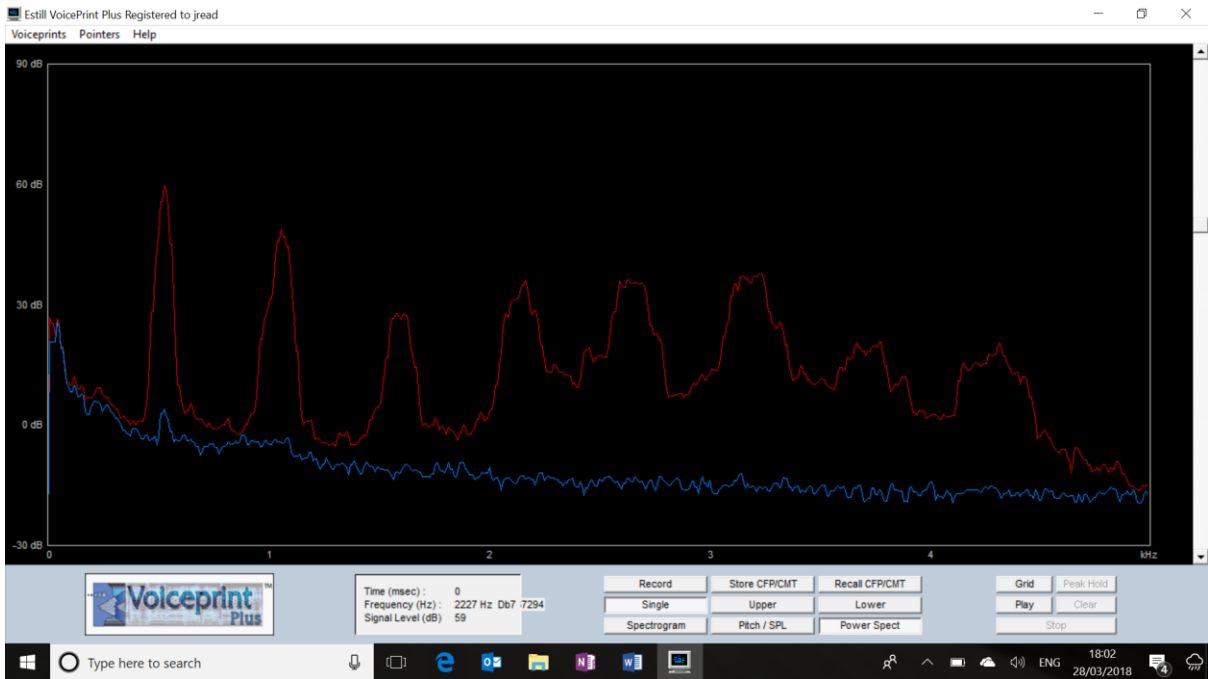
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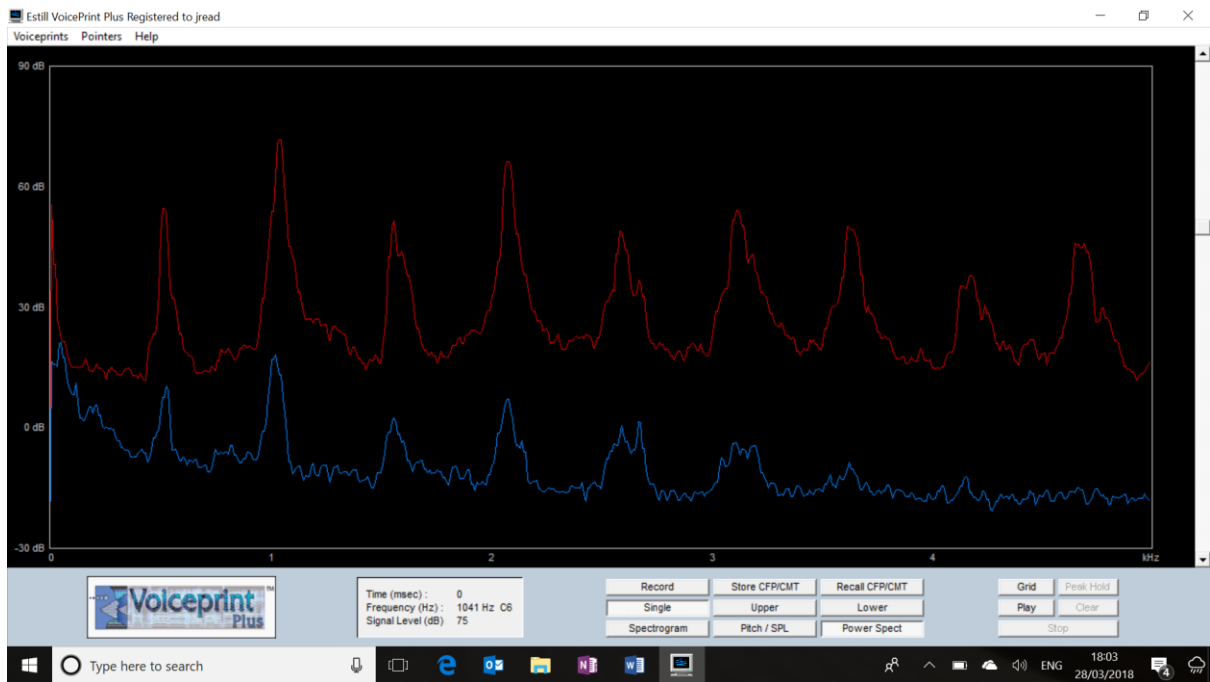
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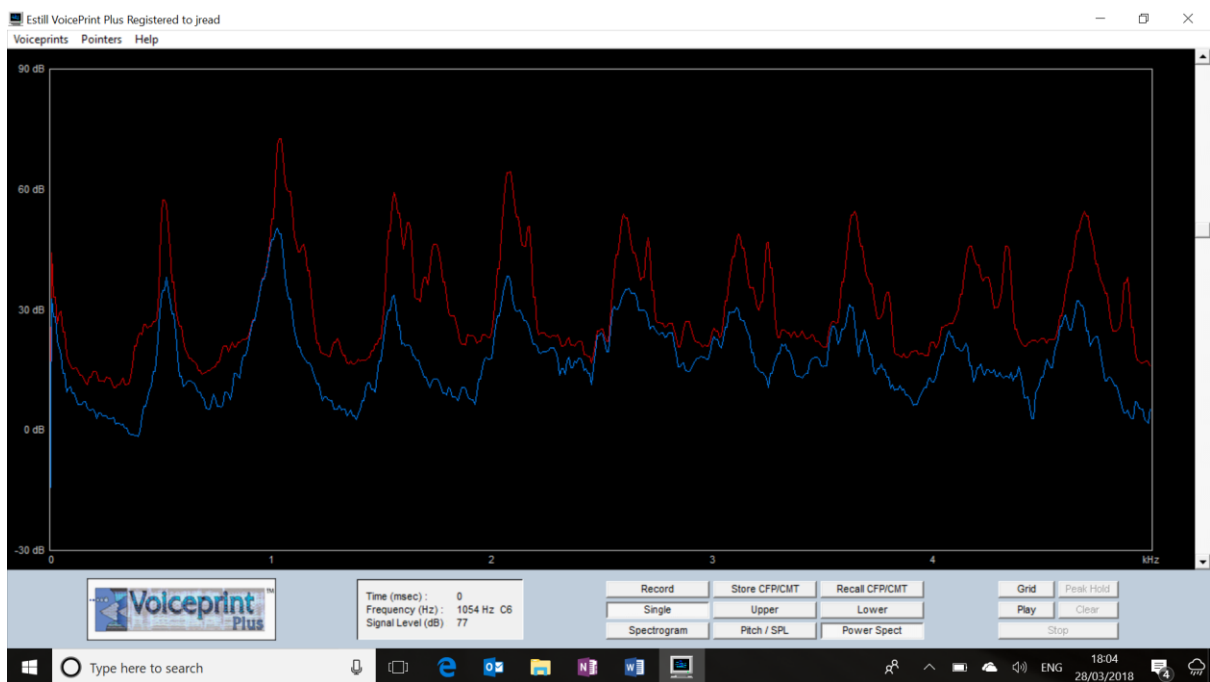
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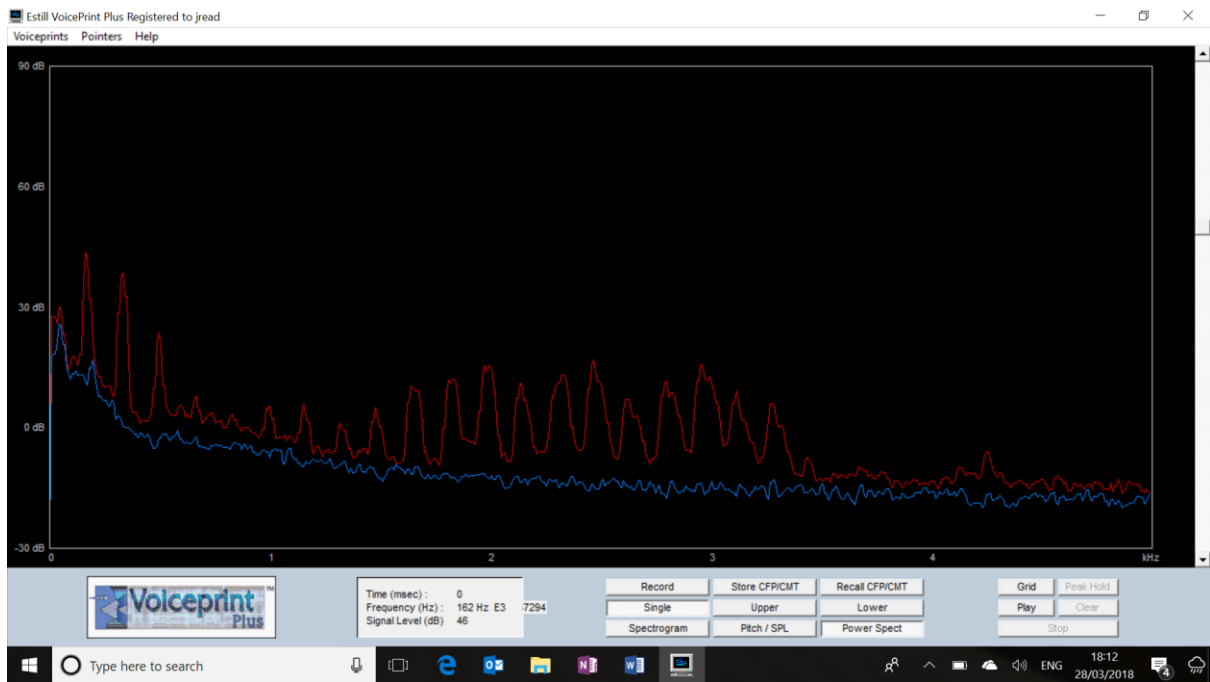
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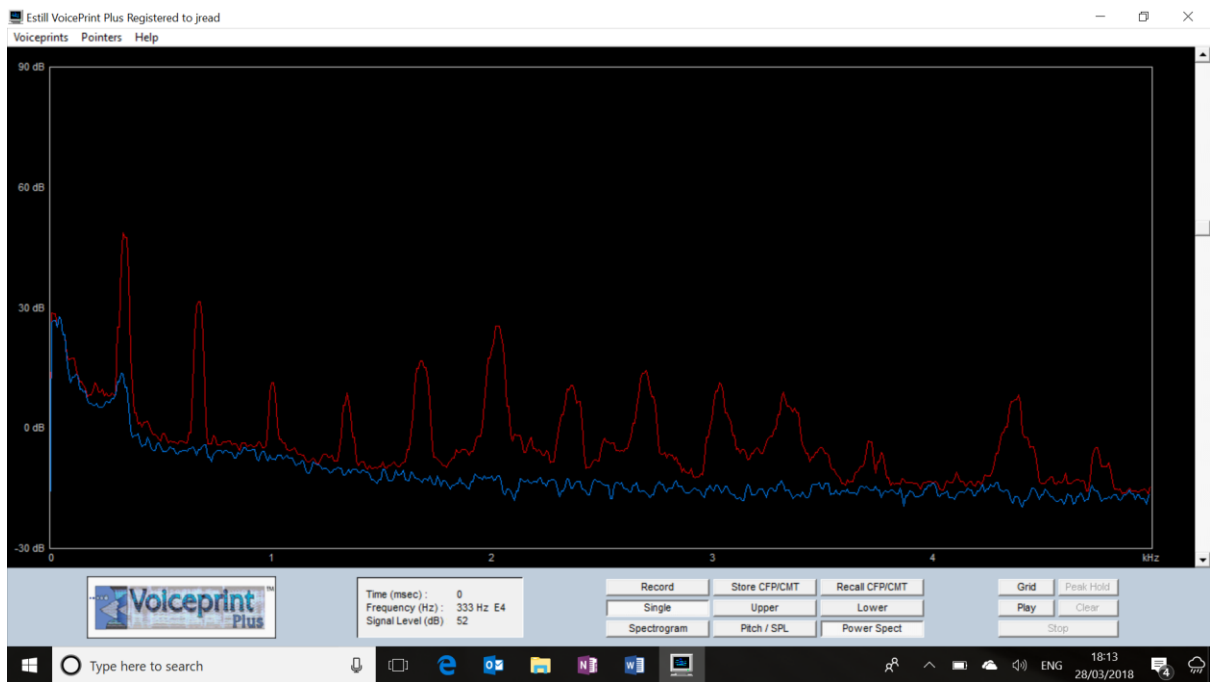
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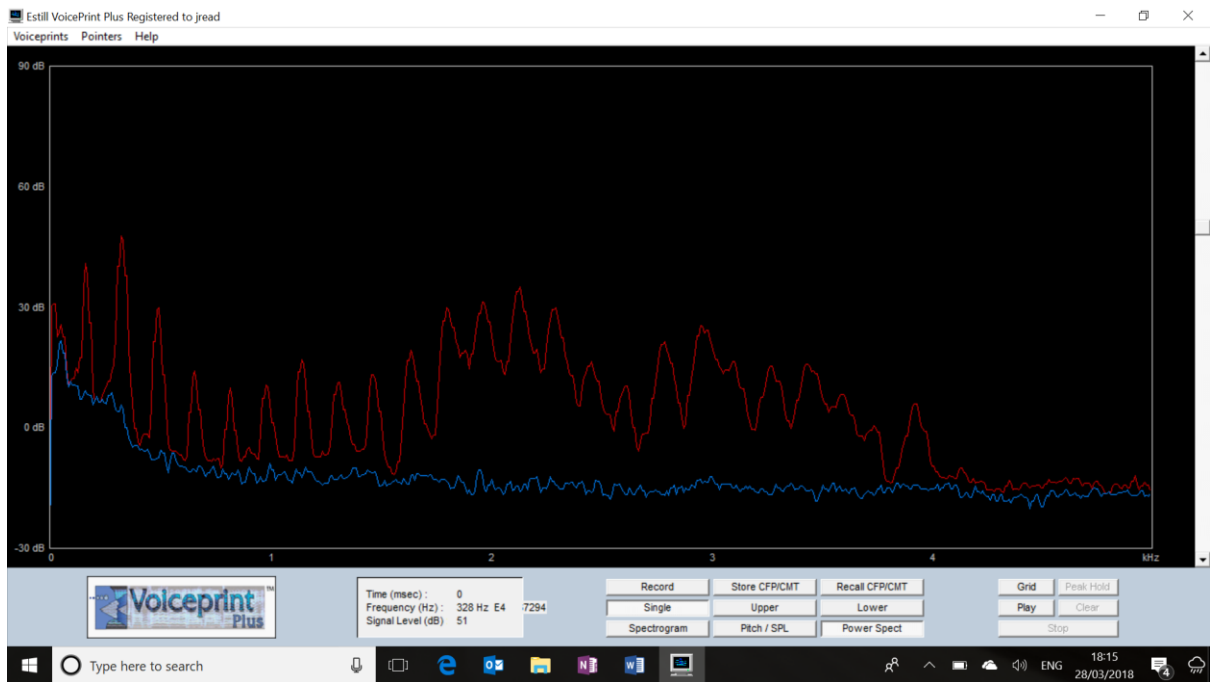
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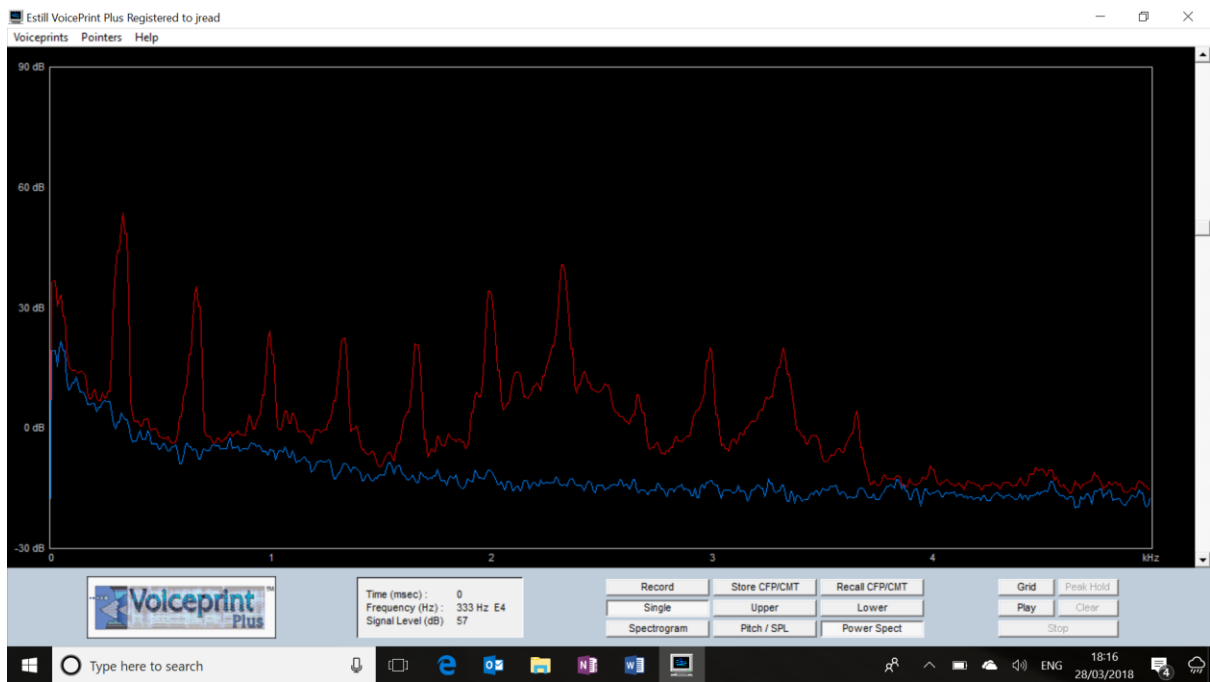
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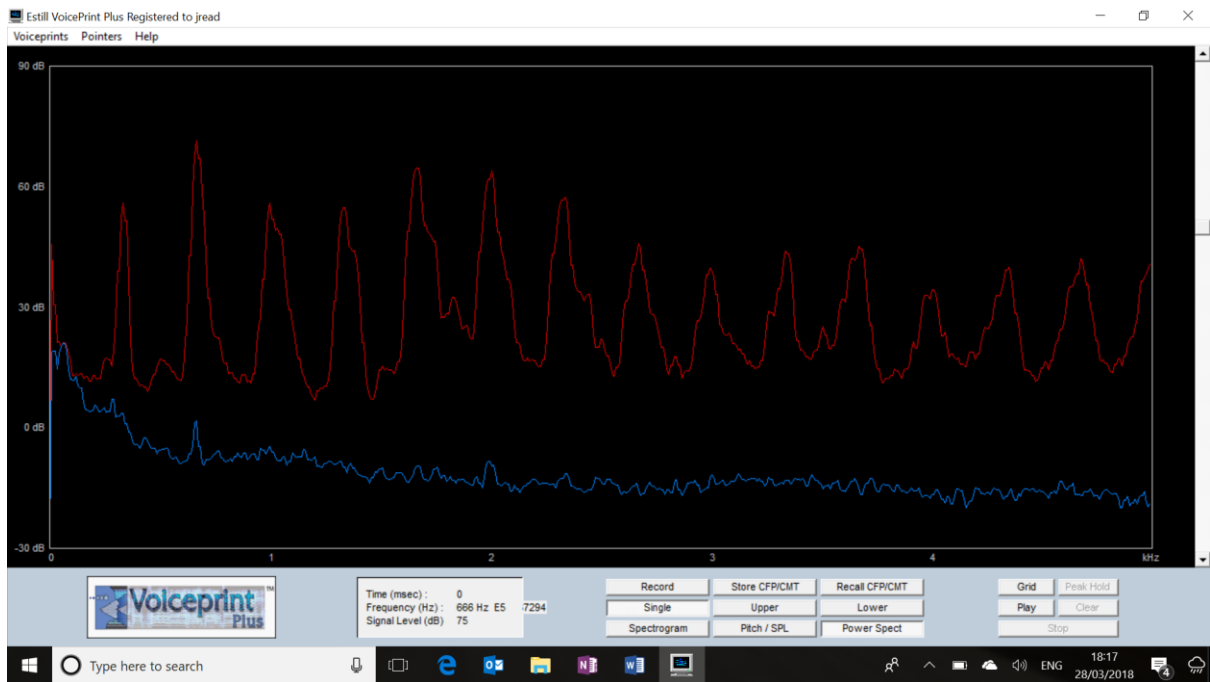
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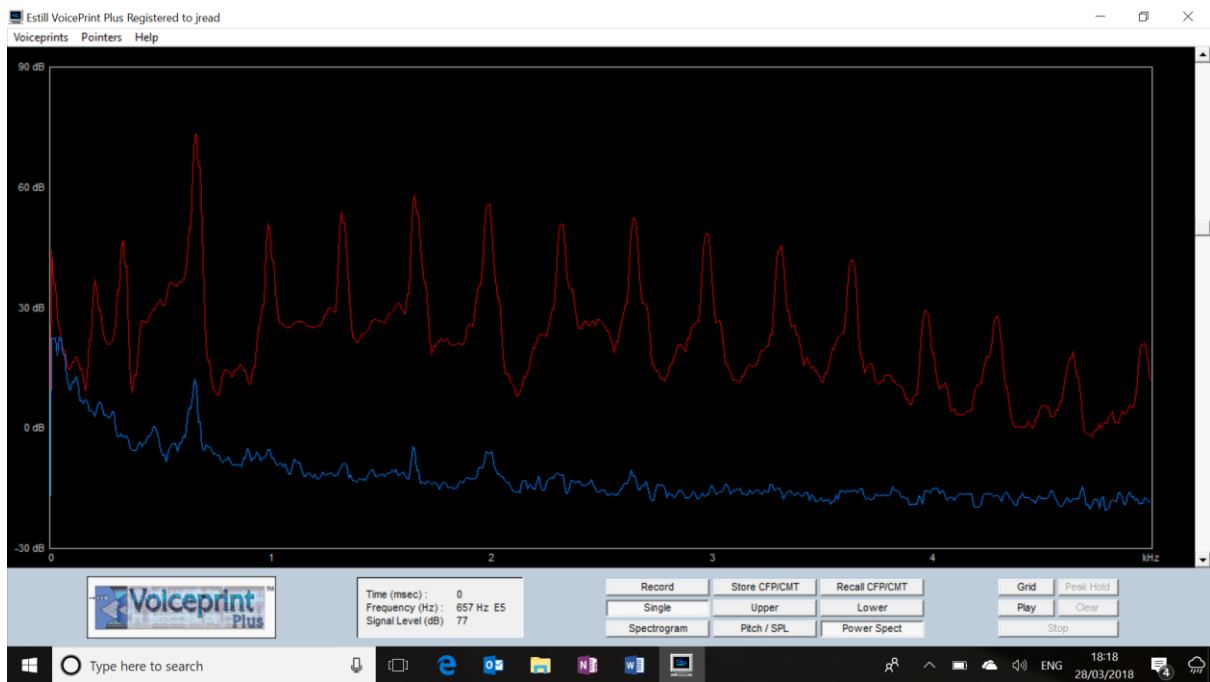
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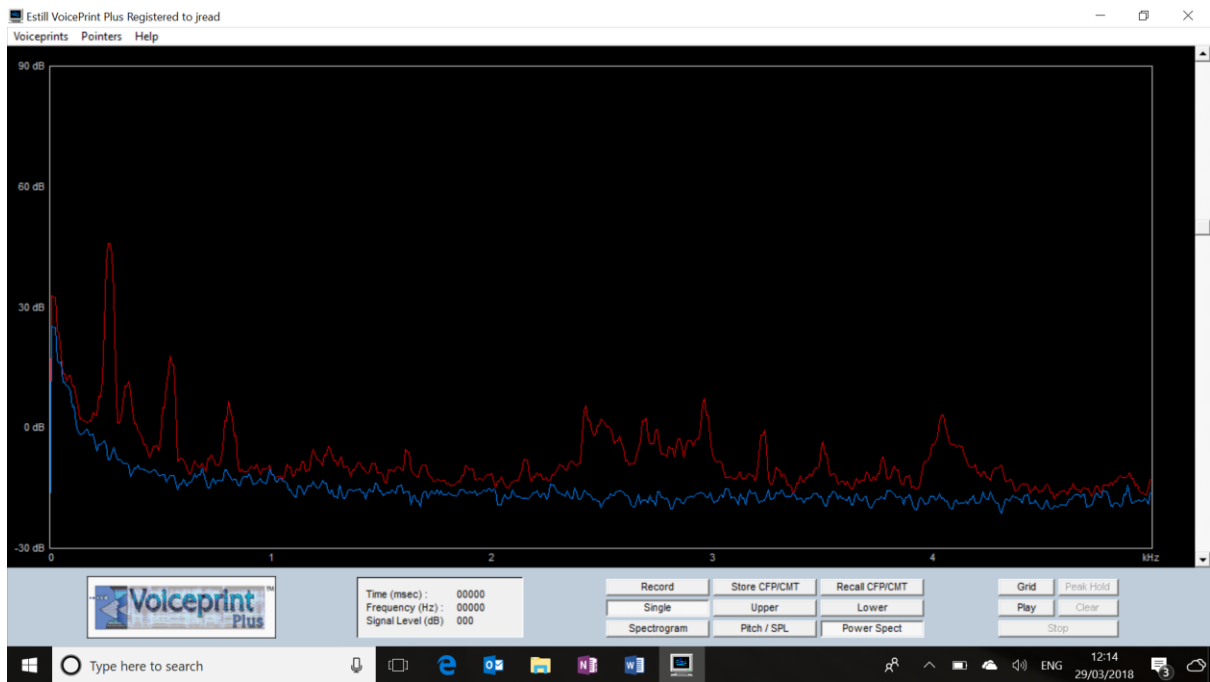
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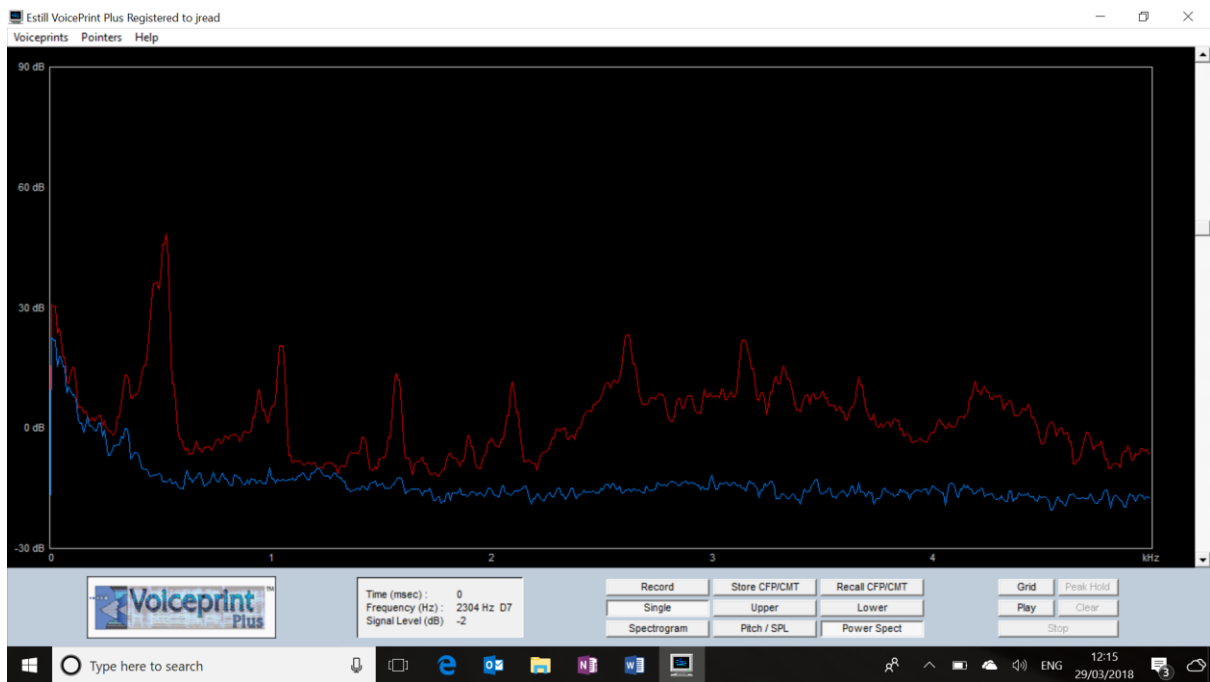
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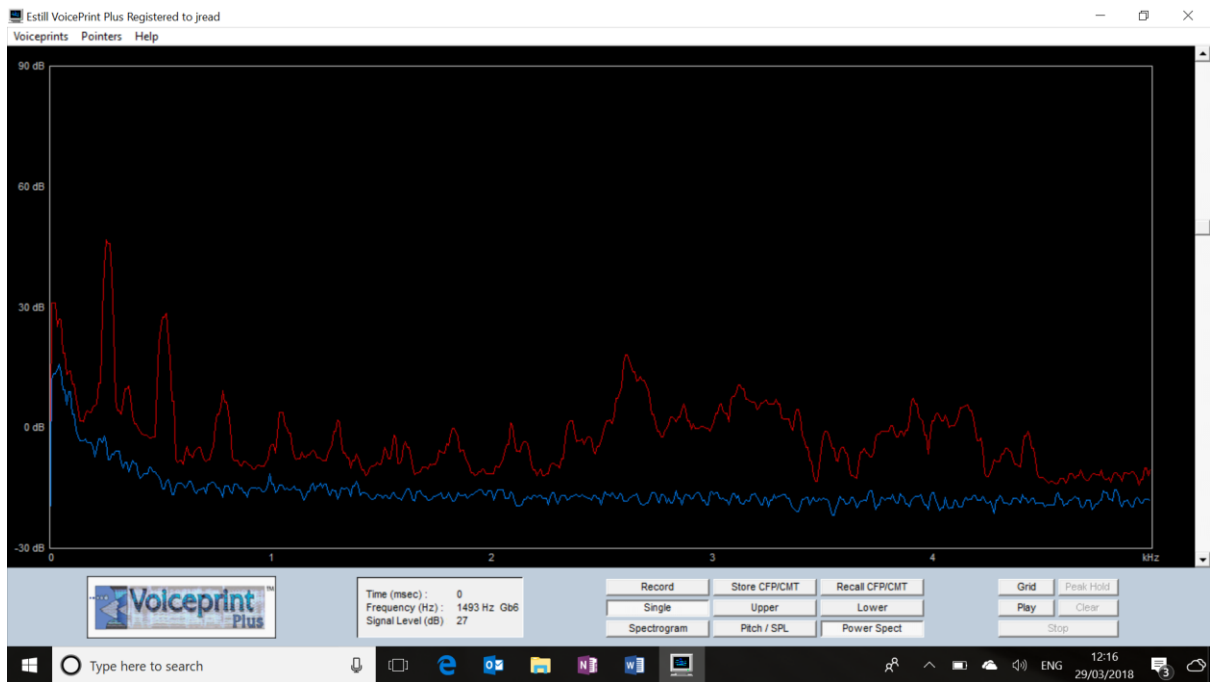
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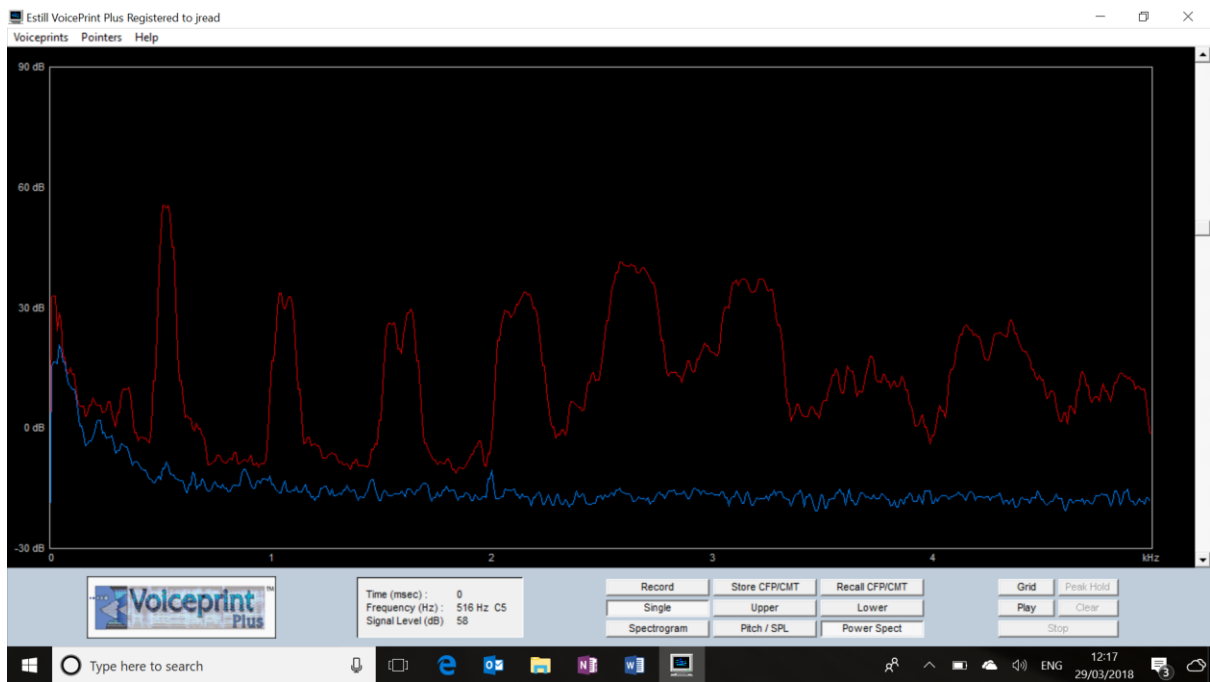
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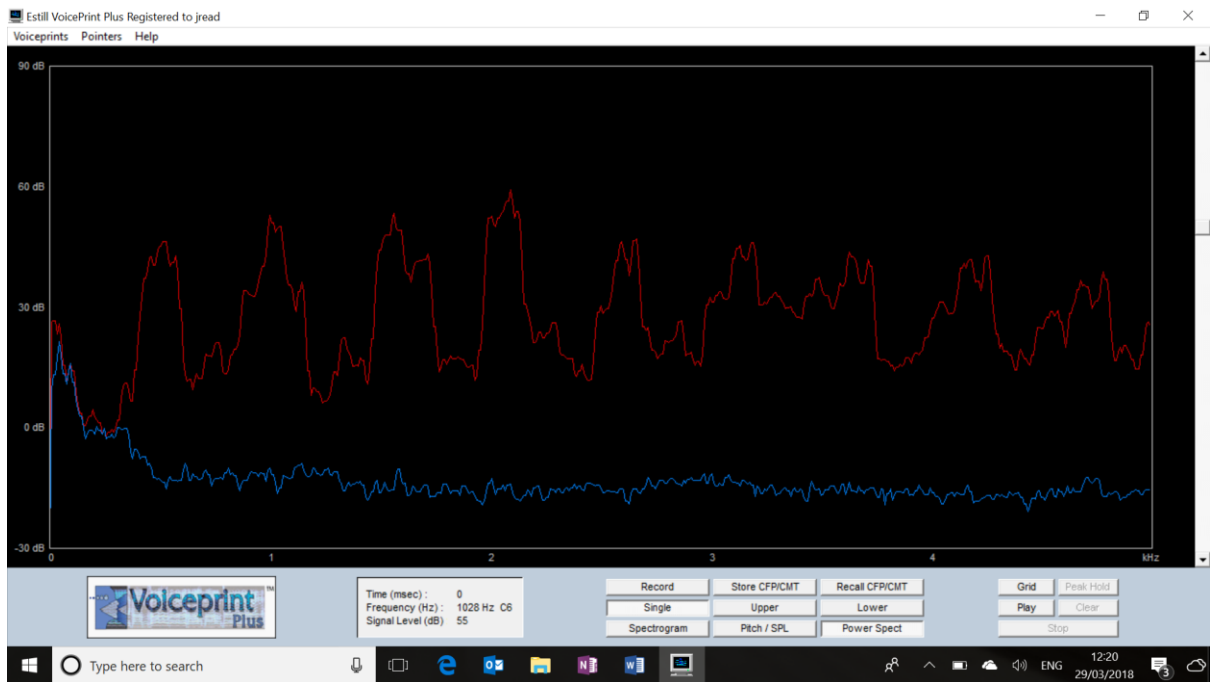
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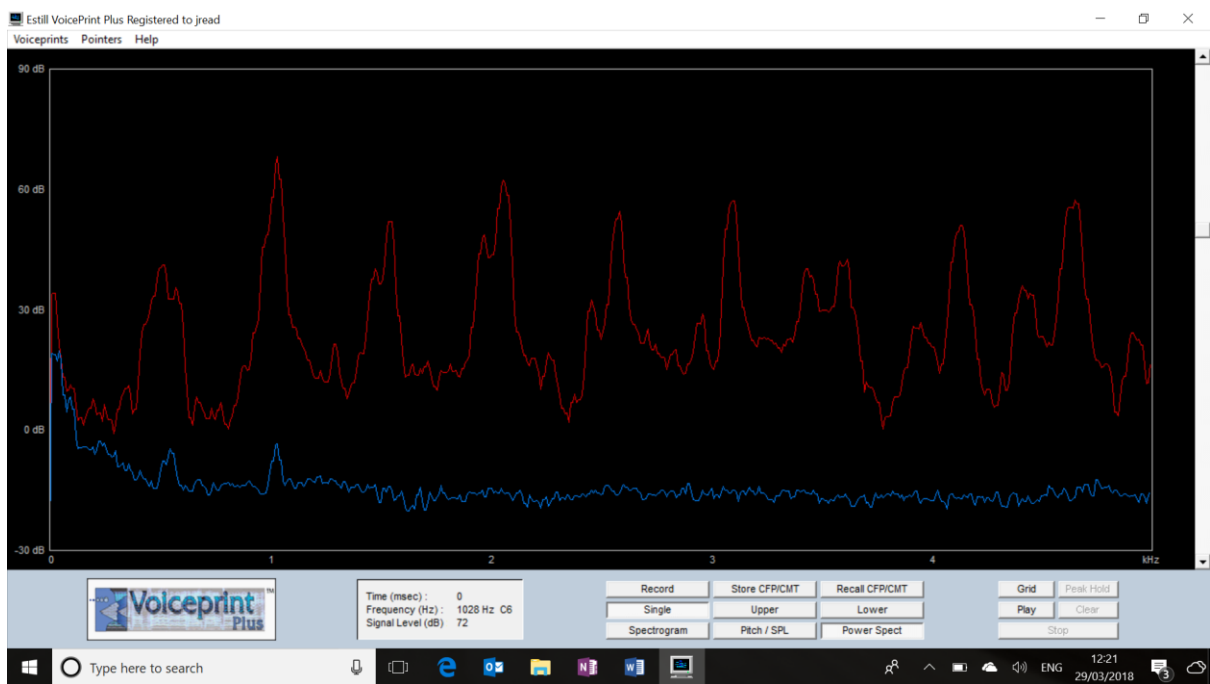
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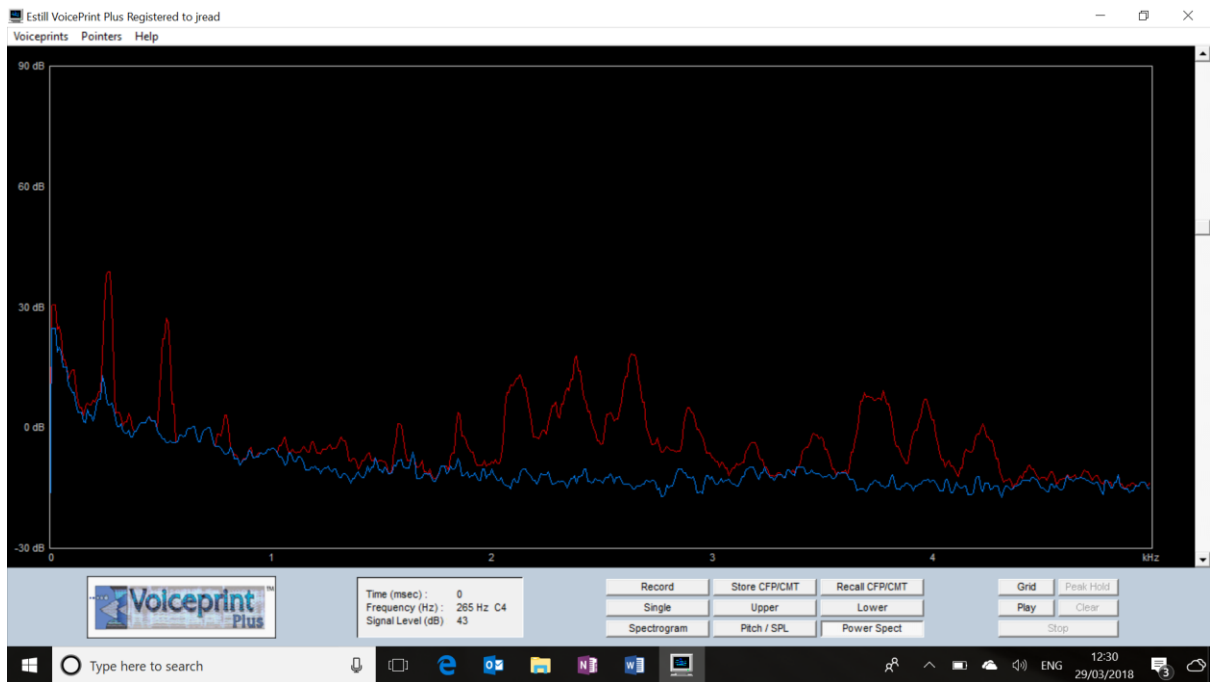
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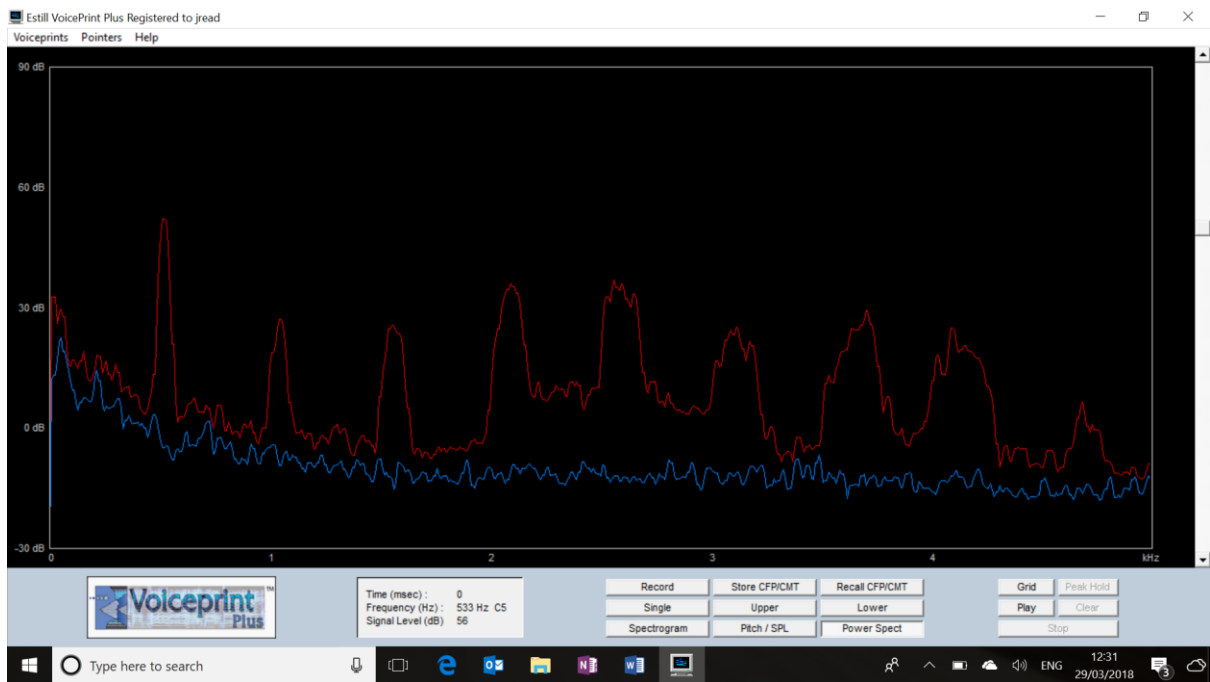
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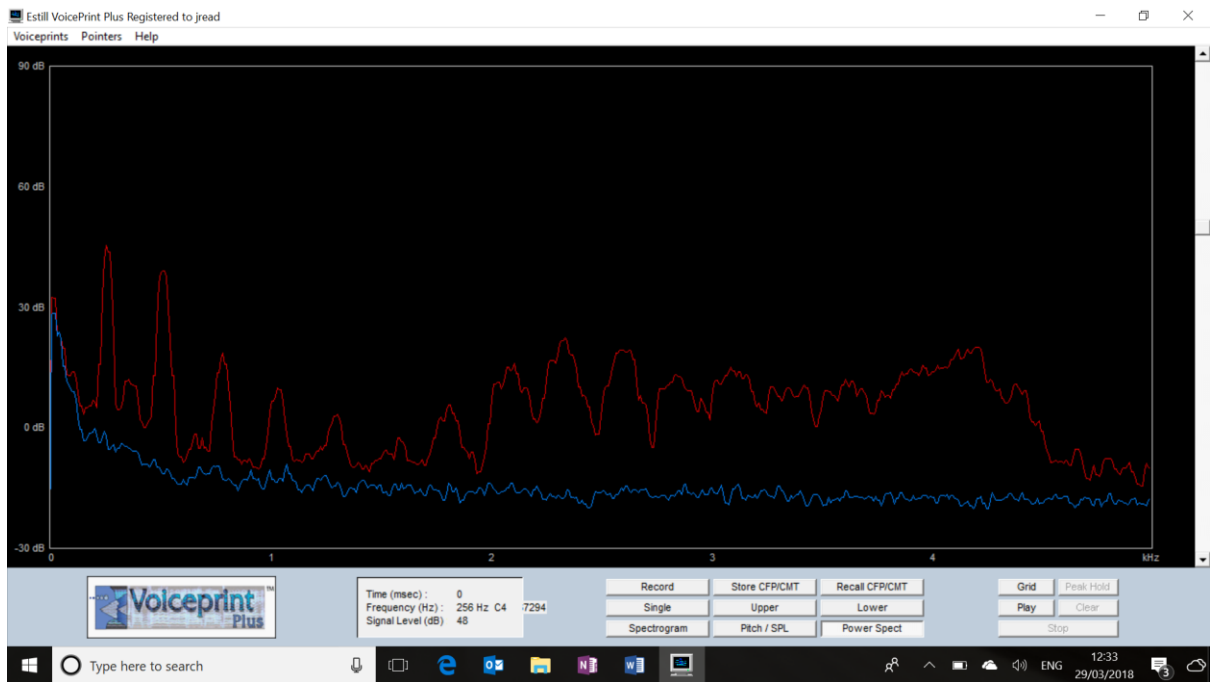
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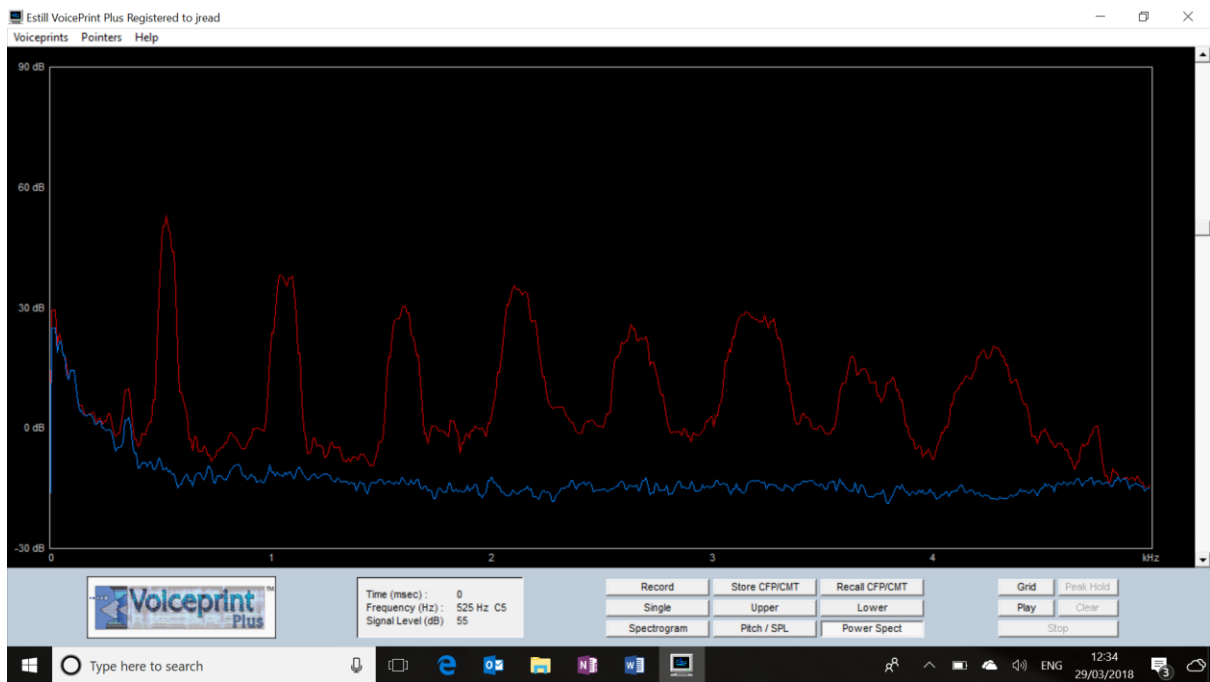
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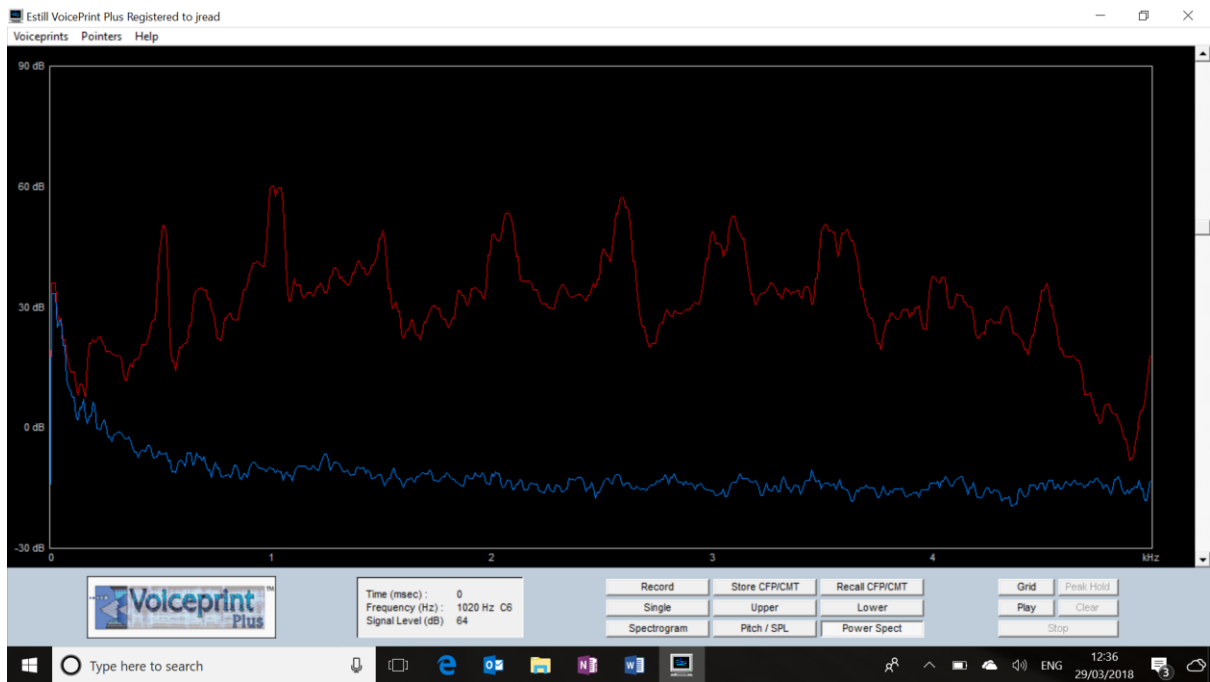
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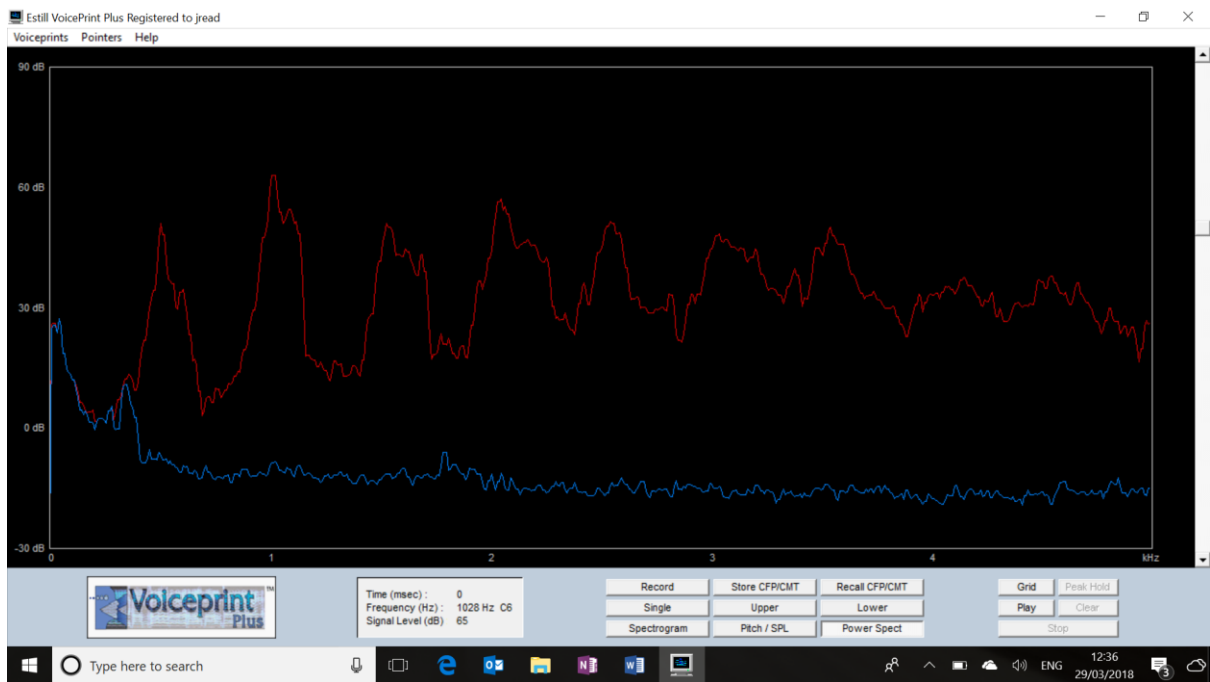
## Student 2 C5 legit



## Student 6 C5 belt



## Student 2 C5 belt



**Appendix B – Student Consent Form and Information Sheet Exemplars**

**PARTICIPANT CONSENT FORM**

**Cardiff Metropolitan University Ethics Reference Number:**

**Participant name or Study ID Number:**

**Title of Project:** “Assessing The Efficacy of Spectrographic Software in the training of Musical Theatre Singers”

**Name of Researcher:** Jamie Read

**Participant to complete this section:**

**Please initial each box.**

1. I confirm that I have read and understand the information sheet for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. [ ]
  
2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason. [ ]
  
3. I agree to take part in the above study. [ ]
  
4. I agree to the coaching session and focus group being recorded [ ]
  
5. I agree to the use of anonymised quotes in publications [ ] Yes No [ ] [ ]
  
6. I would like my organisations' name to be anonymised in all publications [ ] [ ]

---

Signature of Participant Date

---

Name of person taking consent Date

---

Signature of person taking consent

*\* When completed, 1 copy for participant & 1 copy for researcher site file*

# **PARTICIPANT INFORMATION SHEET**

## **Assessing The Efficacy of Spectrographic Software in the training of Musical Theatre Singers**

**Cardiff Metropolitan University Protocol Number: N/A**

### **Project summary**

The purpose of this research project is to establish whether it is helpful for Musical Theatre singers in training, when learning to switch between Belt and Legit styles, to use real time spectrographic software as part of their development.

### **Why have you been asked to participate?**

You have been asked to participate because you fit the profile of the population being studied. That is; you are in full-time vocational training for a career in Musical Theatre, with some amount of prior understanding as to what the 'Belt' and 'Legit' sounds are.

### **Project risks**

The research involves the completion of a questionnaire and participation in a one-to-one coaching session and a focus group interview, both of which will be recorded for later analysis. We are not seeking to collect any sensitive data on you; this study is only concerned with the efficacy of different teaching methods. We do not think that there are any significant risks associated with this study. However, if you do not wish to answer the questions or take part in the coaching session then you can stop at any time. Furthermore, you can change your mind and withdraw from the study completely at any time – we will completely respect your decision. The project does not form part of your formal training at READ College and is being conducted independently with the permission of the Board of Trustees, as part of a Post Graduate Certificate (PGCERT) project with Cardiff Metropolitan University and Voice Workshop UK.

### **How we protect your privacy**

All the information you provide will be held in confidence. We have taken careful steps to make sure that you cannot be directly identified from the information given by you. Your personal details (e.g. signature on the consent form) will be kept in a secure location by the researcher. When we have finished the study and analysed all the information, all the documentation used to gather the raw data will be destroyed. The recordings of the focus groups/ interview will also be held in a secure and confidential environment during the study and destroyed after five years.

YOU WILL BE OFFERED A COPY OF THIS INFORMATION SHEET TO KEEP

---

If you require any further information about this project, then please contact the researcher:

**Jamie Read** [jamie.read@readcollege.org](mailto:jamie.read@readcollege.org)

0118 9666275

## ***Appendix C – Focus Group Questions and Training Questionnaire exemplars***

### **Focus Group Questions:**

1. What did you think about Voiceprint as a tool?
2. What, if anything, did you understand about the harmonics of your voice beforehand?
3. What did you understand about Legit and Belt qualities before the sessions?
4. Based on the coaching sessions, do you think there would be any benefits to using Voiceprint for you as students?
5. How important do you think it is for you as singers to understand the harmonics of your voice, or how much do you think it might be a hindrance?
6. Do you think there would be any negatives around using Voiceprint in singing lessons?
7. Do you have any understanding of the harmonics of Belt and Legit quality based on the coaching sessions?
8. Do you think visual feedback is useful and/or important for singers?
9. Any other things you would like to add to the discussion?

### Student Training Questionnaire:

1. How would you currently rate yourself in terms of experience of singing in the Legit style?
  - a. Very Experienced
  - b. Some Experience
  - c. Little Experience
  - d. No Experience
2. How would you currently rate yourself in terms of experience of singing in the Belt style?
  - a. Very Experienced
  - b. Some Experience
  - c. Little Experience
  - d. No Experience
3. Are you able to describe the difference between these two styles in terms of the singer's vocal set up?
  - a. Yes
  - b. No
4. If yes, please do so in your own words:
5. How would you currently rate your skill in singing in the Legit style?
  - a. Highly Skilled
  - b. Skilled
  - c. Somewhat Skilled
  - d. Unskilled
6. How would you currently rate your skill in singing in the Belt style?
  - a. Highly Skilled
  - b. Skilled
  - c. Somewhat Skilled
  - d. Unskilled
7. Have you previously had vocal training in the Musical Theatre genre?
  - a. Yes
  - b. No
8. If yes, how many years of training have you had?
9. To the best of your recollection, have you ever previously used the computer software "Estill VoicePrint Plus" in your vocal training?
  - a. Yes
  - b. No

## Appendix D – Raw Data (Focus Group)

### Participant Info overview:

Participant	No.	Age	Gender	Status	Consent	Info	Q'tionnaire
P	1	18	F	Completed	Y	Y	Y
E	2	19	F	Completed	Y	Y	Y
D	3	21	M	Completed	Y	Y	Y
A	4	19	F	Completed	Y	Y	Y
B	5	20	F	Completed	Y	Y	Y
V	6	19	F	Completed	Y	Y	Y
M	7	19	F	Completed	Y	Y	Y
C	8	18	M	Completed	Y	Y	Y
K	9	19	F	Withdrew due to scheduling issues	N/A	N/A	N/A
T	10	19	F	Withdrew through ill health	N/A	N/A	N/A

Mean age	19.1	(all)
Mean age	19.1	(completed)

### Transcript - Key words and phrases:

#### ***What did you think about voiceprint?***

Cool

I Love It

I like being able to see your own voice

Interesting

Can't always hear, so good to be able to see stuff

I didn't realise that I was twangy

I like looking at the difference between my voice and C

You can see it in order to fix something

It stays there [unlike a sung note]

If you capture it you can actually work on it

Nice to be able to see you were doing the right thing

What we were doing with our technique was correct

You were immediately able to show that [breathiness] so knew how to fix it

Nice to match what you feel with what you can see

Affirmative, could see it was right

Muscle memory, comparison to using mirror when dancing

You know it's right so you keep that

#### ***What did you understand about harmonics beforehand***

No previous understanding of harmonics

I felt like I had an idea of different vocal qualities

That made it more clear [sic]

Knew how it should feel and placement of it

Not about specifics or what you're actually doing

When it came to harmonics, I didn't know too much about that

Knew about physiology but not sure whether I can always apply that

Seeing it helped to get a basic understanding

I knew I was twangy, it was cool to see

You see it all at the same time  
Nice to reflect on how you've been told you're singing

***What did you understand about Legit and Belt qualities before the sessions***

Legit is birds and sweet sounds  
I think of belting as just screaming and being loud  
When I think of legit I think of older musicals  
A more operatic kind of sound - thinner and not as strong [as belt]  
Softer, gentler  
Belting is the opposite of that [soft, gentle, thin, operatic]  
Legit is like opera and Disney princesses  
Soft and quiet  
Belting is like MT Broadway  
I feel that legit is a lot darker [male perspective]  
Belting is in a lighter place [compared to 'dark' legit]  
Belting is much more powerful  
Legit is like trying to do something without any of the power behind it  
Perception of greater effort in Legit  
Belt is quite natural and legit is something I have to work hard on  
Belting is letting go of everything and just letting it happen  
Legit is really manufacturing to get the setup  
You really have to think about it [legit]  
\* 1,3 and 5 all reported belt as more natural and less effort \*  
\* 6 reported that both style require a lot of effort technically \*  
\* 4 wasn't sure \*  
\* 7 felt legit was much easier and effortless, whereas finding belt place is quite hard \*

***Would there be any benefits in using VP in training?***

Yes, 100%  
If I could see the sound and play around with it I think that would help  
Not just feel it  
Helpful to see each other using it, and seeing someone achieve the changes  
She was able to change her voice and quality and get it [harmonic peak] lower  
By seeing that you can learn to help yourself  
We were all able to produce the 2 different qualities without it anyway  
Could potentially be something you get caught up on  
Singing is natural and it's about how it feels and what works for you  
Use it more to fix an issue rather than a teaching thing  
Would be great to use initially to get legit and belt  
If you just gave me that, I would sit for hours trying to get things right  
I would get control freaky-and upset if I couldn't do it  
I think it's a good starting platform for a noise you find difficult  
Not using it to fix every single note  
It was interesting that me and [1] have different voices but when you looked at it they were similar  
As an initial thing it was really good to look at  
I really like it as something to fix problems  
Would require supervision

***How important is it for you to understand harmonics as a singer?***

I think it gives you an edge

Knowledge can't hurt you

As long as you remember you are trying to get to a place where you can just do it

I think it helps you get to that place [correct quality] each time

At the moment I'm relying on my natural attractor state, this gives you the build up to get there

Knowing the harmonics I was able to put in place how to get those 2 notes at the end of a song

While we're still training it gives us the opportunity to explore sounds and different feelings

When we've got to a point where we know what we're doing that's when we can make artistic choices

I think it is important to know what's going on harmonically

Different versions of the same song, helps to understand why harmonically I prefer one to another

When you go into this for a career, you might be asked to change something for a particular role

When different teachers tell me 'place your voice here' I now know they're meaning something else

I know what it is that I'm doing rather than just guessing

***Do you think there would be any negatives in using VP***

Getting hung up on understanding it

Could become infuriating if you're a person who needs the details

Becoming a hang up - 'I didn't get the print right' even if it's aesthetically the right noise

You're not going to have that [vp] when you're actually singing

Singing is quite a physical thing, you can't have the visuals when you've got to get up and sing

If you're learning based on how it looks rather than how it feels then... [that is a problem]

Would have more negative impacts if you were actually working in the industry

Shouldn't be about your vocal print being the same as the person who played the role before you

No-one is going to have exactly the same sound quality as someone else

Self doubt

Really helpful initially for understanding, but not to use in general 'let me check each song'

\* aside comment 'is it expensive' \*

I don't really think you can teach tone of voice

***Based on teaching session, do you have understanding now of harmonics of belt and legit***

Yes I do now have an understanding of belt/legit harmonics

I didn't realise they were that different

I didn't realise there were so many spikes [harmonics] between them

Didn't know contemporary belting had so many formants

Found with belting it was interesting to see that the second peak was the biggest one

I liked seeing the balance

It was really nice seeing that there is almost always a battle between the two [qualities]

It was nice seeing the difference between mine and 3's voice

It was really weird to see that there was that much difference in the voice, it doesn't always seem like there is

It was nice to see further into the voice, like a microscope

I found it was surprising how many harmonics were in one note

It would be really good to use to work on pitching

As someone who doesn't sing or like singing, I think it's quite reassuring to see

You can't hear your voice as everyone else hears it and I don't like recordings of my voice so this is good

Because it's visual it's good to keep in your head

Sometimes singing a note over and over doesn't help you to get it, but being able to see it helps to secure the feeling of what's right

I just like how visually there was a pattern  
Being able to compare the 2 [qualities] and know that there's a difference is good  
Almost turns it into right and wrong - singing is variable, where this makes it factual  
\* further to comment above, is this positive or negative? 'Not sure, depends in the person' \*  
Positive in the sense that you can work on things you're struggling with to get them right  
Could become an obsession  
Would be useful to record whole song and go back through the print to see the places that need improving  
Would be great for private practice  
It's showing you a true representation  
It could play on your perception of how your voice is

***Do you think that visual learning is useful for singers***

I think it's useful but I don't think it's necessary  
It depends if you're a visual person  
I'm not someone who's that kinaesthetic so I can't always feel stuff in my throat, and I can't always hear it, so visual for me is the key thing  
Creating different sounds is different for each person  
Sound should be most important, don't get hung up on the print  
Really good to track progress  
If I'd had that [vp] at the start of my course, I think I'd be shocked at the change in my voice  
Being able to see it rather than just feeling it would be a lot more helpful  
Useful for setting targets during a term  
You can learn how to sing without it, but it has advantages  
Sometimes I get stuck in signing lessons and if I'd been able to set targets [on vp] I feel like I could achieve them  
Use in a lesson but not as an assessment tool  
Should be a personal thing of whether you would like that or not  
I appreciate when a teacher goes a roundabout way to help us get something  
Having something else there as a general tool helps in a way you wouldn't think of  
I wouldn't like it as an assessment or targets because then you're trying to fit a mould  
Use lots of different examples, don't say 'this is a picture of a perfect legit sound'  
I find it most useful because it indicates certain differences  
I wouldn't compare myself to anyone else  
It could be really useful as a teaching tool with a teacher  
If you give it to students on their own it would decrease individuality  
Wouldn't be useful without having a full knowledge of how it works  
I was assuming things in my head that weren't true [by making comparisons]  
It's not a person, it doesn't have aesthetic judgements  
Anecdotal teaching without 'facts' is also very beneficial and makes changes in the voice  
It's really black and white [phrased as a negative]  
Could be useful in other applications such as adding more twang to a US accent  
Would be useful in a vocal tech lesson to have prints of the different qualities  
Requires a good technical understanding of the voice as well [normal vocal tech]  
Don't rely on it for a whole picture of your voice  
Would be useful for finding out more about other voice qualities such as mix

## Thematic Analysis of Data

Initial Coding - "Perceptual Experience for the Singer"	Secondary Coding
I like being able to see your own voice	Positive Engagement
Can't always hear, so good to be able to see stuff	Positive Engagement
I didn't realise that I was twangy	Self Evaluation
I like looking at the difference between my voice and C	Self Evaluation
You can see it in order to fix something	Positive Engagement
Nice to be able to see you were doing the right thing	Positive Engagement
Nice to match what you feel with what you can see	Kinaesthetic
Muscle memory, comparison to using mirror when dancing	Kinaesthetic
Seeing it helped to get a basic understanding of harmonics	Positive Engagement Self Evaluation
I knew I was twangy, it was cool to see	Self Evaluation
If I could see the sound and play around with it I think that would help	Exploring the Voice
Not just feel it	Positive Engagement
Singing is natural and it's about how it feels and what works for you	Kinaesthetic Improved
I think understanding harmonics gives you an edge	Understanding Improved
Knowledge can't hurt you	Understanding
As long as you remember you are trying to get to a place where you can just do it	Obsession
I think it helps you get to that place [correct quality] each time	Aided Learning
I think it is important to know what's going on harmonically	Aided Learning
Different versions of the same song, helps to understand why harmonically I prefer one to another	Improved Understanding
Getting hung up on understanding it	Obsession
Singing is quite a physical thing, you can't have the visuals when you've got to get up and sing	Kinaesthetic
If you're learning based on how it looks rather than how it feels then... [that is a problem]	Kinaesthetic
Would have more negative impacts if you were actually working in the industry	Negative Impact
Shouldn't be about your vocal print being the same as the person who played the role before you	Negative Impact
No-one is going to have exactly the same sound quality as someone else	Negative Impact
Self doubt	Negative Impact
It could play on your perception of how your voice is	Obsession
I found it was surprising how many harmonics were in one note	Improved Understanding
I'm not someone who's that kinesthetic so I can't always feel stuff in my throat, and I can't always hear it, so visual for me is the key thing	Positive Engagement

I was assuming things in my head that weren't true [by making comparisons]

Self Evaluation

**Initial Coding - "Engagement with the Tool"**

**Secondary Coding**

Cool	Positive Engagement
I Love It	Positive Engagement
I like being able to see your own voice	Positive Engagement
Interesting	Positive Engagement
If you capture it you can actually work on it	Aided Learning
Affirmative, could see it was right	Self Evaluation
Nice to reflect on how you've been told you're singing	Self Evaluation
That made it more clear [sic]	Improved
Seeing it helped to get a basic understanding	Understanding
You see it all at the same time	Positive Engagement
Nice to reflect on how you've been told you're singing	Self Evaluation
Yes, 100% there would be positives to using VP	Positive Engagement
If I could see the sound and play around with it I think that would help	Exploring the Voice
Not just feel it	Kinaesthetic
Helpful to see each other using it, and seeing someone achieve the changes	Aided Learning
She was able to change her voice and quality and get it [harmonic peak] lower	Improved
By seeing that you can learn to help yourself	Understanding
Could potentially be something you get caught up on	Aided Learning
Singing is natural and it's about how it feels and what works for you	Obsession
Use it more to fix an issue rather than a teaching thing	Kinaesthetic
Would be great to use initially to get legit and belt	Specific Usage
If you just gave me that, I would sit for hours trying to get things right	Specific Usage
I would get control freaky-and upset if I couldn't do it	Obsession
I think it's a good starting platform for a noise you find difficult	Obsession
Not using it to fix every single note	Specific Usage
It was interesting that me and [1] have different voices but when you looked at it they were similar	Specific Usage
As an initial thing it was really good to look at	Aided Learning
I really like it as something to fix problems	Aided Learning
Would require supervision	Specific Usage

I think it helps you get to that place [correct quality] each time	Positive Engagement
At the moment I'm relying on my natural attractor state, this gives you the build up to get there	Aided Learning
Knowing the harmonics I was able to put in place how to get those 2 notes at the end of a song	Aided Learning
While we're still training it gives us the opportunity to explore sounds and different feelings	Positive Engagement
I know what it is that I'm doing rather than just guessing	Aided Learning
You're not going to have that [vp] when you're actually singing	Specific Usage
Could become infuriating if you're a person who needs the details	Obsession
Becoming a hang up - 'I didn't get the print right' even if it's aesthetically the right noise	Obsession
Really helpful initially for understanding, but not to use in general 'let me check each song'	Specific Usage
It would be really good to use to work on pitching	Specific Usage
As someone who doesn't sing or like singing, I think it's quite reassuring to see	Positive Engagement
You can't hear your voice as everyone else hears it and I don't like recordings of my voice so this is good	Positive Engagement
Because it's visual it's good to keep in your head	Positive Engagement
I just like how visually there was a pattern	Positive Engagement
Almost turns it into right and wrong - singing is variable, where this makes it factual	Negative Impact
* further to comment above, is this positive or negative? 'Not sure, depends in the person' *	
Positive in the sense that you can work on things you're struggling with to get them right	Aided Learning
Could become an obsession	Obsession
Would be great for private practice	Specific Usage
It's showing you a true representation	Positive Engagement
It could play on your perception of how your voice is	Obsession
Really good to track progress	Specific Usage
If I'd had that [vp] at the start of my course, I think I'd be shocked at the change in my voice	Positive Engagement
Useful for setting targets during a term	Specific Usage
You can learn how to sing without it, but it has advantages	Positive Engagement
Sometimes I get stuck in singing lessons and if I'd been able to set targets [on vp] I feel like I could achieve them	Aided Learning
Use in a lesson but not as an assessment tool	Specific Usage

Should be a personal thing of whether you would like that or not	Specific Usage
Having something else there as a general tool helps in a way you wouldn't think of	Positive Engagement
I wouldn't like it as an assessment or targets because then you're trying to fit a mold	Negative Impact
Use lots of different examples, don't say 'this is a picture of a perfect legit sound'	Positive Engagement
I find it most useful because it indicates certain differences	Aided Learning
It could be really useful as a teaching tool with a teacher	Aided Learning
If you give it to students on their own it would decrease individuality	Negative Impact

It's really black and white [phrased as a negative]	Negative Impact
Could be useful in other applications such as adding more twang to a US accent	Positive Engagement
Would be useful in a vocal tech lesson to have prints of the different qualities	Positive Engagement
Requires a good technical understanding of the voice as well [normal vocal tech]	Aided Learning

Would be useful for finding out more about other voice qualities such as mix	Positive Engagement
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<b>Initial Coding - "Learning Experiences and Outcomes"</b>	<b>Secondary Coding</b>
I didn't realise that I was twangy	Self Evaluation
You can see it in order to fix something	Positive Engagement
It stays there [unlike a sung note]	Positive Engagement
If you capture it you can actually work on it	Aided Learning
	Improved
Nice to be able to see you were doing the right thing	Understanding
What we were doing with our technique was correct	Affirming
You were immediately able to show that [breathiness] so knew how to fix it	Improved
	Understanding
Nice to match what you feel with what you can see	Affirming
Affirmative, could see it was right	Affirming
Muscle memory, comparison to using mirror when dancing	Kinaesthetic
You know it's right so you keep that	Affirming
	Improved
No previous understanding of harmonics	Understanding
	Improved
I felt like I had an idea of different vocal qualities	Understanding
Helpful to see each other using it, and seeing someone achieve the changes	Aided Learning
Knew how it should feel and placement of it	Kinaesthetic
Not about specifics or what you're actually doing	Aided Learning

When it came to harmonics, I didn't know too much about that	Aided Learning
Knew about physiology but not sure whether I can always apply that	Self Evaluation
She was able to change her voice and quality and get it [harmonic peak] lower	Improved Understanding
I knew I was twangy, it was cool to see	Self Evaluation
By seeing that you can learn to help yourself	Self Evaluation
Nice to reflect on how you've been told you're singing	Affirming
Would be great to use initially to get legit and belt	Specific Usage
Use it more to fix an issue rather than a teaching thing	Specific Usage Improved
Knowledge can't hurt you	Understanding
When we've got to a point where we know what we're doing that's when we can make artistic choices	Self Evaluation
When different teachers tell me 'place your voice here' I now know they're meaning something else	Improved Understanding
I know what it is that I'm doing rather than just guessing	Aided Learning
Really helpful initially for understanding, but not to use in general 'let me check each song'	Specific Usage
Yes I do now have an understanding of belt/legit harmonics	Improved Understanding
I didn't realise they were that different	Aided Learning
I didn't realise there were so many spikes [harmonics] between them	Improved Understanding
I liked seeing the balance	Aided Learning
Found with belting it was interesting to see that the second peak was the biggest one	Aided Learning
It was really nice seeing that there is almost always a battle between the two [qualities]	Aided Learning
It was nice seeing the difference between mine and 3's voice	Self Evaluation
It was really weird to see that there was that much difference in the voice, it doesn't always seem like there is	Improved Understanding
It was nice to see further into the voice, like a microscope	Aided Learning
I found it was surprising how many harmonics were in one note	Improved Understanding
Sometimes singing a note over and over doesn't help you to get it, but being able to see it helps to secure the feeling of what's right	Aided Learning
Would be useful to record whole song and go back through the print to see the places that need improving	Aided Learning
Being able to compare the 2 [qualities] and know that there's a difference is good	Aided Learning

I'm not someone who's that kinesthetic so I can't always feel stuff in my throat, and I can't always hear it, so visual for me is the key thing	Positive Engagement
Sound should be most important, don't get hung up on the print	Kinaesthetic
You can learn how to sing without it, but it has advantages	Aided Learning
If I'd had that [vp] at the start of my course, I think I'd be shocked at the change in my voice	Improved Understanding
Being able to see it rather than just feeling it would be a lot more helpful	Aided Learning
I appreciate when a teacher goes a roundabout way to help us get something	Aided Learning
Having something else there as a general tool helps in a way you wouldn't think of	Aided Learning
I wouldn't compare myself to anyone else	Self Evaluation
I was assuming things in my head that weren't true [by making comparisons]	Self Evaluation
Requires a good technical understanding of the voice as well [normal vocal tech]	Aided Learning

<b>Initial Coding - "Voice Quality Understanding"</b>	<b>Secondary Coding</b>
Nice to match what you feel with what you can see	Positive Engagement
Muscle memory, comparison to using mirror when dancing	Kinaesthetic Improved
I felt like I had an idea of different vocal qualities	Understanding
Legit is birds and sweet sounds	Perception
I think of belting as just screaming and being loud	Perception
When I think of legit I think of older musicals	Perception
A more operatic kind of sound - thinner and not as strong [as belt]	Perception
Softer, gentler	Perception
Belting is the opposite of that [soft, gentle, thin, operatic]	Perception
Legit is like opera and Disney princesses	Perception
Soft and quiet	Perception
Belting is like MT Broadway	Perception
I feel that legit is a lot darker [male perspective]	Perception
Belting is in a lighter place [compared to 'dark' legit]	Perception
Belting is much more powerful	Perception
Legit is like trying to do something without any of the power behind it	Perception
Perception of greater effort in Legit	Perception
Belt is quite natural and legit is something I have to work hard on	Self Evaluation

Belting is letting go of everything and just letting it happen	Self Evaluation
Legit is really manufacturing to get the setup	Perception
You really have to think about it [legit]	Perception
* 1,3 and 5 all reported belt as more natural and less effort *	
* 6 reported that both style require a lot of effort technically *	
* 4 wasn't sure *	
* 7 felt legit was much easier and effortless, whereas finding belt place is quite hard *	
Would be great to use initially to get legit and belt	Aided Learning
It was interesting that me and [1] have different voices but when you looked at it they were similar	Improved Understanding
I think understanding harmonics gives you an edge	Improved Understanding
I think it helps you get to that place [correct quality] each time	Improved Understanding
When you go into this for a career, you might be asked to change something for a particular role	Self Evaluation
Yes I do now have an understanding of belt/legit harmonics	Improved Understanding
I didn't realise they were that different	Aided Learning
I didn't realise there were so many spikes [harmonics] between them	Aided Learning
Didn't know contemporary belting had so many formants	Improved Understanding
Found with belting it was interesting to see that the second peak was the biggest one	Improved Understanding
It was really weird to see that there was that much difference in the voice, it doesn't always seem like there is	Positive Engagement
It was really nice seeing that there is almost always a battle between the two [qualities]	Aided Learning
Being able to compare the 2 [qualities] and know that there's a difference is good	Aided Learning
Would be useful in a vocal tech lesson to have prints of the different qualities	Positive Engagement
Would be useful for finding out more about other voice qualities such as mix	Positive Engagement