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The Impact of Training Aids on Aerodynamic and Acoustic Measures in Singing

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THE IMPACT OF TRAINING AIDS ON
AERODYNAMIC AND ACOUSTIC MEASURES IN SINGING

by

Julie Kaldor Grives

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THE IMPACT OF TRAINING AIDS ON
AERODYNAMIC AND ACOUSTIC MEASURES IN SINGING

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This research investigated whether exercise equipment serving as training aids for singers changes aerodynamic and acoustic measures and, if so, whether any of the changes persist or increase with regular training. Nineteen subjects, eleven women and eight men, in their first two years of voice study at the collegiate level and between nineteen and twenty-two years old, participated in the studies. Seven subjects tested an exercise band. Three subjects tested an exercise ball. Two subjects tested a balance ball. Each study asked subjects to participate in three testing sessions that included a baseline, a training aid and a post-training aid phase. The researcher followed the same protocol in each, gathering aerodynamic and acoustic data through the Glottal Enterprises Aeroview system and the Kay-Pentax Computerized Speech Lab (CSL 4500). The five subjects of the case study participated in a testing session before a month-long training period with the exercise band. They were tested again immediately after the training period and once more one month later during which time subjects did not use the exercise band. Case study subjects also recorded their perceptions of change during the month-long training period.

Paired samples t-tests revealed significant changes in aerodynamic and acoustic measures when comparing averaged baseline, training and post-training phases for all three preliminary studies. The exercise band showed the most significant changes from

the baseline with moderate and large effect sizes to both aerodynamic and acoustic measures. Both the exercise ball and balance ball showed significant changes in fewer measures, but with moderate and large effect sizes, as well. In the case study, paired samples t-tests compared all subjects averaged aerodynamic and acoustic measures. The analysis revealed that while no significant differences occurred in aerodynamic measures, in acoustic measures significant differences from the baseline phases occurred with large effect sizes. In the case study, subjects, who regularly practiced with the exercise band, showed persisting, consistent change. Future study will better define why and how training aids affect singers' aerodynamic and acoustic measures. The three training aids and the specific methods tested show potential to be an effective training tool for singers.

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GLOSSARY

Energy Ratio (ER) – measures the difference between the average intensity between 0 and 2 kHz and the average intensity between 2 and 4 kHz, identifying how efficiently singers use the larynx when singing to regulate respiration (Schutte, 1984).

Glottal Resistance (GR) – the ratio of subglottal pressure over airflow that describes how firmly the vocal folds are closing.

Long-Term Average Spectrum (LTAS) – graphic representation of the intensity of frequency peaks.

Singing Power Ratio (SPR) – measures the difference the maximum intensity between 0 and 2 kHz and 2 and 4 kHz (Omori *et al.*, 1996).

Subglottal Pressure (Psub) – the amount of air pressure that builds up under the vocal folds just before the onset of phonation

Vocal Efficiency (VE) – measures the efficiency of glottal closure by dividing sound pressure level by the product of subglottal pressure and airflow rate

CHAPTER 1: PURPOSE AND BACKGROUND

The following chapter describes how exercise equipment has evolved into training aids for voice teachers and the benefits they ascribe to them. It also describes the exercise science and physical therapy research that has shown these training aids caused increased muscle activation and improved body alignment. The chapter closes with the research questions and objectives that these studies explore in the following chapters and discusses how understanding them may further vocal pedagogy.

Exercise equipment serving as training aids for singers have appeared in the voice studio over the past 25 years. Proponents for these training aids have attributed improved respiration, better alignment, and more consistent tone quality to their usage.

Recommended methods are purported to stretch or engage muscles, train proprioception, and possibly affect alignment, respiration, and tone quality. Voice teachers have prescribed these methods for use to prepare the body for singing or to make changes during practice.

History of Training Aids

Gustav Gossweiler patented a form of an exercise band in 1896 that he made from surgical tubing (Heffernan, 2017). The development of the exercise band's present form as an elastic band began in the 1960s (Resistance Band, 2014). Physical therapists popularized it for use in injury recovery at first, but by the 1980s it was appearing in fitness studios (Resistance Band, 2014). The exercise band is widely used today for general fitness, strength training and therapy for various muscle groups (Heffernan, 2017). Voice teachers likewise have developed multiple methods for its use in the studio. Some teachers advise students to hold it out in front of the body with both hands pulling

horizontally away from each other to keep the shoulders open and lungs expanded longer while singing. Others ask students to stand on the middle while pulling up with the hands to create resistance with the core muscles. Singers may also wrap it around the shoulders and across the back pulling the ends forward with hands for better alignment.

Aquilino Cosani first developed the exercise ball as a toy that he called “Gymnastik” in Italy in 1963 (Everleigh, 2016). After seeing Swiss physical therapists demonstrate its therapeutic potential, American physical therapists brought it to the United States in the 1980s. These Americans coined the name “Swiss ball.” (Everleigh, 2016). The exercise ball moved into fitness studios in the 1990s and then appeared as home exercise equipment (Everleigh, 2016). Today, they even serve as chairs helping people who sit at desks for long periods to improve their posture and possibly strengthen core muscles (Everleigh, 2016). Voice teachers looking for ways to explain alignment and muscle engagement to singers have brought them into the voice studio. Teachers ask students to sit and bounce while singing, lay over the ball or lean against the ball to push it into the wall.

The balance ball appeared later than the exercise ball and exercise band (Hefferman, 2018). David Weck, an athletic trainer, created it in the 1990s to coordinate stability and strengthen core muscles (Hefferman, 2018). Also called a BOSU[®] ball or yoga balance ball, it looks like an exercise ball cut in half. Weck gave one half of an exercise ball a base to make it easier to stand on (Hefferman, 2018). Voice teachers have students balance on it while singing to improve alignment and engage core muscles.

Incorporating Training Aids in the Voice Studio

Anecdotal evidence that training aids help a singer improve respiration efficiency is found in Blades-Zeller (2002), Friedlander (2017), Hanson (2013), Hennessey (2015), McCoy (2015), Pine (2013), Scarce (2016), Wilson (2012), Wurster (2017) and Verdare (2009). These authors have attributed various respiration changes to different training aids and methods. In teacher training workshops, Hennessey (2015) has demonstrated the method that asks singers to pull up of the ends of an exercise band, keeping arms parallel to the floor, while standing on the middle of the band. According to Hennessy, singers who use this method align their body and engage respiration muscles for better breath management (2015).

Wilson (2013) has perceived more efficient use of respiration muscles when a singer sits on an exercise ball and gently bounces. Scarce (2016, p. 193) detailed a similar method in her book, writing that she believes this action is “...freeing the abdominal and respiratory muscles to make them more available for effective breath support.” Scarce also wrote that when singers recruit core abdominal muscles through exercises like this, they also free the larynx (2016). Wurster (2017) writes that sitting on an exercise ball and gently bouncing while singing engages muscles in a “gentle, but stable way.” Other voice teachers, Friedlander (2014), Pine (2013), and Petry and Manahan (2011) have suggested that this method of using an exercise ball releases tension, and properly aligns the body for better respiration.

Wilson (2013) has instructed singers to stand on balance ball because it seems to strengthen back muscles to improve respiration. Verdare (2009) reported her students find more ease in singing with greater breath control when standing on a balance ball.

She related the increased control to perceived core muscle engagement (Verdare, 2009). McCoy (2015), meanwhile, has observed that his students seem to have increased energy when they stand on a balance ball.

Exercise Science's Research on Training Aids

Each of the training aids in this study were created to train athletes, improve users' fitness or help physical therapy patients recover from injuries. Researchers have found that using the exercise ball in the manner described in this present study helps people with back pain strengthen their spinal stability reducing pain (Carter *et al*, 2006). Granacher *et al* (2013) performed a systematic review of studies that followed the effectiveness of the exercise ball in strengthening trunk muscles to improve seniors' balance and prevent falls. The specific method of sitting on a ball and bouncing used in the present study is one the methods cited as useful in the strengthening of trunk muscles (Granacher *et al*, 2013). Gregory, Dunk and Callaghan (2006) found that sitting on an exercise ball increased muscle activation specifically in the erector spinae and decreased pelvic tilt, both important to proper alignment. In a similar study, Holmes *et al* (2015) showed that core muscle strength increased when study subjects exercised abdominal and back muscles by sitting and bouncing on an exercise ball. If the exercise ball can better align a singer's body and strengthen core muscles as shown by these studies, it follows that respiration may work more efficiently when a singer uses the method described above.

Using Electromyography (EMG), Yasuda *et al* (2014) measured increased core muscle intensity when subjects pull up on the ends of an exercise band while standing on the middle. Colado *et al* (2010) confirmed that the exercise band can cause muscle

activation that results in improved strength. Because studies like these also note that an exercise band is a well-tolerated low intensity training aid, it can be useful for a wide range of singers no matter their fitness level (Colado *et al*, 2010; Yasuda *et al*, 2014).

Wahl and Behm (2008) found that instability devices like a balance ball did not increase muscle activation for elite athletes. Still in a systematic review of all studies that have investigated them, instability devices have had a positive effect on muscle activation in trained tasks (Kümmel *et al*, 2016). The present study tested repeated pitches as a trained task while the subject stood on a balance ball. As no one in the studies is an elite athlete, this review suggests that it is more likely subjects activated muscles related to both alignment and respiration.

Research Goal and Objectives

Do these training aids help singers improve respiration or tone quality? Published research has not yet quantified anecdotally perceived change to singers' aerodynamic and acoustic measures. To fill this void, this research measured three training aids' effects on aerodynamic and acoustic measures. It also investigated whether singers can increase and maintain any changes when training with one method for an extended time.

The initial three studies are non-experimental method comparisons to find the training aid that shows the most potential for changing aerodynamic and acoustic measures in singers. Subjects in the first two years of collegiate voice study were tested one of the training aids three times, in one-week intervals, to find whether change occurred during each testing session with the given training aid and if any change persisted after its use.

A case study then followed subjects over a two-month period. Subjects used the exercise band for the case study as it was the training aid method that showed the most promise for change. The study further defined whether lasting change occurred for singers who regularly used the exercise band and whether change persisted beyond the training period.

Hypotheses

This research tested three hypotheses. First, singers who use an exercise band, balance ball, or exercise ball as a training aid were anticipated to show a change in aerodynamic and acoustic measurements. This was assessed by comparing the subject's baseline measurements of the aerodynamic and acoustic measures without a training aid (baseline phase) to the same measures obtained while they were using their assigned training aid (training phase). Second, singers were predicted to maintain some aerodynamic and acoustic change immediately after using the assigned training aid. To test this hypothesis, subjects repeated the test (post-training phase) without the training aid immediately after the second phase. Third, the training aid showing the most change potential in the initial three studies was hypothesized to be associated with consistent aerodynamic and acoustic change over a longer testing period, and the change was expected to be maintained after ending regular training. To test this hypothesis, a two-month case study was performed with five subjects.

Pedagogical Significance

The research explored the effectiveness of training aids significantly changing aerodynamic and acoustic measures for singers. The findings confirmed the perception that training aids change aerodynamic and acoustic measures, suggesting that they are

useful tools in the voice studio. Often these changes positively affected a subject's respiration and resonance. Still, each training aid's effectiveness cannot be conclusively confirmed because of the small sample size and inconsistencies in the results. Further study is required, including a larger sample and perceptual ratings to ascertain how training aids may affect a wider group of singers. Future investigation may look at how a singer's experience, general health and preferred style of singing may interact with each training aid.

CHAPTER 2: LITERATURE REVIEW

The existing literature reveals an increasing interest in using training aids.

Teachers perceive that their students show improvement in alignment, respiration and tone quality when they utilize training aids in the studio and while practicing.

Researchers in exercise science have already studied how training aids may improve balance, alignment and muscle engagement. Voice researchers have also demonstrated how some of these same factors such as body alignment and muscle engagement affect a singer's aerodynamic and acoustic measures. Similar studies to this current research have described how using other training aids such as straws has successfully shown change in aerodynamic and acoustic measures. The following review looks at previous research that describes how the use of training aids could positively affect a singer.

Alignment and Respiration

Many vocal pedagogy studies have outlined how body alignment influences respiration's efficiency. Hoit (1995) explored how body position influences breathing and how this influence can aid clinical treatment of voice disorders. She described the breathing apparatus muscular functions, including relaxation, inspiration and expiration, and these functions' effects on speech (Hoit, 1995). She compared supine and upright body positions, differentiating the muscular mechanism used for each position (Hoit, 1995). While this article was mainly concerned with breathing for speech, it provided excellent approaches for refining the upright body position that each of the training aids considered here influence.

Iwarsson (2001) studied whether the larynx consistently descends when the abdominal wall expands during inhalation. She found that sometimes the larynx was

higher when the abdominal wall expanded and lowered than when the abdominal wall was pulled in (Ivarsson, 2001). Upon further investigation, Ivarsson found that the test subject was tucking the chin each time these unexpected results occurred (Ivarsson, 2001). Releasing the muscles that habitually tucked the chin upon inhalation allowed singers to lower the larynx to its relaxed position (Ivarsson, 2001). This study's recommendations for proper body alignment provided important guidelines for head and neck positioning during testing and for the alignment goals of using each training aid.

Through Electromyographic (EMG) muscular activity recordings, Pettersen and Westegaard (2004) studied the effect of reducing the trapezius muscle and sternocleidomastoid muscle activity when singing. While no significant effect of reduced shoulder and neck muscle activity was found, the study did record higher levels of trunk muscle activity in the professional singers than in the student singers (Pettersen and Westegaard, 2004). The muscle usage pattern changed when the singers switched from singing arias to only sustained pitches at a variety of dynamic levels (Pettersen and Westegaard, 2004). This study reasoned that experienced singers only involve trunk muscles at higher levels when singing long sustained phrases. Because the present research used short repeated phrases, it is important to note that these phrases would not necessarily show the full involvement of an experienced singer's muscle engagement. Because of this result limitation, subjects in this study may not have shown the full range of aerodynamic and acoustic change possible if they are not engaging these described muscles fully.

Breath Management Strategies' Effects on Aerodynamic Levels

Callaghan (2006) reviewed and compared books and studies regarding respiration for singing in the chapter titled Breath Management in *Singing and Voice Science*. She considered breath management strategies, such as the *appoggio* technique, through the investigation of the function of the diaphragm and body posture (Callaghan, 2006).

Callaghan (2006) found that a student's body awareness and voluntary control of the respiratory process can be learned through traditional training, but also visual feedback (Callaghan, 2006). The training aid methods being measured may be additional tools in accessing body awareness and respiratory control as they may enhance traditional vocal training.

Foulds-Elliott and colleagues (2000) studied whether singing with emotional connection would change respiration in comparison to singing only with good technique. Researchers tested five professional singers singing "Drink to me only with Thine Eyes" and individual arias multiple times with different intentions (Foulds-Elliott *et al*, 2000). The singers sang each piece with perceived good technique, technically loud, technically soft and emotional connection (Foulds-Elliott *et al*, 2000). Emotional connection caused increased airflow for each singer, while subglottal pressure and phrase duration remained constant across the different intentions (Foulds-Elliott *et al*, 2000). This study suggests that state of mind affects airflow. Test subjects for the present studies perform exercises that do not allow time for emotional connection; however, any large changes in a subject's airflow between testing phases may be explained by state of mind or belief in the training aid's ability to affect respiration. Further study of the use of training aids during song preparation with emotional connection may also be warranted.

Airflow and Subglottal Pressure Influence on Resonance

In his 2004 article “What makes a voice acoustically strong,” Titze considers the respiration factors that allow for increased acoustic intensity. Increasing lung pressure in the low register or narrowing the acoustic tube above the vocal folds in the high register are the two ways that singers achieve acoustic strength with maximum airflow efficiency (Titze, 2004).

The singers who achieve balanced airflow and subglottal pressure described above demonstrate more perceived ring or *chiaroscuro* (Fangan, 2008; Titze, 2004). Also referred to as balanced resonance, *chiaroscuro* is tone that balances high and low harmonics; a tone quality that has both warmth and brilliance (Bozeman, 2013). Schutte (1995) notes that many singers may use air less efficiently when achieving this tone quality, especially at the outer limits of the range and at high intensities. Singers must have strength and finely-tuned muscle memory to accurately adjust airflow and subglottal pressure that maintains the desired resonance whatever the musical and expressive expectations.

Thorpe, Cala, Chapman, and Davis (2001) in “Patterns of Breath Support in the Projection of the Singing Voice” confirm that balanced aerodynamic measures positively affect resonance, and thereby, projection. In their study, when both male and female singers activate abdominal respiratory muscles and raise the rib cage, they experience enhanced formants that increase projection for all voice types (Thorpe *et al*, 2001).

Approaches to studying aerodynamic and acoustic measures

Studies of straws as training aids confirm their efficacy in providing students with consistent airflow (Finnegan, Jaiswal, Laukkanen and Titze, 2002; Laukkanen,

Horáček, Krupa, and Švec, 2012; Titze, 2016). In one study, researchers found that both male and female singers can increase lung pressure 50% to 100% phonating through a straw (Finnegan *et al.*, 2002). The studies showed that singers can maintain the increased pressure after using straw phonation.

In another study that looked at semi-occluded vocal tract exercises, including the above straw phonation, Dargin and Searl (2015) found that acoustic changes can be seen on spectrograms after using these exercises. They noted that a singer can lower the first formant 150-300 Hz with semi-occluded exercises (Dargin and Searl, 2015). The authors added that singers increased “mean F0 [fundamental frequency] on a sustained vowel, formant intensity, and intensity across the spectrum” (Dargin and Searl, 2015, p.156). More plainly put, these exercises helped study subjects be louder and more resonant.

Guzman *et al* (2013) reported in the article “Vocal Tract and Glottal Function During and After Vocal Exercising with Resonance Tube and Straw” that the acoustic spectrogram revealed after using straw exercises the singer’s formant cluster increased an average of 2.5 dB (Guzman, Laukkanen, Krupa, Horacek and Svec, 2013). This increase would make the sung tone noticeably louder without amplification, even over a full orchestra. The success of studies showing changes like these indicate that researchers can conduct similar studies of other training aids to measure their effectiveness in changing aerodynamic and acoustic measures.

Studying Aerodynamic Measures

Studies that measure singers’ airflow and subglottal pressure have given examples for the approach to this research. Björkner, Sundberg, Cleveland and Stone (2005) studied chest and head register use by female musical theater singers. In a similar 2006

study, Björkner, Sundberg and Alku measured aerodynamic rates of classically-trained baritones. In both studies, researchers capture airflow and subglottal pressure through a Rothenberg mask connected to Glottal Enterprises pressure transducers. The voice lab at the Glenn Korff School of Music at the University of Nebraska-Lincoln uses the same equipment. Protocol for these present studies follow a similar approach in which subjects sing repeated [pa] syllables at consistent volume and at 80 beats per minute.

Solomon (2014) in “Assessment of Laryngeal Airway Resistance and Phonation Threshold Pressure: Glottal Enterprises,” describes how to accurately measure subglottal pressure. Solomon (2014) recommends using the [p] during testing for a “stoppage of airflow during the closed phase” to make the best estimation of subglottal pressure. Björkner *et al* (2005) note that a vowel such as [a] that has a high first and second formant added “to the reliability of inverse filtering,” the method used to approximate the airflow rate. Although the goals for data of the present research were different from the above studies, data collection and analysis were done in a similar manner.

Studying Acoustic Measures

Omori’s Singing Power Ratio (SPR), measures the difference of the greatest harmonic peaks on long-term average spectra (LTAS) between 0 and 2 kHz and 2 and 4 kHz (Omori *et al.*, 1996). It also connects to well-balanced, consistent subglottal pressure and airflow rates (Omori *et al.*, 1996). SPR does not detect the singer’s formant around 2800 Hz, but rather the spectral energy that a singer may use and whether that energy is emphasized in the singer’s formant area between 2 and 4 kHz (Guzman *et al*, 2013; Kenny and Mitchell, 2006).

Energy ratio (ER) looks at the difference between the average harmonic peak intensity on LTAS, identifying how efficiently singers use the larynx when singing expressively to regulate respiration (Schutte, 1984). ER can find the singer's formant cluster peak rather than just one peak that might be close to the singer's formant (Ferguson, Kenny and Cabrera, 2010). A lower ER indicates that more spectral energy is present between 2 and 4 kHz (Kenny and Mitchell, 2006). The increased spectral energy allows a singer to be more clearly heard over an orchestra that has a rapidly diminishing spectral tilt above 2 kHz.

Kenny and Mitchell (2006) compared perceptual ratings to acoustic measures on LTAS to find if the SPR or ER accurately identified tonal qualities. The study found no relationship between the perceptual ratings and either SPR or ER, but there was a significant relationship between the two ratios (Kenny and Mitchell, 2006). The study indicated a statistically significant relationship may exist between the ratios, but the measures themselves may not accurately predict whether a listener perceives a good tone quality. The present study did not automatically equate a change in SPR or ER with a change in tone quality due to the lack of relationship between the perceptual ratings and the two ratios in previous studies.

Average intensity between 600 and 800 Hz is the region where the first formant lies. When acoustic intensity increases in the first formant region, the sound is perceived as fuller or warmer (Bozeman, 2013; Grenier *et al*, 2007). In the region between 900 and 1400 Hz where the second formant lies, increased intensity means vowels are more clearly defined and the tone quality brightened (Bozeman, 2013). While formants are not

measured in this research, the average intensity in these two regions will define whether perceivable change in tone quality may have occurred.

CHAPTER 3: METHODOLOGY

Subjects

The first three studies of this project collect data on subjects' aerodynamic and acoustic measures before, during, and after training aid use. The subjects were in the first two years of collegiate voice study. The case study that followed the initial three studies likewise required the subjects to be in the first two years of collegiate voice study. All subjects reported they were in good vocal health at the time of testing. The subjects were all students at the University of Nebraska-Lincoln (UNL) and volunteered for the studies. The UNL Internal Review Board (IRB) approved the three preliminary studies and case study. IRB project numbers were 16633 for the exercise band study, 17835 for the exercise ball and balance ball studies and 18657 for the case study.

The subjects were 19 to 23 years old at the time of testing. In the initial three studies, 14 students participated, six men and eight women. Two subjects, one man and one woman, did not complete all phases of testing due to illness, so their results for the first testing session are not included here. In the case study, three women and two men participated. Subjects' degree programs and number of years of previous voice study are listed in Table 3.1.

Table 3.1
Subjects of Preliminary Studies

| Subject | Age | Sex | Major | Years of Study | Training Aid Tested |
|---------|-----|--------|-------------------|----------------|---------------------|
| 1 | 19 | Male | Vocal Performance | 3 | Ex Band |
| 2 | 19 | Male | Vocal Music Ed | 2 | Ex Band |
| 3 | 19 | Male | Vocal Performance | 1 | Ex Band |
| 4 | 20 | Female | Vocal Performance | 3 | Ex Band |
| 5 | 20 | Female | Non-Music Major | 2 | Ex Band |
| 6 | 22 | Female | Vocal Music Ed | 2 | Ex Band |
| 7 | 23 | Male | Vocal Music Ed | 6 | Ex Band |
| 8 | 20 | Female | Vocal Performance | 5 | Ex Ball |
| 9 | 20 | Female | Non-Music Major | 1 | Ex Ball |
| 10 | 23 | Male | Vocal Music Ed | 6 | Ex Ball |
| 11 | 20 | Female | Vocal Performance | 5 | Balance ball |
| 12 | 20 | Female | Non-Music Major | 1 | Balance ball |

Subjects of Case Study

| Subject | Age | Sex | Major | Years of Study | Training Aid Tested |
|---------|-----|--------|----------------|----------------|---------------------|
| 1 | 19 | Female | Vocal Music Ed | 1.5 | Ex Band |
| 2 | 19 | Male | Vocal Music Ed | 1 | Ex Band |
| 3 | 20 | Female | Vocal Music Ed | 2 | Ex Band |
| 4 | 20 | Male | Vocal Music Ed | 2 | Ex Band |
| 5 | 19 | Female | Vocal Music Ed | 1 | Ex Band |

Equipment

The Glottal Enterprises Aeroview system including the PT-2E transducer with one inch long, 10 millimeter round disposable pressure tube, PT-25 transducer, OroNasal 2-chamber mask, and mask handle calculated aerodynamic data. The MS-110 and headset microphone simultaneously recorded the audio signal at a sampling rate of 44.1 kHz through the Kay-Pentax Computerized Speech Lab (CSL 4500). Calibration of the

Aeroview System was achieved using the PC-1H pressure calibrator, and FC-C flow calibrator. An Extech sound pressure level meter measured the sound pressure for both the mask and headset microphone. Subjects used the light tension Super Exercise seven-foot latex free resistance band, Unifam stability ball with Incline Fit exercise ball base, and Giantex 23” yoga ball balance trainer for the initial three studies. During the case study, each subject received their own light tension Super Exercise seven-foot resistance band. They were given specific instructions with the exercise band, exercise ball and balance ball and trained on the correct procedure by the researcher.

Research Design

Single-subject design meant subjects completed a baseline, treatment (training), and reversal (post-training) phase at each testing session. The baseline established aerodynamic and acoustic measures before using the training aid. After using the training aid in the test session, the training aid was removed in the post-training phase. The quantitative values of these tests were analyzed and statistically tested. Further qualitative information was gained through visual analysis of the test data, survey information taken before testing and practice trackers kept by case study subjects.

Procedures

Subjects sang into the OroNasal mask with pressure tube attached to the pressure transducer resting in the mouth at approximately 45 degrees. A lab assistant held the OroNasal mask over the mouth and nose so that the subject was free to use the training aid. The assistant was trained to sterilize the mask before use, to insure a proper seal around the mask for all phases and monitor the correct use of the training aid during the training phase of testing.

Subjects wore the headset microphone that recorded each test so that the sound recordings could be spectrographically analyzed. Subjects sang four short and one sustained pitch using the syllable [pa] at the tempo of 80 beats per minute, measured by a metronome for each separate testing sequence. Male subjects sang D4 (294 Hz) and female subjects sang D5 (587 Hz). These pitches were chosen because they are high enough to require the subjects to fully engage respiratory muscles. The pitch was played before each five-note sequence. Each testing session included three phases. In the first, or baseline phase, subjects sang 10 sequences without the training aid to establish a baseline for comparison. In the second or training phase, they repeated the 10 sequences with the training aid to which they had been assigned to measure any change that occurred while using it. Finally, in the third, or post-training phase, subjects sang 10 sequences without the training aid to measure whether any change persisted after the training phase. They sang the sequences with the same perceived medium-loud intensity during each phase of testing. Three testing sessions for each subject took place at approximately the same time a day, one week apart.

After the initial three studies of each training aid, a case study followed subjects using the exercise band because it showed the most potential for changing aerodynamic and acoustic measures.

Data Analysis

During data analysis, aerodynamic measures, including estimated subglottal pressure, airflow rate, pressure/airflow (glottal resistance), airflow/pressure and sound pressure level (SPL) were extracted by Glottal Enterprises' AeroviewPro software for

each sound file. For each file, three samples were taken and averaged by the software. Each file's average was combined into an overall average for each testing sequence.

Praat software 6.0.29 (Boersma and Weenink, 2017) was used to create spectrograms for visual analysis and frequency and amplitude values for each test sequence (Styler, 2017). First, using the Omori Singer's Power Ratio (SPR) approach, the difference between the highest peak intensity taken between 2 and 4 kHz and the highest peak intensity 0–2 kHz frequency bands were calculated for all subjects' trials (Omori *et al*, 1996). Second, for all subjects' test sequences, the energy ratio (ER) was calculated as the difference between average intensity in the range of 2 and 4 kHz subtracted from the average intensity in the range of 0 and 2 kHz (Kenny and Mitchell, 2007). Both measures are intended to quantify a singer's spectral intensity above 2 kHz for later statistical testing (Omori *et al*, 1996; Kenny and Mitchell, 2007).

Third, analysis and comparison of average intensities for various frequency bands, i.e. 600-800 Hz, 900-1400 Hz, and 2000-4000 Hz were made for all subjects' trials. The chosen frequency bands roughly align with the first formant and second formant frequencies of the vowel [a] between 600-1000 Hz and 900-1400 Hz respectively, and the singer's formant cluster averaging around 2800 Hz (Doscher, 1994; Sundberg, 1989; Titze, 2000; and Vennard, 1967). If average intensity increased in any of these regions, a singer may have adjusted their articulators to allow formants to better align with the sung fundamental and gain resonant quality (Bozeman, 2013). While formants are not measured here, any intensity increases may indicate further research is warranted in this area.

Paired sample t-tests compared individual subject's aerodynamic and acoustic measures in baseline, training and post-training phases to ascertain if statistically significant change occurred and persisted. The training aid that showed, on average, the most significant change was chosen to be used in the case study.

Validity and Reliability

The sample sizes of the present studies were small limiting their generalizability. It is impossible to avoid all threats to validity and reliability. That said, subjects' results were consistent showing no outliers during the three repeated testing sessions. The data also showed statistical consistency indicating the studies reliably measured subjects' levels. The phases of the three testing sessions were averaged to eliminate threat to validity from unreported illness or fatigue during testing or improvement due to a subject learning the process.

The subjects were volunteers. They may not fully represent all students in their first two years of college voice study. A survey of their singing experience indicated that the nineteen subjects had a wide-ranging number of years of experience, from six years to less than one year of voice lessons.

The subjects also did not participate in the testing of all three training aids. The preliminary studies do not compare the training aids' effectiveness with the same subjects limiting the reliability of the comparative results. As outlined in the studies' methodologies, subjects repeated the testing procedure three times to insure reliable individual results. While the results are not generalizable to a larger population, this research revealed how using one of the training aids affected singers according to their

unique strengths and weaknesses. It can serve as a guide to choosing the training methods that would most effectively address a singer's challenges.

The subjects were all studying voice in applied lessons while they completed testing; therefore, these lessons may have influenced the aerodynamic and acoustic output of subjects outside of the use of the training aids. Subjects each may have changes also due to maturation especially considering all were between 19 and 23 years old while completing the testing. Some of the subjects as well may have been more physically active than others. For these subjects, training aids may not have shown as much influence over the more active students' measures tested

The researcher and lab assistants trained using the equipment before testing began. They followed the prescribed testing protocol each session. Calibration of the equipment was done at the beginning of each testing session and repeated if any output base levels suddenly changed during the session. When calibration was repeated, the session began over after the second calibration. These recorded calibration values ensured that the day's environment and instrumentation levels were considered during analysis.

Summary

Every effort was made to consistently measure the aerodynamic and acoustic measures of the subjects. The aerodynamic results, however, cannot be compared to previous studies as many factors influence aerodynamic levels and a wide range is possible. Acoustic measures have much more consistent established ranges.

To accurately measure both aerodynamic and acoustic measures, the equipment was calibrated for all three testing sessions. Calibration information was used during both aerodynamic and acoustic data analysis. Although every effort was made to test the

subjects accurately and without outside influence, it is impossible to avoid change caused by subjects' training in voice lessons outside the studies or other factor such as unreported illness. Subjects data was averaged over three testing sessions to mitigate some changes due to these outside influences.

CHAPTER 4: RESULTS OF PRELIMINARY EXERCISE BAND STUDY

The results of this preliminary study showed change in subjects' aerodynamic and acoustic measures when they used the exercise band during testing and some persisting change when they tested after using the exercise band. The seven subjects showed both a variety of baseline measures and of direction of change. Because of the wide variety, statistical analysis was important to reveal what aerodynamic and acoustic measures were significantly different between testing phases.

Exercise Band Methodology

Before testing began subjects stood on the middle portion of the band and marked where their feet would be shoulder width apart (Figure 4.1). These markings guided subjects where to stand so that they used a consistent amount of resistance in each testing session. During the second phase of testing, subjects pulled up on the ends of the band, and raised the forearms so that they were parallel to the floor. Because subjects needed to use both hands to pull up on the band during the second phase of testing, a research assistant held the mask for all three testing phases to insure consistent placement.

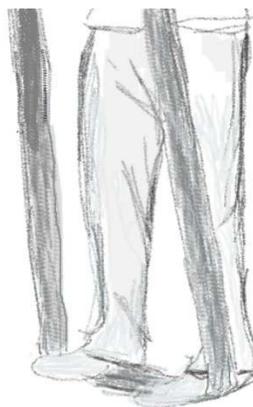


Figure 4.1 Method Used with Exercise Band in the First Preliminary Study. Grives, J. (2019).

Subjects

Subject 1 is a tenor who was 19 years old and in his first year as a vocal performance major. Subject 2 is a baritone who was 20 years old in his second year of voice study as a music education major. Subject 3 is a tenor who was 19 years old and a first-year vocal performance major. Subject 4 is a mezzo-soprano who was 20 years old and in her second year as a vocal performance major. Subject 5 is a mezzo-soprano who was 20 years old in her second year of voice study as a music minor. Subject 6 is a soprano who was 21 years old and in her second year as a music education major. Subject 7 is a baritone who was 22 years old and in his second year as a music education major.

Aerodynamic Results

Subjects' averaged aerodynamic rates show increased subglottal pressure and airflow between the baseline and training phases (Table 4.1). After using the exercise band, these subjects showed some persisting aerodynamic change, although not at the same levels of the training phase. During the post-training phase, subjects on average showed a decrease in both subglottal pressure and airflow rates, but the average remained above the baseline measure.

Glottal resistance, calculated by dividing subglottal pressure by airflow rate, is an important ratio to consider as too little resistance results in a breathy tone and diminished breath efficiency. More glottal resistance may result in greater efficiency, but too much resistance can result in a pressed tone. On average subjects' glottal resistance was lower during the training phase when subglottal pressure also increased for all seven subjects (Table 4.1). Subjects showed a decrease in glottal resistance during the post-training phase, but the average was above the baseline measure.

Table 4.1

All Exercise Band Subjects Individual and Averaged Phase Results for Average Subglottal Pressure (cm of H₂O)

| Phase | Sub 1 | Sub2 | Sub 3 | Sub 4 | Sub 5 | Sub 6 | Sub 7 | Average |
|---------------|-------|-------|-------|-------|-------|-------|-------|---------|
| Baseline | 15.04 | 15.67 | 15.65 | 12.71 | 12.03 | 5.06 | 9.88 | 12.29 |
| Training | 16.16 | 15.97 | 18.01 | 13.75 | 14.31 | 5.83 | 10.10 | 13.44 |
| Post-Training | 15.51 | 15.92 | 17.91 | 12.83 | 13.46 | 4.98 | 9.87 | 12.80 |

All Exercise Band Subjects Individual and Averaged Phase Results for Average Airflow Rate (ml per sec.)

| Phase | Sub 1 | Sub2 | Sub 3 | Sub 4 | Sub 5 | Sub 6 | Sub 7 | Average |
|---------------|-------|------|-------|-------|-------|-------|-------|---------|
| Baseline | 433 | 310 | 331 | 367 | 452 | 264 | 426 | 369 |
| Training | 552 | 319 | 448 | 351 | 442 | 273 | 432 | 402 |
| Post-Training | 522 | 310 | 430 | 343 | 451 | 271 | 316 | 378 |

All Exercise Band Subjects Individual and Averaged Phase Results for Average Glottal Resistance ($P_{\text{sub}}/\text{Airflow}$)

| Phase | Sub 1 | Sub2 | Sub 3 | Sub 4 | Sub 5 | Sub 6 | Sub 7 | Average |
|---------------|--------|--------|--------|--------|--------|--------|--------|---------|
| Baseline | 0.0347 | 0.0505 | 0.0473 | 0.0347 | 0.0266 | 0.0192 | 0.0232 | 0.0333 |
| Training | 0.0293 | 0.0501 | 0.0402 | 0.0392 | 0.0324 | 0.0214 | 0.0234 | 0.0334 |
| Post-Training | 0.0297 | 0.0513 | 0.0417 | 0.0373 | 0.0298 | 0.0184 | 0.0312 | 0.0342 |

All Exercise Band Subjects Individual and Averaged Phase Results for SPL (dB)

| Phase | Sub 1 | Sub2 | Sub 3 | Sub 4 | Sub 5 | Sub 6 | Sub 7 | Average |
|---------------|--------|--------|-------|-------|--------|-------|-------|---------|
| Baseline | 102.26 | 99.98 | 90.56 | 99.91 | 104.86 | 78.91 | 87.77 | 94.89 |
| Training | 104.67 | 100.45 | 99.93 | 99.71 | 104.85 | 76.39 | 87.93 | 96.28 |
| Post-Training | 104.52 | 100.37 | 99.58 | 99.38 | 104.73 | 77.16 | 85.83 | 95.94 |

All Exercise Band Subjects Individual and Averaged Phase Results for Vocal Efficiency ($\text{SPL}/P_{\text{sub}} * \text{Airflow}$)

| Phase | Sub 1 | Sub2 | Sub 3 | Sub 4 | Sub 5 | Sub 6 | Sub 7 | Average |
|---------------|--------|--------|--------|--------|--------|--------|--------|---------|
| Baseline | 0.0157 | 0.0206 | 0.0175 | 0.0214 | 0.0193 | 0.0590 | 0.0208 | 0.0210 |
| Training | 0.0117 | 0.0197 | 0.0124 | 0.0207 | 0.0166 | 0.0481 | 0.0202 | 0.0178 |
| Post-Training | 0.0129 | 0.0203 | 0.0129 | 0.0226 | 0.0172 | 0.0573 | 0.0275 | 0.0198 |

Vocal efficiency (VE), calculated by dividing SPL by subglottal pressure times airflow provides an objective measure of a singer's respiration efficiency (Schutte, 1984). If airflow rate is constant while a subject shows an increasing SPL and subglottal pressure, the subject's vocal efficiency will not be as high. When subjects showed a subglottal pressure increase, SPL usually was approximately one decibel higher. An increase in subglottal pressure and SPL during the training phase meant that the average subject vocal efficiency was lower than the average baseline measure. Subjects' lower average SPL and subglottal pressure during the post-training phase combined for a small vocal efficiency increase over the baseline measure (Table 4.1).

All Exercise Band Subjects' Aerodynamic Measures Paired Samples T-Test Results

Paired t-tests analyzing the average aerodynamic measures between the baseline, training and post-training phases revealed that the average change in subglottal pressure was significant (Table 4.2). Between the baseline and training phases, the average difference in subglottal pressure had a small effect size at 0.28. The average airflow measures between the training phase and the post-training phase also showed a significant difference with an effect size of 0.24 (Table 4.2). These two effect sizes are considered small, but large enough to effect a noticeable change in tone production. Analysis revealed other significant differences in subglottal pressure and vocal efficiency, but their effect sizes were not large enough to be noticeable.

Table 4.2

Significant Results of All Subjects Average Aerodynamic Measures Paired Samples T-Test between Baseline Phase and Training Phase for Exercise Band, n=21, df=20, CI=95%

| Variable | Paired differences | | | Cohen's <i>d</i> | <i>t</i> | <i>p</i> |
|------------------|--------------------|------|-----------------|------------------|----------|----------|
| | Mean | SD | CI Lower, Upper | | | |
| P _{sub} | -1.15 | 1.15 | -1.67, -0.63 | 0.28 | 4.59 | <0.0001 |
| VE | 0.1 | 0.01 | 0, 0 | 0.01 | 2.48 | 0.022 |

Significant Results of All Subjects Average Aerodynamic Measures Paired Samples T-Test between Training Phase and Post-Training Phase for Exercise Band, n=15, df=14, CI=95%

| Variable | Paired differences | | | Cohen's <i>d</i> | <i>t</i> | <i>p</i> |
|------------------|--------------------|-------|-----------------|------------------|----------|----------|
| | Mean | SD | CI Lower, Upper | | | |
| P _{sub} | 0.54 | 0.59 | 0.27, 0.82 | 0.13 | 4.2 | <0.0001 |
| Airflow | 26.07 | 54.95 | 1.06, 51.08 | 0.24 | 2.17 | 0.042 |

Significant Results of All Subjects Average Aerodynamic Measures Paired Samples T-Test between the Baseline Phase and Post-Training Phase for Exercise Band, n=15, df=14, CI=95%

| Variable | Paired differences | | | Cohen's <i>d</i> | <i>t</i> | <i>p</i> |
|------------------|--------------------|------|-----------------|------------------|----------|----------|
| | Mean | SD | CI Lower, Upper | | | |
| P _{sub} | -0.6 | 1.28 | -1.19, -0.02 | 0.15 | 2.16 | 0.043 |

Note: SD = standard deviation; CI = confidence interval; Cohen's d = effect level; p < 0.05 = significant (2-tailed).

Individual Aerodynamic Results

Subject 1 and subject 6 showed favorable observed results in both aerodynamic and acoustic measures. Many of the differences between phases were significant. Subject 1 stood out as a singer who was often singing with balanced respiration that resulted in acoustic data that showed he had a perceivable ringing tone quality. During testing, he still positively reacted to training with the exercise band despite his more advanced technique for his age. Subject 6 had relatively low baseline aerodynamic and acoustic

measures. She showed dramatic and significant change in some of these measures when she used the exercise band during testing and immediately after.

Subject 1, like the average subject measures, showed an increase in subglottal pressure in the training phase (Table 4.1). In the post-training phase, he showed a lower subglottal pressure than the training phase, but still higher than the baseline measure. Subject 1 showed a large increase in airflow rate during the training phase, followed by a decrease in the post-training phase. Subject 1's overall airflow increase was larger than his subglottal pressure increase showing as lower glottal resistance in the post-training phase. Subject 1 showed a substantial increase in SPL that together with the increases in subglottal pressure and airflow effected a decrease in vocal efficiency even though glottal resistance was also lower. All of subject 1's changes persisted after he used the exercise band.

Subject 6 showed increasing subglottal pressure during the training phase (Table 4.1). During the post-training phase, she showed decreasing subglottal pressure that was lower than the baseline measure. Subject 6's airflow rate was nearly constant in each phase, changing less than 3% overall. Her glottal resistance showed a decline in the post-training phase that was lower than baseline because of the decreasing subglottal pressure and consistent airflow. Lower glottal resistance in this case did not allow subject 6 to be more aerodynamically efficient. She showed a decrease in vocal efficiency during the training phase with an increase during the post-training phase that moved close to, but not higher, than baseline. Subject 6 showed a persisting change in the airflow measure after using the exercise band.

Individual Aerodynamic Measures Paired Samples T-Test Results

Subject 1 showed significant change between the baseline phase and training phase in all aerodynamic measures (Table 4.3). The effect sizes were moderate to large. Between the training phase and the post-training phase, subject 1 did not show any significant change. The lack of significant change confirms the persisting change that subject 1 showed in the raw aerodynamic data.

Table 4.3

Significant Results of Subject 1's Aerodynamic Measures Paired Samples T-Test between Baseline Phase and Training Phase for Exercise Band, n=30, df=29, CI=95%

| Variable | Paired differences | | | Cohen's <i>d</i> | <i>t</i> | <i>p</i> |
|------------------|--------------------|--------|-----------------|------------------|----------|----------|
| | Mean | SD | CI Lower, Upper | | | |
| P _{sub} | -1.11 | 2.04 | -1.87, -0.35 | 0.54 | 2.98 | 0.006 |
| Airflow | -118.7 | 214.62 | -198.84, -38.56 | 0.84 | 3.03 | 0.005 |
| GR | 0 | 0.01 | 0, 0.01 | 1.00 | 2.3 | 0.029 |
| SPL | -2.41 | 2.82 | -3.46, -1.36 | 0.54 | 4.69 | <0.0001 |
| VE | 0 | 0.01 | 0, 0.01 | 1.00 | 4.31 | <0.0001 |

Note: SD = standard deviation; CI = confidence interval; Cohen's d = effect level; p < 0.05 = significant (2-tailed).

Another indication that subject 1's changes persisted is the significant differences between the baseline and post-training phase (Table 4.4). Subject 1 showed significant change in all aerodynamic measures except subglottal pressure. The effect sizes again were moderate to large.

Table 4.4

Significant Results of Subject 1's Aerodynamic Measures Paired Samples T-Test between Baseline Phase and Post-Training Phase for Exercise Band, $n=30$, $df=29$, $CI=95\%$

| Variable | Paired differences | | | Cohen's <i>d</i> | <i>t</i> | <i>p</i> |
|----------|--------------------|--------|-----------------|------------------|----------|----------|
| | Mean | SD | CI Lower, Upper | | | |
| Airflow | -88.67 | 162.65 | -149.4, -27.93 | 0.72 | 2.99 | 0.006 |
| GR | 0 | 0.01 | 0, 0.01 | 1.00 | 2.91 | 0.007 |
| SPL | -2.26 | 3.29 | -3.49, -1.03 | 0.50 | 3.77 | 0.001 |
| VE | 0 | 0.01 | 0, 0.01 | 1.00 | 3.84 | 0.001 |

Subject 6 showed significant change in subglottal pressure and SPL between the baseline and training phases (Table 4.5). The effect sizes were moderate for these two significant measures. Her change in subglottal pressure between the training phase and post-training phase was also significant, reflecting its decrease to below the baseline measure. None of subject 6's aerodynamic measures showed significance between the baseline phase and post-training phase. This result confirms the observed data that many of subject 6's aerodynamic measures were close to the baseline results after she used the exercise band.

Table 4.5

Significant Results of Subject 6's Aerodynamic Measures Paired Samples T-Test between Baseline Phase and Training Phase for Exercise Band, $n=30$, $df=29$, $CI=95\%$

| Variable | Paired differences | | | Cohen's d | t | p |
|-----------|--------------------|------|-----------------|-------------|------|-------|
| | Mean | SD | CI Lower, Upper | | | |
| P_{sub} | -0.77 | 1.59 | -1.36, -0.17 | 0.44 | 2.64 | 0.013 |
| SPL | 2.52 | 6.11 | 0.24, 4.8 | 0.35 | 2.26 | 0.032 |

Significant Results of Subject 6's Aerodynamic Measures Paired Samples T-Test between Training Phase and Post-Training Phase for Exercise Band, $n=30$, $df=29$, $CI=95\%$

| Variable | Paired differences | | | Cohen's d | t | p |
|-----------|--------------------|------|-----------------|-------------|-----|-------|
| | Mean | SD | CI Lower, Upper | | | |
| P_{sub} | 0.96 | 1.88 | 0.26, 1.67 | 0.55 | 2.8 | 0.009 |

Note: SD = standard deviation; CI = confidence interval; Cohen's d = effect level; $p < 0.05$ = significant (2-tailed).

Acoustic Results

As previously noted in chapter 2, singers have more perceived acoustic energy between 2 and 4 kHz when they show an increase in subglottal pressure and SoSPL (Fangan, 2008; Titze 2004). These subjects showed an increase in maximum intensity between 2 and 4 kHz during the training phase and again during the post-training phase (Table 4.6). These increases relate to the average increase seen in subjects' subglottal pressure and Sound Pressure Level (SPL). Subjects showed decreasing maximum intensity between 0 and 2 between the baseline phase and the training phase (Table 4.6).

The increase in maximum intensity between 2 and 4 kHz accounts for the lower Singing Power Ratio (SPR) during the training phase and the post-training phase (Table 4.6). As an objective measure of increased spectral energy, the decrease indicates that the spectral tilt between 2 and 4 kHz was shallower. Subjects' ability to project was likely

strengthened both when they used the training and after in comparison to the baseline measure.

Table 4.6

All Exercise Band Subjects Individual and Averaged Phase Results for Maximum Intensity 0-2 kHz (dB)

| Phase | Sub 1 | Sub2 | Sub 3 | Sub 4 | Sub 5 | Sub 6 | Sub 7 | Average |
|---------------|-------|-------|-------|-------|-------|-------|-------|---------|
| Baseline | 49.04 | 45.83 | 52.36 | 44.92 | 50.78 | 51.50 | 51.00 | 49.35 |
| Training | 49.47 | 45.95 | 52.78 | 44.47 | 50.45 | 52.10 | 51.12 | 49.48 |
| Post-Training | 48.28 | 46.03 | 52.68 | 44.21 | 50.37 | 53.49 | 52.19 | 49.61 |

All Exercise Band Subjects Individual and Averaged Phase Results for Maximum Intensity 2-4 kHz (dB)

| Phase | Sub 1 | Sub2 | Sub 3 | Sub 4 | Sub 5 | Sub 6 | Sub 7 | Average |
|---------------|--------|--------|-------|-------|-------|-------|-------|---------|
| Baseline | 11.12 | 8.5961 | 9.213 | 5.56 | 7.50 | 9.59 | 7.39 | 8.45 |
| Training | 11.200 | 8.6007 | 9.238 | 6.10 | 7.69 | 14.94 | 8.70 | 9.50 |
| Post-Training | 11.204 | 8.6012 | 9.218 | 6.03 | 6.98 | 13.68 | 9.67 | 9.33 |

All Exercise Band Subjects Individual and Averaged Phase Results for SPR (Max Intensity 0-2 kHz – Max Intensity 2-4 kHz)

| Phase | Sub 1 | Sub2 | Sub 3 | Sub 4 | Sub 5 | Sub 6 | Sub 7 | Average |
|---------------|-------|-------|-------|-------|-------|-------|-------|---------|
| Baseline | 37.92 | 37.24 | 43.15 | 39.36 | 43.29 | 41.91 | 43.61 | 40.92 |
| Training | 38.27 | 37.35 | 43.54 | 38.36 | 42.76 | 37.16 | 42.42 | 39.98 |
| Post-Training | 37.08 | 37.43 | 43.46 | 38.19 | 43.38 | 39.81 | 42.53 | 40.27 |

Subjects showed an increasing average intensity between 0 and 2 kHz between baseline and training phases followed by a small decrease in the post-training phase (Table 4.7). Subjects showed a decrease in average intensity between 2 and 4 kHz during the training phase. Their average intensity between 2 and 4 kHz was higher in the post-training phase, but not as high as the baseline measure. With the loss of acoustic energy above 2 kHz subjects showed an increase in ER over the baseline measure. The result suggests that most subjects' average spectral energy above 2 kHz may diminish while they use the exercise band.

Table 4.7

All Exercise Band Subjects Individual and Averaged Phase Results for Average Intensity 0-2 kHz (dB)

| Phase | Sub 1 | Sub2 | Sub 3 | Sub 4 | Sub 5 | Sub 6 | Sub 7 | Average |
|---------------|-------|-------|-------|-------|-------|-------|-------|---------|
| Baseline | 28.18 | 21.88 | 22.41 | 13.97 | 21.75 | 17.07 | 20.26 | 20.79 |
| Training | 27.66 | 22.13 | 22.78 | 14.10 | 22.70 | 18.84 | 20.62 | 21.26 |
| Post-Training | 27.02 | 21.38 | 22.16 | 13.98 | 21.79 | 20.11 | 21.45 | 21.13 |

All Exercise Band Subjects Individual and Averaged Phase Results for Average Intensity 2-4 kHz (dB)

| Phase | Sub 1 | Sub2 | Sub 3 | Sub 4 | Sub 5 | Sub 6 | Sub 7 | Average |
|---------------|-------|------|-------|-------|-------|-------|-------|---------|
| Baseline | 5.31 | 1.98 | 2.84 | 6.50 | 1.57 | -3.96 | 5.23 | 2.78 |
| Training | 4.80 | 2.13 | 2.72 | 6.34 | 1.45 | -1.15 | 4.55 | 2.98 |
| Post-Training | 6.95 | 2.18 | 2.62 | 6.45 | 1.31 | 2.04 | 4.34 | 3.70 |

All Exercise Band Subjects Individual and Averaged Phase Results for ER (Avg Intensity 0-2 kHz – Avg Intensity 2-4 kHz)

| Phase | Sub 1 | Sub2 | Sub 3 | Sub 4 | Sub 5 | Sub 6 | Sub 7 | Average |
|---------------|-------|-------|-------|-------|-------|-------|-------|---------|
| Baseline | 22.87 | 19.91 | 19.56 | 7.47 | 20.19 | 21.03 | 15.03 | 18.01 |
| Training | 22.86 | 20.00 | 20.06 | 7.76 | 21.26 | 19.99 | 16.07 | 18.29 |
| Post-Training | 20.07 | 19.20 | 19.54 | 7.52 | 20.48 | 18.07 | 17.12 | 17.43 |

Even though subjects showed a small increase in the training phase, on average subjects experienced a decrease in average intensity between 600 and 800 Hz in the post-training phase (Table 4.8). This frequency region is where the first formant usually lies for most vowels. In contrast subjects showed an increase in average intensity between 900 and 1400 Hz during the training and the post-training phases (Figure 4.8).

Table 4.8

All Exercise Band Subjects Individual and Averaged Phase Results for Average Intensity 600-800 Hz (dB)

| Phase | Sub 1 | Sub2 | Sub 3 | Sub 4 | Sub 5 | Sub 6 | Sub 7 | Average |
|---------------|-------|-------|-------|-------|-------|-------|-------|---------|
| Baseline | 33.42 | 24.07 | 20.82 | 21.17 | 28.11 | 32.00 | 24.35 | 26.27 |
| Training | 34.40 | 24.14 | 21.16 | 19.80 | 29.42 | 32.93 | 24.79 | 26.66 |
| Post-Training | 31.85 | 22.64 | 19.97 | 19.61 | 28.41 | 33.29 | 26.11 | 25.98 |

All Exercise Band Subjects Individual and Averaged Phase Results for Average 900-1400 Hz (dB)

| Phase | Sub 1 | Sub2 | Sub 3 | Sub 4 | Sub 5 | Sub 6 | Sub 7 | Average |
|---------------|-------|-------|-------|-------|-------|-------|-------|---------|
| Baseline | 30.77 | 17.11 | 17.22 | 14.01 | 21.52 | 25.85 | 19.20 | 20.81 |
| Training | 29.12 | 16.85 | 17.54 | 13.45 | 22.10 | 26.89 | 20.10 | 20.86 |
| Post-Training | 29.91 | 16.23 | 17.04 | 13.82 | 22.35 | 26.88 | 20.98 | 21.03 |

Paired t-tests analyzed the average acoustic results of the exercise band subjects.

No significant differences were found between any of the three phases. The lack of significance was due to the wide variation in amount of change made by individual subjects.

Individual Acoustic Results

Subject 1 showed an overall decrease in maximum intensity between 0 and 2 kHz (Table 4.6). During the training and the post-training phases, subject 1 showed an increase in maximum intensity between 2 and 4 kHz resulting a decrease in SPR during the post-training phase (Table 4.6). On subject 1's average LTAS, the increase during the training phase is shown with a red line and the increase during the post-training phase with a black line (Figure 4.2).

Between 0 and 2 kHz, subject 1 showed a decrease in average intensity in the training phase and post-training phase (Table 4.7). Between 2 and 4 kHz, subject 1's average intensity was lower during the training phase, but it was higher during the post-

training phase. This increase can be seen on the LTAS as the black line peak widening between 2.5 and 3 kHz and a shallower spectral tilt above 2 kHz indicating intensified acoustic energy (Figure 4.2). Subject 1's LTAS also shows that the frequency peak above 2 kHz was just above 2.5 kHz during the baseline and training phases. During the post-training phase, it was near 2.7 kHz. The frequency change indicates that subject 1 possibly lowered his laryngeal position after using the exercise band for an increase in perceived resonant tone quality (Bozeman, 2013).

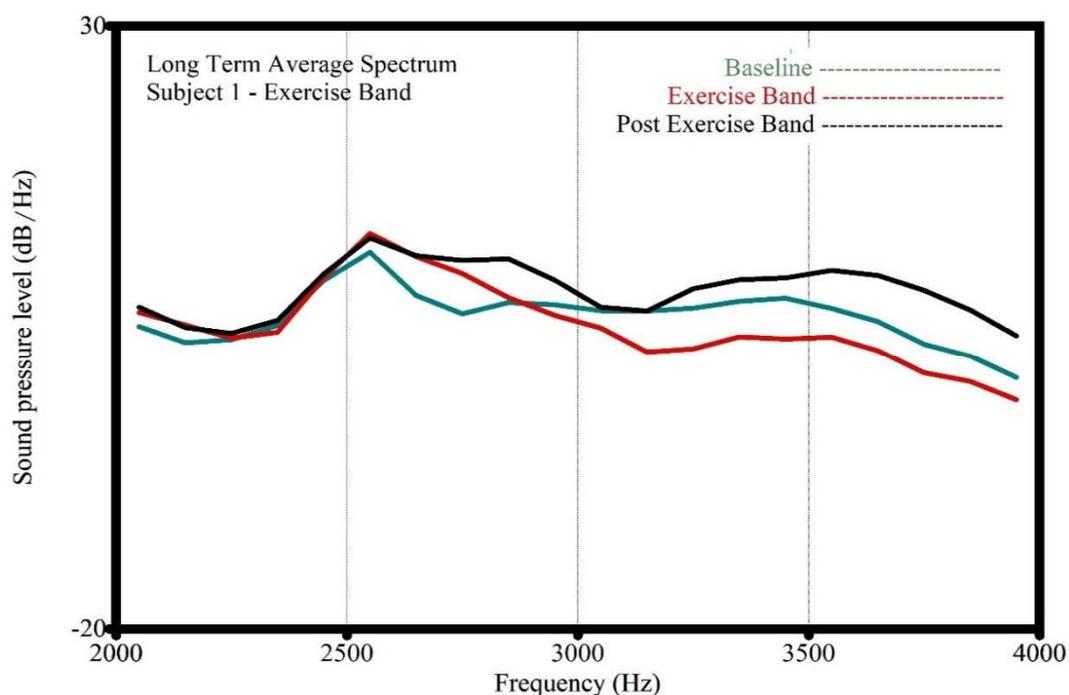


Figure 4.2 Exercise Band Subject 1's Long-Term Average Spectra 2-4 kHz of Three Averaged Phases

Subject 6 showed an overall increase in all acoustic intensity measures. She was the only subject to show this kind of consistent beneficial change. In both maximum intensity measures between 0 and 2 kHz and between 2 and 4 kHz subject 6 showed an increase during the training and post-training phases (Table 4.6). Because of the increase

above 2 kHz, subject 6's SPR was lower between the baseline and post-training phases, indicating increased spectral energy above 2 kHz.

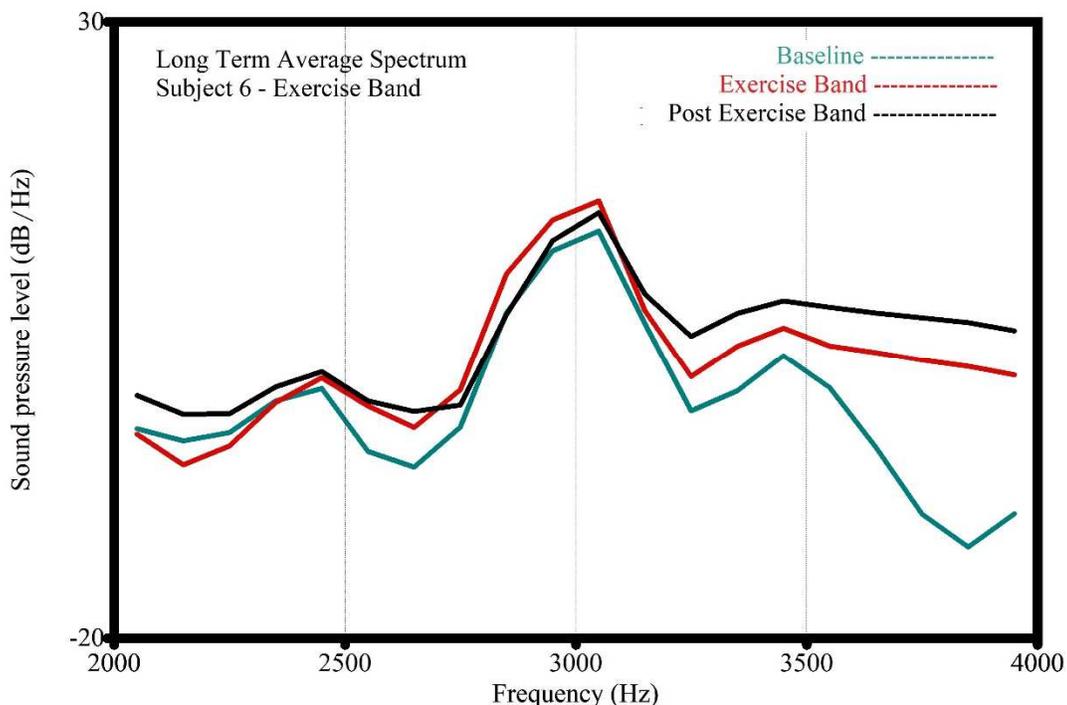


Figure 4.3 Exercise Band Subject 6's Long-Term Average Spectra 2-4 kHz of Three Averaged Phases

Subject 6 showed another increase in average intensity between 0 and 2 kHz and between 2 and 4 kHz during the training and post-training phases. The widening black post-training peaks on the LTAS reflect the increased average intensity between 2 and 4 kHz (Figure 4.3). Both the red training phase line and the black post-training phase line on the LTAS show a shallow decline in subject 6's spectral tilt above 3.5 kHz reflecting her decreasing ER measure.

Individual Subjects' Acoustic Measures Paired Samples T-Test Results

Subject 1 did not show significant change in acoustic measures between the baseline and training phases. His significant acoustic differences occurred between the training phase and post-training phases when he showed seven significant favorable

changes seemingly in response to using the exercise band (Table 4.9). The significant differences in four of these measures, average intensity between 2 and 4 kHz, ER, average intensity between 600 and 800 Hz and peak frequency between 2 and 4 kHz had moderate or large effect sizes.

Table 4.9

Significant Results of Subject 1's Acoustic Measures Paired Samples T-Test between Baseline Phase and Training Phase for Exercise Band, n=30, df=29, CI=95%

| Variable | Paired differences | | | Cohen's <i>d</i> | <i>t</i> | <i>p</i> |
|--------------------|--------------------|-------|-----------------|------------------|----------|----------|
| | Mean | SD | CI Lower, Upper | | | |
| Max Int 0-2 kHz | 1.19 | 2.05 | 0.42, 1.95 | 0.37 | 3.17 | 0.004 |
| SPR | 1.19 | 3.19 | 0, 2.38 | 0.29 | 2.04 | 0.049 |
| Avg Int 0-2 kHz | 0.64 | 1.69 | 0, 1.27 | 0.21 | 2.06 | 0.049 |
| Avg Int 2-4 kHz | -2.15 | 3.46 | -3.44, -0.86 | 0.86 | 3.4 | 0.002 |
| ER | 2.86 | 4.31 | 1.25, 4.47 | 0.71 | 3.63 | 0.001 |
| Avg Int 600-800 Hz | 2.55 | 2.84 | 1.49, 3.61 | 0.61 | 4.92 | <0.0001 |
| Peak Freq 2-4 kHz | -113.2 | 208.3 | -190.96, -35.42 | 0.63 | 2.98 | 0.006 |

Note: SD = standard deviation; CI = confidence interval; Cohen's d = effect level; p < 0.05 = significant (2-tailed).

Subject 1 showed more significant change between the baseline and post-training phases. The significant change was in the same four acoustic measures that had moderate or large effect sizes between the training and post-training phases above (Table 4.10). The significant change in average intensity between 600 and 800 Hz, or in the first formant region, indicates that subject 1 experienced increased warmth or depth of tone both while he used the exercise band and immediately after. The significant differences in ER, driven by the change in average intensity between 2 and 4 kHz indicate that subject 1 also experienced more ringing quality.

Table 4.10

Significant Results of Subject 1's Acoustic Measures Paired Samples T-Test between Baseline Phase and Post-Training Phase for Exercise Band $n=30$, $df=29$, $CI=95\%$

| Variable | Paired differences | | | Cohen's <i>d</i> | <i>t</i> | <i>p</i> |
|--------------------|--------------------|-------|-----------------|------------------|----------|----------|
| | Mean | SD | CI Lower, Upper | | | |
| Avg Int 2-4 kHz | -1.64 | 2.3 | -2.5, -0.78 | 0.63 | 3.9 | 0.001 |
| ER | 2.8 | 3.55 | 1.47, 4.12 | 0.59 | 4.32 | <0.0001 |
| Avg Int 600-800 Hz | 1.57 | 3.13 | 0.4, 2.73 | 0.42 | 2.74 | 0.01 |
| Peak Freq 2-4 kHz | -142.6 | 212.3 | -221.83, -63.3 | 0.80 | 3.68 | 0.001 |

Note: SD = standard deviation; CI = confidence interval; Cohen's d = effect level; $p < 0.05$ = significant (2-tailed).

Subject 6's increases in acoustic intensity also were significant differences. She showed a significant difference in seven measures between the baseline and training phases (Table 4.11). As seen in the observed data, subject 6 showed further changes in the post-training phase. The paired samples t-test comparing the training and post-training phases showed significant differences in five of these changes (Table 4.11). Because subject 6's changes during the post-training phase were often further away from the baseline levels, the paired samples t-test showed more significant differences between the baseline and post-training phases (Table 4.11).

Table 4.11

Significant Results of Subject 6's Acoustic Measures Paired Samples T-Test between Baseline Phase and Training Phase for Exercise Band, n=30, df=29, CI=95%

| Variable | Paired differences | | | Cohen's <i>d</i> | <i>t</i> | <i>p</i> |
|---------------------|--------------------|-------|-----------------|------------------|----------|----------|
| | Mean | SD | CI Lower, Upper | | | |
| Max Int 2-4 kHz | -5.17 | 5.33 | -7.16, -3.18 | 1.29 | 5.31 | <0.0001 |
| SPR | 4.6 | 3.52 | 3.29, 5.92 | 1.46 | 7.16 | <0.0001 |
| Avg Int 0-2 kHz | -1.78 | 1.69 | -2.41, -1.15 | 0.38 | 5.78 | <0.0001 |
| Avg Int 2-4 kHz | -2.94 | 2.1 | -3.44, -0.86 | 0.67 | 7.64 | <0.0001 |
| Avg Int 600-800 Hz | -0.84 | 2.07 | -1.61, -0.06 | 0.20 | 2.21 | 0.035 |
| Avg Int 900-1400 Hz | -0.98 | 2.5 | -1.91, -0.04 | 0.25 | 2.14 | 0.041 |
| Peak Freq 0-2 kHz | 113.2 | 208.3 | -191, -35.4 | 0.56 | 2.98 | 0.006 |

Significant Results of Paired Samples T-Test between Acoustic Measures Baseline Phase and Post-Training Phase for Exercise Band Subject 6, n=30, df=29, CI=95%

| Variable | Paired differences | | | Cohen's <i>d</i> | <i>t</i> | <i>p</i> |
|--------------------|--------------------|------|-----------------|------------------|----------|----------|
| | Mean | SD | CI Lower, Upper | | | |
| Max Int 0-2 kHz | -1.95 | 2.27 | -2.8, -1.11 | 0.44 | 4.72 | <0.0001 |
| Max Int 2-4 kHz | -3.84 | 3.63 | -5.19, -2.48 | 0.57 | 5.8 | <0.0001 |
| SPR | 1.88 | 2.4 | 0.99, 2.78 | 0.67 | 4.3 | <0.0001 |
| Avg Int 0-2 kHz | -1.71 | 1.52 | -2.27, -1.14 | 0.37 | 6.15 | <0.0001 |
| Avg Int 2-4 kHz | -6.13 | 2.5 | -7.06, -5.19 | 1.61 | 13.4 | <0.0001 |
| Avg Int 600-800 Hz | -1.02 | 1.6 | -1.61, -0.42 | 0.23 | 3.5 | 0.002 |

Note: SD = standard deviation; CI = confidence interval; Cohen's d = effect level; p < 0.05 = significant (2-tailed).

Summary

Both subject 1 and subject 6 showed change in aerodynamic and acoustic measures while using the exercise band. Some of this change increased after they used the exercise band. Subject 1 made many persisting or increasing changes to aerodynamic measures. His additional significant acoustic changes did not occur in tandem with the aerodynamic changes, so it is unclear whether respiration change affects acoustic change.

He likely had some change in muscular engagement or alignment or both to significantly change the aerodynamic and acoustic measures.

While subject 6 showed less change to aerodynamic measures than subject 1, she showed increasing changes to all acoustic intensity measures. Her acoustic changes, like subject 1's, did not appear to occur with or because of the aerodynamic changes. She may have experienced alignment adjustments from tension release after using the exercise band that affected her acoustic output.

All subjects in the exercise band testing showed some significant change in at least a few measures. On average, exercise band subjects showed increases in subglottal pressure, airflow, glottal resistance and a related decrease in vocal efficiency. Subjects showed persisting changes in these aerodynamic measures. Average intensity change was higher than the baseline in the measures above 2 kHz in both training and post-training phases. Below 2 kHz, change was more varied. It appears from these results that using the exercise band may affect singers differently, but can be instrumental creating change in muscular engagement, alignment or some other factor that persists or increases after using the exercise band.

CHAPTER 5: RESULTS OF PRELIMINARY EXERCISE BALL STUDY

The results of the exercise ball study showed change in subjects' aerodynamic and acoustic measures but did not show the same amount of persisting change as the exercise band study. Statistical analysis supported the observed data that indicated subjects showed more change during the training phase of testing, when subjects used the exercise ball, than during the post-training phase.

Exercise Ball Methodology

In this study subjects sat on a fully inflated ball before testing (Figure 5.1). If the subject could not sit on the ball so that knees were at a 90-degree angle, the ball was inflated or deflated slightly to reach the right level. The ball was measured so that the same diameter was used for all three testing sessions. Maintaining a 90-degree angle at the knees was important to insure a relaxed, open posture that allowed consistent core muscle engagement. It was also safer as subjects could balance themselves on the ball better when their feet rested comfortably on the floor. An exercise ball base was also used to prevent the exercise ball from rolling. In the training phase of each testing session, subjects sat on an exercise ball and gently bounced while singing. Using the same testing procedure as in the other preliminary studies, a research assistant held the mask over the mouth and nose of the subject through all three phases of testing.

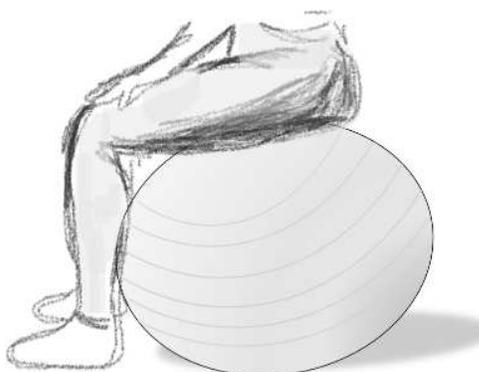


Figure 5.1 Method Used with Exercise Ball in the Second Preliminary Study. Grives, J. (2019).

Subjects

Subject 8 is a soprano who was 19 years old and in her second year as a vocal performance major. Subject 9 is a soprano who was 20 years old in her first year of voice study as a non-music major. Subject ten is a baritone who was 22 years old and a second-year music education major.

Aerodynamic Results

Subjects showed an increase in subglottal pressure between the baseline and training phases (Table 5.1). After using the exercise ball, the observed average subglottal pressure showed a slight decrease. Subject 8 showed an increase in subglottal pressure during the post-training phase. Both subject 9 and ten showed decreases during the post-training phase.

Table 5.1

All Exercise Ball Subjects Individual and Averaged Phase Results for Subglottal Pressure (cm of H₂O)

| Phase | Subject 8 | Subject 9 | Subject 10 | Averaged |
|---------------|-----------|-----------|------------|----------|
| Baseline | 12.88 | 8.07 | 14.49 | 11.81 |
| Training | 14.78 | 10.34 | 15.30 | 13.47 |
| Post-Training | 15.74 | 8.53 | 14.73 | 13.00 |

When averaging airflow rates, a pattern of an increase during the training phase followed by a decrease in the post-training phase appeared (Table 5.2). Both subject 8 and 9's individual airflow rates followed this pattern. Subject 9, however, showed decreasing airflow rates in both the training phase and post-training phase. Using the exercise ball appeared to help subject 9 regulate a comparatively high baseline airflow rate. She still did not show a decrease in any airflow rate that approached the much lower airflow rates shown by the other two subjects.

Table 5.2

All Exercise Ball Subjects Individual and Averaged Phase Results for Airflow (ml per sec)

| Phase | Subject 8 | Subject 9 | Subject 10 | Averaged |
|---------------|-----------|-----------|------------|----------|
| Baseline | 365 | 1208 | 566 | 713 |
| Training | 550 | 1059 | 746 | 785 |
| Post-Training | 515 | 1032 | 579 | 709 |

Because of her persistently high airflow rates and overall static subglottal pressure, subject 9's glottal resistance and vocal efficiency were low in each phase (Table 5.3). Subject 8 and 10 both showed much higher glottal resistance than subject 9. These two subjects also had relatively higher vocal efficiency than subject 9, maintaining higher intensity without as much airflow. The higher glottal resistance levels in this instance were closer to the average rates shown by subjects in other studies. The low glottal resistance shown by subject 9 was lower than needed to effectively improve vocal efficiency.

Table 5.3

All Exercise Ball Subjects Individual Phase Results for Glottal Resistance (GR) and Vocal Efficiency (VE)

| Phase | Sub 8 GR | Sub 8 VE | Sub 9 GR | Sub 9 VE | Sub 10 GR | Sub 10 VE |
|---------------|----------|----------|----------|----------|-----------|-----------|
| Baseline | 0.047 | 0.025 | 0.007 | 0.010 | 0.034 | 0.016 |
| Training | 0.029 | 0.014 | 0.011 | 0.009 | 0.021 | 0.009 |
| Post-Training | 0.034 | 0.013 | 0.009 | 0.012 | 0.032 | 0.014 |

Individual Subjects' Aerodynamic Measures Paired Samples T-Tests

Paired samples t-tests showed that the subjects each had significant differences in aerodynamic measures between testing phases. Subject 8 showed significant change in subglottal pressure, airflow rate, glottal resistance and vocal efficiency between the baseline phase and the training phase (Table 5.4). Subjects 9 and 10 did not significantly change glottal resistance despite their significant differences in subglottal pressure.

Table 5.4

Significant Results of Subject 8's Aerodynamic Measures Paired Samples T-Test between Baseline Phase and Training Phase for Exercise Ball, n=30, df=29, CI=95%

| Variable | Paired differences | | | Cohen's <i>d</i> | <i>t</i> | <i>p</i> |
|------------------|--------------------|--------|------------------|------------------|----------|----------|
| | Mean | SD | CI Lower, Upper | | | |
| P _{sub} | -1.91 | 2.9 | -2.99, -0.83 | 0.57 | 3.6 | 0.001 |
| Airflow | -185.04 | 201.86 | -260.41, -109.67 | 0.98 | 5.02 | <0.0001 |
| GR | 0.02 | 0.04 | 0, 0.03 | 0.69 | 2.57 | 0.016 |
| VE | 0.01 | 0.02 | 0.01, 0.02 | 1.26 | 3.9 | 0.001 |

Significant Results of Paired Samples T-Test between Aerodynamic Measures Baseline Phase and Training Phase for Exercise Ball Subject 9, n=30, df=29, CI=95%

| Variable | Paired differences | | | Cohen's <i>d</i> | <i>t</i> | <i>p</i> |
|------------------|--------------------|--------|-----------------|------------------|----------|----------|
| | Mean | SD | CI Lower, Upper | | | |
| P _{sub} | -2.26 | 0.143 | -2.70, -1.73 | 2.0 | 8.7 | <0.0001 |
| Airflow | 149.03 | 312.12 | 32.49, 265.58 | -0.50 | 2.62 | 0.0014 |

Significant Results of Paired Samples T-Test between Aerodynamic Measures between Baseline Phase and Training Phase for Exercise Ball Subject 10 n=30, df=29, CI=95%

| Variable | Paired differences | | | Cohen's <i>d</i> | <i>t</i> | <i>p</i> |
|------------------|--------------------|------|-----------------|------------------|----------|----------|
| | Mean | SD | CI Lower, Upper | | | |
| P _{sub} | -2.25 | 2.17 | -3.06, -1.44 | 1.40 | 5.69 | <0.0001 |

Note: SD = standard deviation; CI = confidence interval; Cohen's d = effect level; p < 0.05 = significant.

Subject 8 again had significant differences with large effect sizes in subglottal pressure, airflow rate, glottal resistance and vocal efficiency between the baseline phase and post-training phase (Table 5.5). While these changes were significant, subject 8's glottal resistance and vocal efficiency were lower than the baseline phase during the post-training phase.

Subject 9 significantly changed airflow rate and vocal efficiency (Table 5.5).

Vocal efficiency's effect size was zero indicating that any change, while significant, was not a large enough to be perceived. Subject 10 meanwhile did not significantly change

any aerodynamic measures between the baseline phase and post-training phase. He showed changes in the post-training phase that moved close to the baseline in each of the aerodynamic measures. Any change that occurred for subject 10 during the training phase did not persist in the post-training phase.

Table 5.5

Significant Results of Subject 8's Aerodynamic Measures Paired Samples T-Test between Baseline Phase and Post-Training Phase, $n=30$, $df=29$, $CI=95\%$

| Variable | Paired differences | | | Cohen's d | t | p |
|-----------|--------------------|---------|-----------------|-------------|------|---------|
| | Mean | SD | CI Lower, Upper | | | |
| P_{sub} | -2.86 | 3.01 | -3.99, -1.74 | 0.78 | 5.2 | <0.0001 |
| Airflow | -150.04 | -154.04 | -207.55, -92.53 | 0.87 | 5.34 | <0.0001 |
| GR | 0.01 | 0.03 | 0, 0.03 | -0.69 | 2.22 | 0.034 |
| VE | 0.01 | 0.02 | 0.01, 0.02 | -1.26 | 4.22 | <0.0001 |

Significant Results of Subject 9's Aerodynamic Measures Paired Samples T-Test between Baseline Phase and Post-Training Phase $n=30$, $df=29$, $CI=95\%$

| Variable | Paired differences | | | Cohen's d | t | p |
|----------|--------------------|--------|-----------------|-------------|------|-------|
| | Mean | SD | CI Lower, Upper | | | |
| Airflow | 150.4 | 352.82 | 18.66, 282.14 | -0.48 | 2.33 | 0.027 |
| VE | 0.00 | 0.01 | 0, 0 | 0.00 | 2.33 | 0.027 |

Note: SD = standard deviation; CI = confidence interval; Cohen's d = effect level; $p < 0.05$ = significant (2-tailed).

The paired samples t-tests showed significant change during the training phase for all three subjects, but only subject 8 significantly changed all four aerodynamic measures during the post-training phase.

Acoustic Results

On average, subjects showed an increase during the training phase in both maximum intensity between 0 and 2 kHz and maximum intensity between 2 and 4 kHz

(Table 5.6). Subjects followed that increase with a decrease in both maximum intensity measures in the post-training phase.

Subject 8 showed increasing maximum intensity between 0 and 2 kHz during the training phase and post-training phase (Table 5.6). She only showed increase in maximum intensity between 2 and 4 kHz during the training phase, however, and a slight decrease in the post-training phase. Singing Power Ratio (SPR) was lower in the post-training phase due to the higher maximum intensity between 2 and 4 kHz and despite the higher maximum intensity between 0 and 2 kHz. The spectral tilt had a shallower decline during both the training and post-training phases.

Table 5.6

All Exercise Ball Subjects Individual and Averaged Phase Results for Maximum Intensity 0-2 kHz (dB)

| Phase | Subject 8 | Subject 9 | Subject 10 | Averaged |
|---------------|-----------|-----------|------------|----------|
| Baseline | 55.89 | 53.46 | 48.72 | 52.69 |
| Training | 56.99 | 52.77 | 50.15 | 53.30 |
| Post-Training | 57.17 | 52.13 | 49.17 | 52.82 |

All Exercise Ball Subjects Individual and Averaged Phase Results for Maximum Intensity 2-4 kHz (dB)

| Phase | Subject 8 | Subject 9 | Subject 10 | Averaged |
|---------------|-----------|-----------|------------|----------|
| Baseline | 21.16 | 26.71 | 9.42 | 19.10 |
| Training | 24.82 | 26.87 | 8.94 | 20.21 |
| Post-Training | 24.46 | 26.75 | 9.11 | 20.11 |

All Exercise Ball Subjects Individual and Averaged Phase Results for of Singing Power Ratio (Max 0-2 kHz – Max 2-4 kHz)

| Phase | Subject 8 | Subject 9 | Subject 10 | Averaged |
|---------------|-----------|-----------|------------|----------|
| Baseline | 34.73 | 26.75 | 39.30 | 33.59 |
| Training | 32.17 | 25.90 | 41.21 | 33.09 |
| Post-Training | 32.71 | 25.37 | 40.06 | 32.71 |

Subject 9 showed increasing maximum intensity above 2 kHz, but a decrease in maximum intensity between 0 and 2 kHz while using the exercise ball. Because the increase in maximum intensity above 2 kHz was very small, the decrease in SPR was due to the larger decrease in maximum intensity between 0 and 2 kHz rather than the increase above 2 kHz. The decreasing energy below 2 kHz may reflect subject 9's low vocal efficiency observed in the aerodynamic measures.

Subjects in this study showed increases in average intensity between 0 and 2 kHz and between 2 and 4 kHz during the training phase (Table 5.7). The three subjects did not show any further increases in the post-training phase. Subject 8 had the largest changes during the training phase. She also showed the smallest decreases in the average intensity measures in the post-training phase. Subject 8's increased average intensity effected a decrease in ER as well (Table 5.7). She showed the largest decrease during the training phase. In the post-training phase, she showed a small increase in ER that was closer to the level during the training phase than the baseline phase. Subject 8 likely had a perceivable increase in resonant tone quality that confirms the increase suggested by her decreasing SPR measure.

Table 5.7

All Exercise Ball Subjects Individual and Averaged Phase Results for Average Intensity 0-2 kHz (dB)

| Phase | Subject 8 | Subject 9 | Subject 10 | Averaged |
|---------------|-----------|-----------|------------|----------|
| Baseline | 17.46 | 23.90 | 21.13 | 20.83 |
| Training | 21.21 | 24.04 | 22.79 | 22.68 |
| Post-Training | 19.23 | 23.14 | 21.49 | 21.29 |

All Exercise Ball Subjects Individual and Averaged Phase Results for Average Intensity 2-4 kHz (dB)

| Phase | Subject 8 | Subject 9 | Subject 10 | Averaged |
|---------------|-----------|-----------|------------|----------|
| Baseline | 5.71 | 8.88 | 3.88 | 6.16 |
| Training | 11.16 | 9.64 | 4.13 | 8.31 |
| Post-Training | 8.62 | 8.88 | 4.05 | 7.19 |

All Exercise Ball Subjects Individual and Averaged Phase Results for Energy Ratio (Avg 0-2 kHz – Avg 2-4 kHz)

| Phase | Subject 8 | Subject 9 | Subject 10 | Averaged |
|---------------|-----------|-----------|------------|----------|
| Baseline | 11.74 | 15.03 | 17.26 | 14.68 |
| Training | 10.04 | 14.41 | 18.66 | 14.37 |
| Post-Training | 10.61 | 14.26 | 17.44 | 14.10 |

Subject 8's Long-Term Average Spectrum (LTAS) showed the increase in maximum intensity in the rising peaks. Subject 8's increasing average intensity showed in the widening of the peaks between 2 and 4 kHz in the training phase (Figure 5.2). The LTAS also showed the decreased intensity measures during the post-training phase. In addition to the intensity measure changes, the LTAS clearly showed that the peak frequency moved into the singer's formant region between 2800 and 3500 Hz during the training phase. Subject 8's post-training phase LTAS also showed that the spectral slope's decline was shallower. Subject 8 appeared to have persisting or even increasing acoustic energy above 3.5 kHz after using the exercise ball.

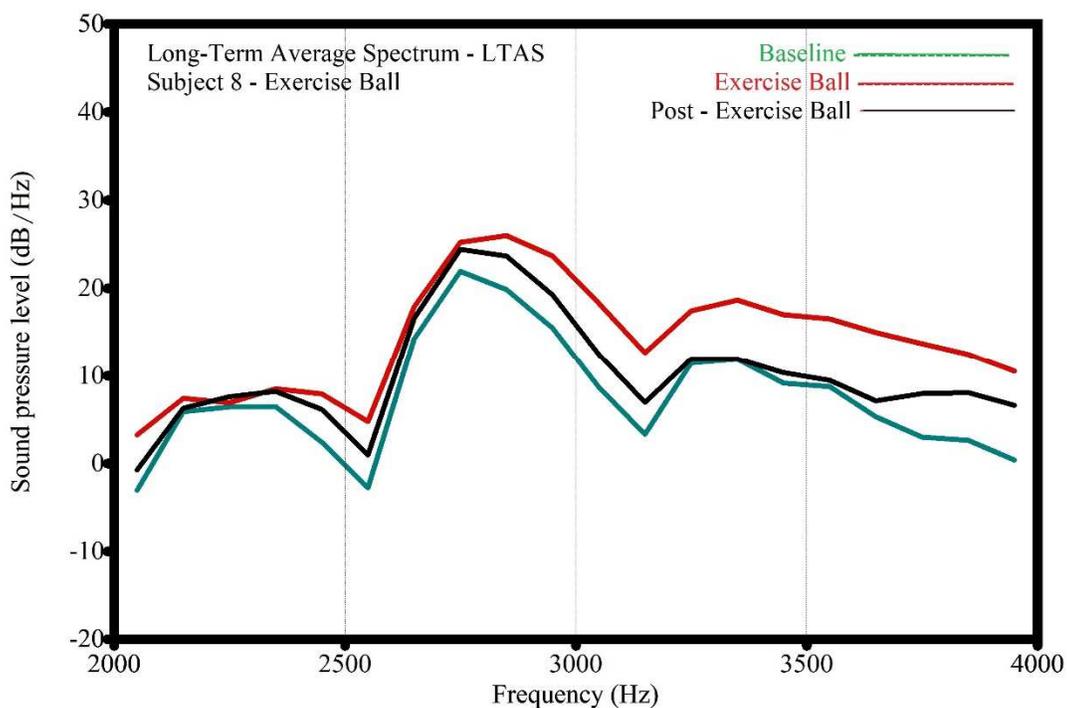


Figure 5.2 Exercise Ball Subject 8's Long-Term Average Spectra 2-4 kHz of Three Averaged Phases

In average intensity below 2 kHz, subjects showed a similar pattern of increase during the training phase, followed by a decrease during the post-training phase (Table 5.8). During the post-training phase, subject 8 and 10 both showed a small decrease in average intensity between 600 and 800 Hz and between 900 and 1400 Hz. Their increased acoustic energy below 2 kHz persisted, though, at a higher level than the baseline measures after they stopped using the exercise ball. Both subjects likely showed an increase in perceived tonal depth due to the overall rise in intensity between 600 and 800 Hz. They also likely had an appreciably brighter tone quality due to the overall increase in intensity between 900 and 1400 Hz.

Individual Subjects' Acoustic Measures Paired Samples T-Tests

The subjects' acoustic changes were significant with large effects sizes (Table 5.9). Between the baseline phase and the training phase, subject 8 was again the only one to have significant change in almost all acoustic measures as she did in aerodynamic measures. She significantly changed all intensity measures, Singing Power Ratio (SPR), Energy Ratio (ER) and peak frequency between 2 and 4 kHz. The average intensity measures all showed large effect sizes indicating the changes were perceivable.

Subject 9 showed a significant change in maximum intensity between 0 and 2 kHz, SPR, average intensity between 2 and 4 kHz, and ER between the baseline phase and the training phase (Table 5.9). The effect sizes of the changes in SPR and ER were moderately sized, suggesting the increased acoustic energy above 2 kHz was perceivable.

Subject 10 showed significant change in both maximum intensity between 0 and 2 kHz and average intensity between 0 and 2 kHz between the baseline and training phases (Table 5.9). These two changes effected significant changes with large effect sizes in SPR and ER respectively. Subject 10 also showed significant increases in average intensity between 600 and 800 Hz and between 900 and 1400 Hz.

Table 5.9

Significant Results of Subject 8's Acoustic Measures Paired Samples T-Test between Baseline Phase and Training Phase for Exercise Ball, n=30, df=29, CI=95%

| Variable | Paired differences | | | Cohen's <i>d</i> | <i>t</i> | <i>p</i> |
|---------------------|--------------------|-------|-----------------|------------------|----------|----------|
| | Mean | SD | CI Lower, Upper | | | |
| Max Int. 0-2 kHz | -1.1 | 2.02 | -1.85, -0.34 | 0.62 | 2.97 | 0.006 |
| Max Int 2-4 kHz | -3.66 | 4.62 | -5.38, -1.93 | 0.95 | 4.34 | <0.0001 |
| SPR | 2.56 | 4.98 | 0.7, 4.42 | 0.67 | 2.82 | 0.009 |
| Avg Int 0-2 kHz | -3.75 | 2.09 | -4.53, -2.97 | 1.90 | 9.85 | <0.0001 |
| Avg Int 2-4 kHz | -5.45 | 4.42 | -7.1, -3.8 | 1.69 | 4.22 | <0.0001 |
| ER | 1.7 | 3.88 | 0.25, 3.15 | 0.55 | 2.4 | 0.0023 |
| Avg Int 600-800 Hz | -2.77 | 1.92 | -3.48, -2.05 | 1.70 | 7.9 | <0.0001 |
| Avg Int 900-1400 Hz | -3.67 | 4.01 | -5.17, -2.17 | 1.18 | 5.01 | <0.0001 |
| Peak Int 2-4 kHz | -33.8 | 41.81 | -49.42, -18.2 | 1.20 | 4.43 | <0.0001 |

Significant Results of Subject 9's Acoustic Measures Paired Samples T-Test between Baseline Phase and Training Phase for Exercise Ball, n=30, df=29, CI=95%

| Variable | Paired differences | | | Cohen's <i>d</i> | <i>t</i> | <i>p</i> |
|------------------|--------------------|------|-----------------|------------------|----------|----------|
| | Mean | SD | CI Lower, Upper | | | |
| Max Int. 0-2 kHz | 0.69 | 1.71 | 0.05, 1.33 | 0.29 | 2.21 | 0.035 |
| SPR | 0.85 | 1.98 | 0.11, 1.59 | 0.39 | 2.36 | 0.025 |
| Avg Int 2-4 kHz | -0.76 | 1.16 | -1.2, -0.33 | 0.76 | 3.6 | 0.001 |
| ER | 0.62 | 1.35 | 0.12, 1.12 | 0.44 | 2.52 | 0.017 |

Significant Results of Subject 10's Acoustic Measures Paired Samples T-Test between Baseline Phase and Training Phase for Exercise Ball, n=30, df=29, CI=95%,

| Variable | Paired differences | | | Cohen's <i>d</i> | <i>t</i> | <i>p</i> |
|---------------------|--------------------|------|-----------------|------------------|----------|----------|
| | Mean | SD | CI Lower, Upper | | | |
| Max Int 0-2 kHz | -1.42 | 1.81 | -2.1, -0.75 | 0.63 | 4.31 | <0.0001 |
| SPR | -1.91 | 1.86 | -2.51, -1.22 | 0.92 | 5.64 | <0.0001 |
| Avg Int 0-2 kHz | -1.65 | 2.08 | -2.43, -0.88 | 0.95 | 4.36 | <0.0001 |
| ER | -1.4 | 1.87 | -2.1, -0.7 | 0.89 | 4.09 | <0.0001 |
| Avg Int 600-800 Hz | -2.56 | 3.91 | -4.02, -1.1 | 0.91 | 3.59 | 0.001 |
| Avg Int 900-1400 Hz | -2.42 | 3.41 | -3.69, -1.14 | 0.98 | 3.88 | 0.001 |

Note: SD = standard deviation; CI = confidence interval; Cohen's d = effect level; p < 0.05 = significant (2-tailed).

Although the subjects had significant differences between the baseline and training phases, only subject 8 showed significant change in more than three measures between the baseline and post-training phases (Table 5.10). She showed persisting significant differences in all measures in the post-training phase except ER, suggesting that she benefitted acoustically the most while she was using the exercise ball and not after.

The other two subjects showed fewer persisting significant differences. Subject 9's average intensity between 900 and 1400 Hz, average intensity between 0 and 2 kHz, and maximum intensity between 0 and 2 kHz showed significant differences. All were below 2 kHz. No increases in intensity above 2 kHz persisted for subject 8 or 9.

Table 5.10

Significant Results of Subject 8's Acoustic Measures Paired Samples T-Test between Baseline Phase and Post-Training Phase for Exercise Ball, n=30, df=29, CI=95%

| Variable | Paired differences | | | Cohen's <i>d</i> | <i>t</i> | <i>p</i> |
|---------------------|--------------------|-------|-----------------|------------------|----------|----------|
| | Mean | SD | CI Lower, Upper | | | |
| Max Int. 0-2 kHz | -1.28 | 2.23 | -1.85, -0.34 | 0.70 | 3.13 | 0.004 |
| Max Int 2-4 kHz | -3.3 | 3.93 | -5.38, -1.93 | 1.12 | 4.6 | <0.0001 |
| SPR | 2.02 | 3.81 | 0.7, 4.42 | 0.56 | 2.91 | 0.007 |
| Avg Int 0-2 kHz | -1.78 | 2.8 | -4.53, -2.97 | 0.81 | 3.47 | 0.002 |
| Avg Int 2-4 kHz | -2.91 | 3.73 | -7.1, -3.8 | 1.04 | 4.28 | <0.0001 |
| Avg Int 600-800 Hz | -1.83 | 2.31 | -3.48, -2.05 | 1.12 | 4.34 | <0.0001 |
| Avg Int 900-1400 Hz | -3.3 | 4.21 | -5.17, -2,17 | 0.26 | 1.06 | <0.0001 |
| Peak Int 2-4 kHz | -16.7 | 41.81 | -49.42, -18.2 | 0.70 | 2.95 | 0.006 |

Significant Results of Subject 9's Acoustic Measures Paired Samples T-Test between Baseline Phase and Post-Training Phase for Exercise Ball, n=30, df=29, CI=95%

| Variable | Paired differences | | | Cohen's <i>d</i> | <i>t</i> | <i>P</i> |
|---------------------|--------------------|------|-----------------|------------------|----------|----------|
| | Mean | SD | CI Lower, Upper | | | |
| Max Int 0-2 kHz | 1.33 | 2.33 | 0.46, 2.2 | 0.55 | 3.12 | 0.004 |
| Avg Int 0-2 kHz | 0.76 | 1.7 | 0.13, 1.4 | 0.44 | 2.45 | 0.021 |
| Avg Int 900-1400 Hz | 1.2 | 2.99 | 0.08, 2.32 | 0.38 | 2.2 | 0.036 |

Significant Results of Subject 10's Acoustic Measures Paired Samples T-Test between Baseline Phase and Post-Training Phase for Exercise Ball, n=30, df=29, CI=95%

| Variable | Paired differences | | | Cohen's <i>d</i> | <i>t</i> | <i>p</i> |
|-----------------|--------------------|------|-----------------|------------------|----------|----------|
| | Mean | SD | CI Lower, Upper | | | |
| Max Int 0-2 kHz | -0.45 | 0.94 | -0.8, -0.1 | 0.27 | 2.64 | 0.013 |
| SPR | -0.76 | 1.38 | -1.28, -0.25 | 0.50 | 3.03 | 0.005 |

Note: SD = standard deviation; CI = confidence interval; Cohen's d = effect level; p < 0.05 = significant (2-tailed).

Summary

Using the exercise ball appeared to create advantageous change in some measures for all subjects. Subject 8 showed the most aerodynamic and acoustic change during the training phase. She maintained or increased changes in the post-training phase. The other two subjects also showed change in some aerodynamic and acoustic measures while they used the exercise ball. Most of their changes did not persist in the post-training phase. It is possible that longer training with the exercise ball could enable singers to maintain the muscular or alignment improvements that occurred. This could potentially result in increased aerodynamic control and acoustic energy.

CHAPTER 6: RESULTS OF PRELIMINARY BALANCE BALL STUDY

The balance ball study showed many of the same changes to the subjects' aerodynamic and acoustic measures as the exercise band study. Change size was more moderate with the balance ball, however. Only two subjects participated in this study. Both subjects' results and their averaged results are discussed below.

Subjects who participated in the balance ball study showed change in both aerodynamic and acoustic measures during the training phase, with some persisting change in the post-training phase. The two subjects had widely varied experience levels and their results appear to reflect the difference in experience. This difference was most likely positive as it produced extremes in measures that more accurately measured the effects of the balance ball.

Balance Ball Methodology

To evaluate this method, subjects stood on a balance ball with the flat board side on the bottom for the subjects' safety (Figure 6.1). Before testing began at the first session, the ball was measured. The ball was inflated or deflated to return to the same width for all three testing sessions to insure subjects used consistent effort when balancing on it. During the second phase of testing, subjects balanced on the ball. While using the same testing procedure as in the first study, a research assistant holds the mask over the mouth and nose of the subject through all three phases of testing.



Figure 6.1 Method Used with Balance Ball in the Third Preliminary Study. Grives, J. (2019).

Subjects

The balance ball preliminary study had just two subjects, both sopranos. Subject 11 was a second-year voice performance music major with five years of previous vocal study. Subject 12 was a non-major in her first year of vocal study. The large difference in the two subjects' experience level could account for some of the variance between their results. Balancing on the ball also requires a longer adjustment period than using the other two methods tested here. The speed at which each subject adjusted to balancing may be another reason for the varying results.

Aerodynamic Results

When averaging both subjects' subglottal pressure (P_{sub}) a small change is evident (Table 6.1). Both subjects showed an increase in subglottal pressure when they used the exercise band in their testing sessions. While subject 11 continued to show an increase in subglottal pressure after using the exercise band in testing, subject 12 showed a decrease to a level below baseline.

Table 6.1

All Balance Ball Subjects Individual and Averaged Phase Results for Subglottal Pressure (cm of H₂O)

| Phase | Subject 11 | Subject 12 | Averaged |
|---------------|------------|------------|----------|
| Baseline | 14.99 | 7.87 | 11.43 |
| Training | 15.26 | 8.36 | 11.81 |
| Post-Training | 16.09 | 7.43 | 11.76 |

Both subjects showed a change in airflow rates when using the balance ball (Table 6.2). On average, subject 12's airflow was lower while standing on it. Subject 11's airflow was higher while standing on the balance ball. The changes, while opposite, were favorable for the individual subjects. Both subjects showed changes in airflow rates that were closer to their baseline levels after using the balance ball, suggesting that either the changes did not persist or longer training is required for consistency.

Table 6.2

All Balance Ball Subjects Individual and Averaged Phase Results for Airflow (ml per sec)

| Phase | Subject 11 | Subject 12 | Averaged |
|---------------|------------|------------|----------|
| Baseline | 239 | 823 | 531 |
| Training | 309 | 526 | 417 |
| Post-Training | 264 | 708 | 486 |

Because subglottal pressure and airflow rate are both factors in calculating glottal resistance (GR) and vocal efficiency (VE), the same change trend occurred in both measures (Table 6.3). Subject 11 showed a decrease in both glottal resistance and vocal efficiency while she stood on the balance ball during testing. Subject 12 showed an increase in both measures during the training phase. After using the balance ball, both subjects showed a return in glottal resistance and vocal efficiency close to the baseline levels.

Table 6.3

All Balance Ball Subjects Individual Phase Results for Glottal Resistance (GR) and Vocal Efficiency (VE)

| Phase | Sub11 GR | Sub11 VE | Sub12 GR | Sub 12 VE |
|---------------|----------|----------|----------|-----------|
| Baseline | 0.0627 | 0.0252 | 0.0096 | 0.0151 |
| Training | 0.0494 | 0.0194 | 0.0159 | 0.0215 |
| Post-Training | 0.0610 | 0.0215 | 0.0105 | 0.0187 |

Individual Subjects' Aerodynamic Measures Paired Samples T-Tests

Paired samples t-tests showed that both subjects had significant differences between baseline and training phases and between the training phase (Table 6.4). Subject 11 did not significantly change subglottal pressure between these first two phases. This was the only aerodynamic measure that the two subjects did not significantly change when they tested while standing on the balance ball.

Table 6.4

Significant Results of Subject 11's Aerodynamic Measures Paired Samples T-Test between Baseline Phase and Training Phase for Balance Ball, $n=30$, $df=29$, $CI=95\%$

| Variable | Paired Differences | | | Cohen's d | t | p |
|----------|--------------------|-------|-----------------|-------------|------|---------|
| | Mean | SD | CI Lower, Upper | | | |
| Airflow | 69.57 | 85.72 | -101.57, -37.56 | 0.96 | 4.45 | <0.0001 |
| GR | -0.02 | 0.03 | 0.01, 0.03 | -0.89 | 3.68 | 0.001 |
| VE | -0.01 | 0.01 | 0, 0.01 | -1.00 | 2.7 | 0.011 |

Significant Results of Subject 12's Aerodynamic Measures Paired Samples T-Test between Baseline Phase and Training Phase for Balance Ball, $n=30$, $df=29$, $CI=95\%$

| Variable | Paired Differences | | | Cohen's d | t | p |
|-----------|--------------------|--------|-----------------|-------------|------|---------|
| | Mean | SD | CI Lower, Upper | | | |
| P_{sub} | 0.48 | 0.94 | -0.83, -0.13 | 0.58 | 2.83 | 0.008 |
| Airflow | -297.4 | 244.09 | 206.25, 388.55 | -1.40 | 6.67 | <0.0001 |
| GR | 0.01 | 0.01 | -0.01, 0.01 | 1.41 | 5.56 | <0.0001 |
| VE | 0.01 | 0.01 | -0.01, 0.01 | 1.41 | 4.85 | <0.0001 |

Note: SD = standard deviation; CI = confidence interval; Cohen's d = effect level; $p < 0.05$ = significant (2-tailed).

Between the training and post-training phases, both subjects again showed significant change in three of the four aerodynamic measures (Table 6.5). Neither subject made a significant difference in vocal efficiency between the training and post-training phases. For subject 11, this is due to the change in intensity, decreasing from 91.45 dB to 91.14 dB. Significant changes in subglottal pressure and airflow were not enough to overcome the SPL change. The significant changes that occurred between the training and post-training phases occurred because both subjects showed change that brought measures closer to the baseline results. The similarity in measures of the baseline phase and the post-training phase, and the lack of significance in the differences, indicate that the aerodynamic measure changes did not persist for either subject.

Table 6.5

Significant Results of Subject 11's Aerodynamic Measures Paired Samples T-Test between Training Phase and Post-Training Phase for Balance Ball, $n=30$, $df=29$, $CI=95\%$

| Variable | Paired Differences | | | Cohen's d | t | p |
|-----------|--------------------|-------|-----------------|-------------|------|-------|
| | Mean | SD | CI Lower, Upper | | | |
| P_{sub} | 0.91 | 1.67 | -1.53, -0.29 | 0.53 | 2.98 | 0.006 |
| Airflow | -44.93 | 93.84 | -292.31, -72.49 | -0.61 | 2.62 | 0.014 |
| GR | 0.01 | 0.03 | 0, 0.01 | -1.26 | 2.9 | 0.007 |

Significant Results of Subject 12's Aerodynamic Measures Paired Samples T-Test between Training Phase and Post-Training Phase for Balance Ball Subject 11, $n=30$, $df=29$, $CI=95\%$

| Variable | Paired Differences | | | Cohen's d | t | p |
|-----------|--------------------|--------|-----------------|-------------|------|---------|
| | Mean | SD | CI Lower, Upper | | | |
| P_{sub} | -0.93 | 1.05 | 0.54, 1.32 | -0.83 | 4.84 | <0.0001 |
| Airflow | 182.4 | 294.35 | -292.31, -72.49 | 0.89 | 3.39 | 0.002 |
| GR | -0.01 | 0.01 | 0, 0.01 | -1.41 | 4.63 | <0.0001 |

Note: SD = standard deviation; CI = confidence interval; Cohen's d = effect level; $p < 0.05$ = significant (2-tailed).

The paired samples t-tests that compared the baseline phase to the post-training phase showed fewer significant changes to aerodynamic measures (Table 6.6). These results reflect how close some post-training measures were to the baseline level. Subject 11 significantly changed subglottal pressure only between the first and last phases, like the earlier observed return to baseline in the other three measures that did not significantly change. Subject 12 significantly changed subglottal pressure, airflow and vocal efficiency. The effect size for vocal efficiency was zero indicating any change, even if significant, was too small to perceive.

Table 6.6

Significant Results of Subject 11's Aerodynamic Measures Paired Samples T-Test between Baseline Phase and Post-Training Phase for Balance Ball, $n=30$, $df=29$, $CI=95\%$

| Variable | Paired Differences | | | Cohen's d | t | p |
|-----------|--------------------|------|-----------------|-------------|------|-------|
| | Mean | SD | CI Lower, Upper | | | |
| P_{sub} | 1.18 | 2.26 | -2.02, -0.34 | 0.65 | 2.86 | 0.008 |

Significant Results of Subject 12's Aerodynamic Measures Paired Samples T-Test between Baseline Phase and Post-Training Phase for Balance Ball, $n=30$, $df=29$, $CI=95\%$

| Variable | Paired Differences | | | Cohen's d | t | p |
|-----------|--------------------|--------|-----------------|-------------|------|-------|
| | Mean | SD | CI Lower, Upper | | | |
| P_{sub} | -0.45 | 1.1 | 0.03, 0.86 | 0.43 | 2.21 | 0.035 |
| Airflow | -115 | 296.91 | 4.13, 225.87 | 0.55 | 2.12 | 0.043 |
| VE | 0.001 | 0.01 | -0.01, 0 | 0 | 2.74 | 0.01 |

Note: SD = standard deviation; CI = confidence interval; Cohen's d = effect level; $p < 0.05$ = significant (2-tailed).

Acoustic Results

The acoustic results are as varied as the aerodynamic results. More significant change occurred, especially during the post-training phase. Both subjects more successfully maintained acoustic change after standing on the balance ball, despite the lack of persisting aerodynamic change.

Subject 11 showed a slight increase in both maximum intensity between 0 and 2 kHz and maximum intensity between 2 and 4 kHz from baseline to the training phase and then again to the post-training phase (Table 6.7). Meanwhile, subject 12 showed a decrease in maximum intensity both below 2 kHz and above 2 kHz from baseline to the training phase. Her maximum intensity in these two regions during the final post-training phase was higher, but subject 11's testing results do not show a return to baseline levels for either measure.

Table 6.7

All Balance Ball Subjects Individual and Averaged Phase Results for Maximum Intensity between 0-2 kHz

| Phase | Subject 11 | Subject 12 | Averaged |
|---------------|------------|------------|----------|
| Baseline | 53.84 | 53.71 | 53.77 |
| Training | 53.93 | 53.23 | 53.58 |
| Post-Training | 54.73 | 55.17 | 54.95 |

All Balance Ball Subjects Individual and Averaged Phase Results for Maximum Intensity between 2-4 kHz

| Phase | Subject 11 | Subject 12 | Averaged |
|---------------|------------|------------|----------|
| Baseline | 19.76 | 26.52 | 23.14 |
| Training | 19.69 | 24.23 | 21.96 |
| Post-Training | 20.81 | 27.12 | 23.97 |

All Balance Ball Subjects Individual and Averaged Phase Results for Singing Power Ratio (Maximum Intensity 0-2 kHz – Maximum Intensity 2-4 kHz)

| Phase | Subject 11 | Subject 12 | Averaged |
|---------------|------------|------------|----------|
| Baseline | 34.07 | 27.19 | 30.63 |
| Training | 34.24 | 29.00 | 31.62 |
| Post-Training | 33.92 | 28.04 | 30.98 |

Because subject 11 showed a higher maximum intensity above 2 kHz, resonant tone quality likely increased. Singing Power Ratio (SPR) quantifies the strength of the intensity between 2 and 4 kHz by finding the difference between the maximum intensity between 0 and 2 kHz and the maximum intensity between 2 and 4 kHz (Omori *et al*, 1996). When subject 11 showed an increase in maximum intensity above 2 kHz, her SPR measure was lower. The decrease in SPR occurred despite an increase in maximum intensity between 0 and 2 kHz. The SPR decrease was only 0.5% from the baseline, however, implying a minimal strengthening of acoustic energy above 2 kHz.

Subject 12 showed an increase in the SPR measure due the decrease in maximum intensity measure between 2 and 4 kHz. The increase in SPR suggests that the strength of

perceptual resonant quality decreased. Still subject 12's SPR was only slightly higher than the baseline level, so the spectral slope did not fall sharply.

Although their maximum intensity measures were somewhat static, both subjects had larger increases in both average intensity measures, especially between 2 and 4 kHz (Table 6.8). Subject 11 showed an increase in average intensity above 2 kHz from the baseline phase to post training phase. Between 0 and 2 kHz, subject 11's average intensity was also higher. Although subject 11 showed an increase in average intensity between 2 and 4 kHz, she did not show a decrease in Energy Ratio (ER). Subject 11's ER measure was higher between baseline testing and the post-training phase indicating a decrease in resonant quality. The increase contradicts the earlier decrease in SPR. Both measures varied slightly from the baseline, though, so it is likely that there was no perceivable spectral energy change in either direction.

Subject 12 showed a decrease in both average intensity measures below 2 kHz and above 2 kHz in the training phase. In the post-training phase, she showed higher levels in both measures than the baseline levels. Subject 12 showed decreased ER due to the increase in average intensity above 2 kHz, indicating that subject 12's spectral tilt was shallower after using the balance ball. Like subject 11, subject 12's ER result contradicts the opposite result in SPR.

Table 6.8

All Balance Ball Subjects Individual and Averaged Phase Results for Average Intensity 0-2 kHz (dB)

| Phase | Subject 11 | Subject 12 | Averaged |
|---------------|------------|------------|----------|
| Baseline | 21.22 | 22.33 | 21.77 |
| Training | 22.22 | 22.19 | 22.21 |
| Post-Training | 22.57 | 23.19 | 22.88 |

All Balance Ball Subjects Individual and Averaged Phase Results for Average Intensity 2-4 kHz (dB)

| Phase | Subject 11 | Subject 12 | Averaged |
|---------------|------------|------------|----------|
| Baseline | 8.32 | 7.15 | 7.74 |
| Training | 8.47 | 6.45 | 7.46 |
| Post-Training | 9.09 | 8.39 | 8.74 |

All Balance Ball Subjects Individual and Averaged Phase Results for Energy Ratio (Avg 0-2 kHz – Avg 2-4 kHz)

| Phase | Subject 11 | Subject 12 | Averaged |
|---------------|------------|------------|----------|
| Baseline | 12.90 | 15.17 | 14.04 |
| Training | 13.75 | 15.74 | 14.74 |
| Post-Training | 13.48 | 14.79 | 14.14 |

Considering subject 11's and subject 12's contradicting SPR and ER results, it appears that the balance ball did little to change the subjects' perceivable acoustic energy above 2 kHz. The statistical significance of average and maximum intensity changes and visual analysis of long-term average spectra (LTAS) (bandwidth 100 Hz) for both subjects tell a different story.

The LTAS of subject 11's baseline, training and post-training phases between 2 and 4 kHz shows an increasing height of the peak around 2.8 kHz (Figure 6.2) The maximum intensity increase of the highest peak grows higher in each successive phase. The growing width of the peak shows the increase in average intensity. Additionally, the LTAS shows that subject 11 intensified another peak between 3 and 3.5 kHz in the

training and post training phases. The singer's formant is an increase in acoustic energy between 28 and 35 kHz and a clustering together of the third, fourth and possibly fifth formants. This LTAS suggests that subject 11 was both intensifying energy and clustering the formants together while she used the balance ball and continued to do so during the post-training phase. The intensification decreased the title of the spectral slope, indicating subject 11 had more perceivable resonant tone.

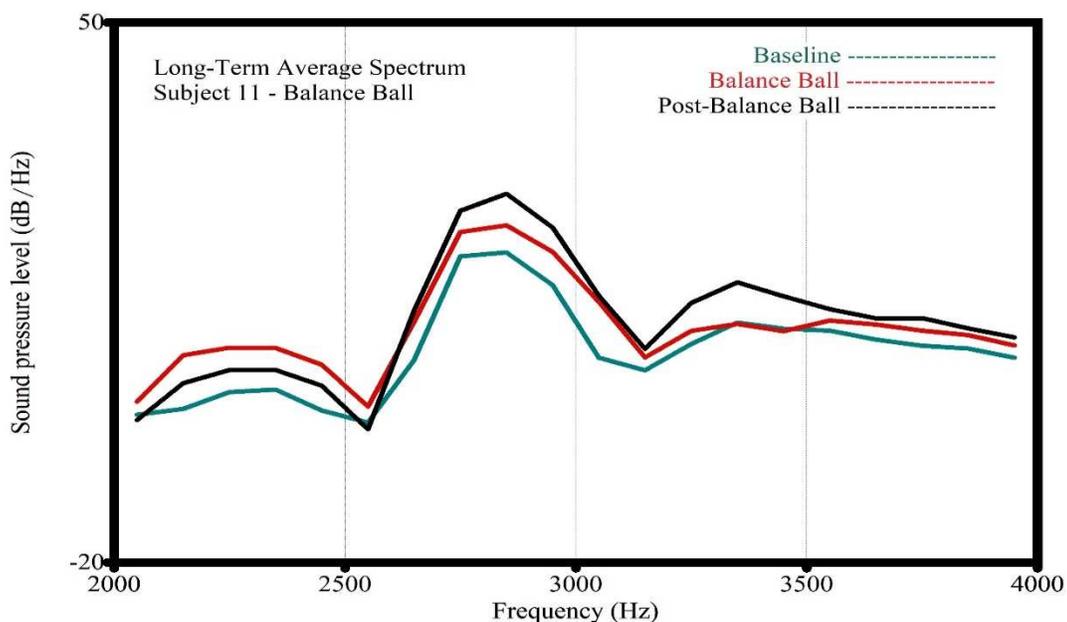


Figure 6.2 Balance Ball Subject 11's Long-Term Average Spectra 2-4 kHz of Three Averaged Phases

Subject 12's LTAS between 2 and 4 kHz shows the decrease in maximum intensity that occurred during the training phase (Figure 6.3). It also shows that she increased maximum intensity in the post-training phase. The average intensity increase can also be seen in the widening of the intensity peaks. Other lower acoustic peaks also intensified and grew wider on either side of the highest peak. The spectral slope specifically grew shallower during the post-training phase of testing.

The LTAS were focused on the region above 2 kHz where SPR and ER measure strengthening and reinforced acoustic energy. The LTAS for these two subjects clearly show that both strengthened and reinforced intensity, even though the SPR and ER measures contradicted each other during testing.

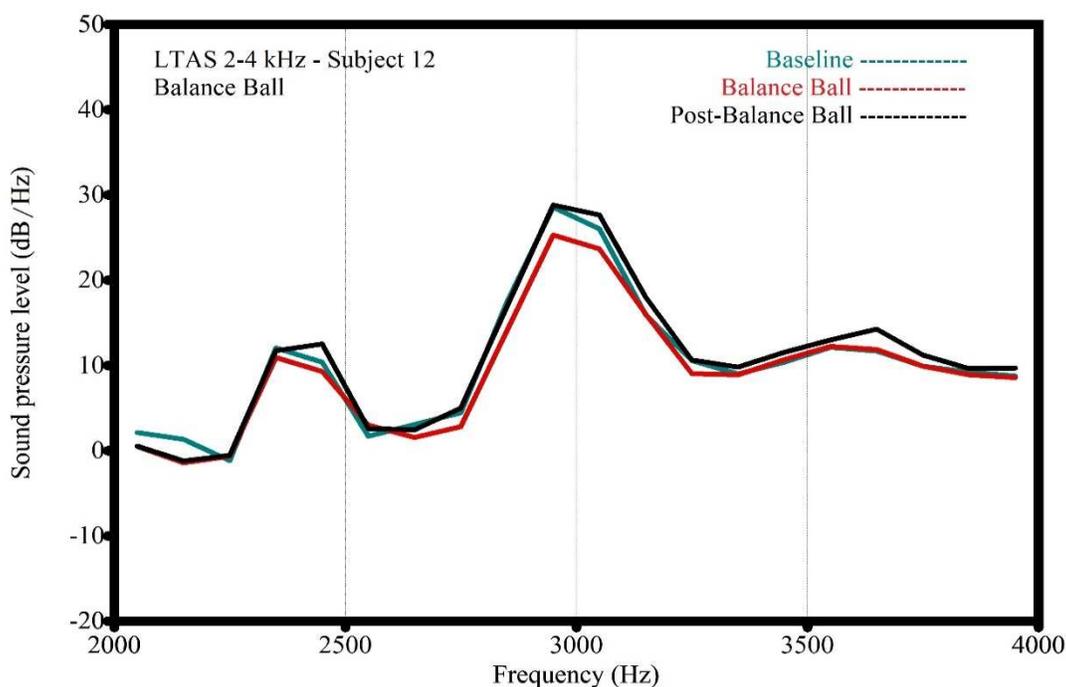


Figure 6.3 Balance Ball Subject 12's Long-Term Average Spectra 2-4 kHz of Three Averaged Phases

Between 600 and 800 Hz, subject 11 and subject 12 showed increases in average intensity between the baseline phase and training phase and again between the training phase and post-training phase (Table 6.9). The increases in average intensity between 600 and 800 Hz indicate more warmth or depth of tone quality. Between 900 and 1400 Hz, both subjects also increased average intensity (Table 6.9). They initially decreased average intensity in this region while standing on the balance ball during testing. They increased intensity higher than baseline after using the balance ball. The changes in

average intensity between 900 and 1400 Hz in the second formant region suggest the subjects had an increase in vowel clarity and brightness after using the balance ball.

Table 6.9

All Balance Ball Subjects Individual and Averaged Phase Results for Average Intensity 600-800 Hz (dB)

| Phase | Subject 11 | Subject 12 | Averaged |
|---------------|------------|------------|----------|
| Baseline | 31.65 | 26.69 | 29.17 |
| Training | 32.27 | 28.88 | 30.57 |
| Post-Training | 32.69 | 29.81 | 31.25 |

All Balance Ball Subjects Individual and Averaged Phase Results for Average Intensity 900-1400 Hz (dB)

| Phase | Subject 11 | Subject 12 | Averaged |
|---------------|------------|------------|----------|
| Baseline | 28.87 | 32.49 | 30.68 |
| Training | 27.38 | 33.74 | 30.56 |
| Post-Training | 29.67 | 34.12 | 31.89 |

Individual Subjects' Acoustic Measures Paired Samples T-Tests

Paired samples t-tests analyzing the both subjects' acoustic measures show many significant differences between phases. They both had significant differences between baseline and training phases (Table 6.10). Subject 11 showed the largest effect sizes in measures below 2 kHz. Subject 12's changes were negative indicating that while her changes were significant, she likely did not acoustically benefit from these changes.

Table 6.10

Significant Results of Subject 11's Acoustic Measures Paired Samples T-Test between Baseline Phase and Training Phase for Balance Ball, n=30, df=29, CI=95%

| Variable | Paired Differences | | | Cohen's <i>d</i> | <i>t</i> | <i>p</i> |
|----------------|--------------------|------|-----------------|------------------|----------|----------|
| | Mean | SD | CI Lower, Upper | | | |
| AI 600-800 Hz | 2.19 | 4.48 | -3.86, -0.31 | 0.73 | 2.67 | 0.012 |
| AI 900-1400 Hz | 1.25 | 2.13 | -2.04, -0.45 | 0.77 | 3.21 | 0.003 |
| AI 0-2 kHz | 1 | 1.6 | -1.6, -0.4 | 0.87 | 3.42 | 0.002 |
| AI 2-4 kHz | 0.81 | 1.69 | -1.44, -0.18 | 0.39 | 2.64 | 0.002 |

Significant Results of Subject 12's Acoustic Measures Paired Samples T-Test between Baseline Phase and Training Phase for Balance Ball, n=30, df=29, CI=95%

| Variable | Paired Differences | | | Cohen's <i>d</i> | <i>t</i> | <i>p</i> |
|----------------|--------------------|------|-----------------|------------------|----------|----------|
| | Mean | SD | CI Lower, Upper | | | |
| AI 900-1400 Hz | -1.49 | 1.98 | 0.75, 2.23 | 0.88 | 4.13 | <0.0001 |
| AI 2-4 kHz | -0.7 | 1.59 | 0.11, 1.29 | 0.23 | 2.41 | 0.022 |
| Max 0-2 kHz | -0.47 | 1.09 | 0.07, 0.88 | 0.33 | 2.39 | 0.024 |
| Max 2-4 kHz | -2.29 | 3.31 | 1.05, 3.52 | 0.79 | 3.78 | 0.001 |

Note: SD = standard deviation; CI = confidence interval; Cohen's d = effect level; p < 0.05 = significant (2-tailed).

More significant change was revealed between the baseline and post-balance ball phases as well (Table 6.11). Subject 11 significantly changed all average intensity and maximum intensity measures. The largest effect sizes were found again in the four measures taken below 2 kHz. Subject 12 significantly changed four measures between the baseline phase and post-training phase. The effect sizes for the average intensity changes were moderate, but maximum intensity between 0 and 2 Hz had a very large effect size indicating that subject 12's change was likely perceivable.

Table 6.11

Significant Results of Subject 11's Acoustic Measures Paired Samples T-Test between Baseline Phase and Post-Training Phase for Balance Ball, $n=30$, $df=29$, $CI=95\%$

| Variable | Paired Differences | | | Cohen's d | t | p |
|----------------|--------------------|------|-----------------|-------------|------|---------|
| | Mean | SD | CI Lower, Upper | | | |
| AI 600-800 Hz | 2.19 | 4.51 | -4.81, -1.44 | 1.03 | 3.79 | 0.001 |
| AI 900-1400 Hz | 1.25 | 2.3 | -2.49, -0.77 | 1.03 | 3.88 | 0.001 |
| AI 0-2 kHz | 1.35 | 1.38 | -1.86, -0.83 | 1.22 | 5.33 | <0.0001 |
| AI 2-4 kHz | 1.43 | 2.72 | -2.45, -0.41 | 0.80 | 2.87 | 0.007 |
| Max 0-2 kHz | 0.89 | 1.66 | -1.5, -0.27 | 0.82 | 2.93 | 0.007 |
| Max 2-4 kHz | 2.38 | 5.84 | -4.56, -0.2 | 0.44 | 2.23 | 0.034 |

Significant Results of Subject 12's Acoustic Measures Paired Samples T-Test between Baseline Phase and Post-Training Phase for Balance Ball, $n=30$, $df=29$, $CI=95\%$

| Variable | Paired Differences | | | Cohen's d | t | p |
|---------------|--------------------|------|-----------------|-------------|------|---------|
| | Mean | SD | CI Lower, Upper | | | |
| AI 600-800 Hz | 1.05 | 2.62 | -2.03, -0.07 | 0.36 | 2.19 | 0.036 |
| AI 0-2 kHz | 0.86 | 1.51 | -1.42, -0.29 | 0.38 | 3.11 | 0.004 |
| AI 2-4 kHz | 1.24 | 2.2 | -2.06, -0.42 | 0.42 | 3.08 | 0.004 |
| Max 0-2 kHz | 1.46 | 2.04 | -2.22, -0.7 | 1.11 | 3.92 | <0.0001 |

Note: SD = standard deviation; CI = confidence interval; Cohen's d = effect level; $p < 0.05$ = significant (2-tailed).

Although both subjects had contradicting SPR and ER results, the numerous examples of significant change of the paired samples t-tests indicate that SPR and ER do not account for some perceivable acoustic changes, especially below 2 kHz. Many of the subjects' significant changes occurred below 2 kHz with large effect sizes. These significant differences may indicate that the subjects had perceivable change in acoustic energy, most noticeable as added tone depth and/or brightness.

Summary

While subjects were able to change the aerodynamic measures when standing on the balance ball, they did not maintain changes in the post-training phases. The lack of persistent aerodynamic change did not seem to relate to the acoustic results, though. Both subjects maintained or increased acoustic intensity in many measures. They may have changed their alignment when using the balance ball which in turn affected acoustic output. The changes appeared to persist after using the balance ball at least for a short time. These results suggest that the balance ball may offer more influence over acoustic measures than aerodynamic.

CHAPTER 7 – METHODS COMPARISON

Aerodynamic Measures Comparison

Subjects showed almost parallel average change in subglottal pressure and airflow with all three training aids. Averaged results for all three training aids show an increase in subglottal pressure between the baseline and training phases, followed by a decrease between the training and post-training phases (Figure 7.1). The overall result was persisting increase in subglottal pressure between the baseline and post-training phases. Subjects who used the exercise ball showed the largest increase in subglottal pressure.

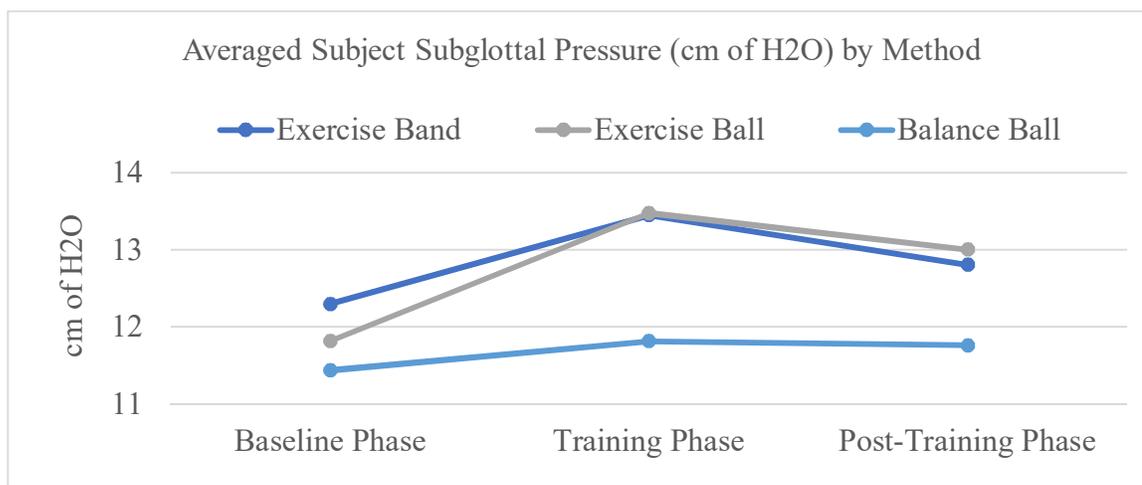


Figure 7.1 Averaged Subject Subglottal Pressure (cm of H₂O) by Method

Subjects who used the exercise band and exercise ball during testing also showed an increase in average airflow between the baseline and training phase, followed by a decrease between the training and post-training phases (Figure 7.2). The subjects who used the balance ball, however, showed a decrease between the baseline and training phases, followed by an increase between the training and post-training phases. Their overall airflow rate was lower between the baseline and post-training phases. The inverse pattern was due to one subject's comparatively high baseline airflow rate. The outlier rate

skewed the average results because of the small number of subjects in this preliminary study. Subjects who used the exercise ball showed the most overall change in airflow rate.

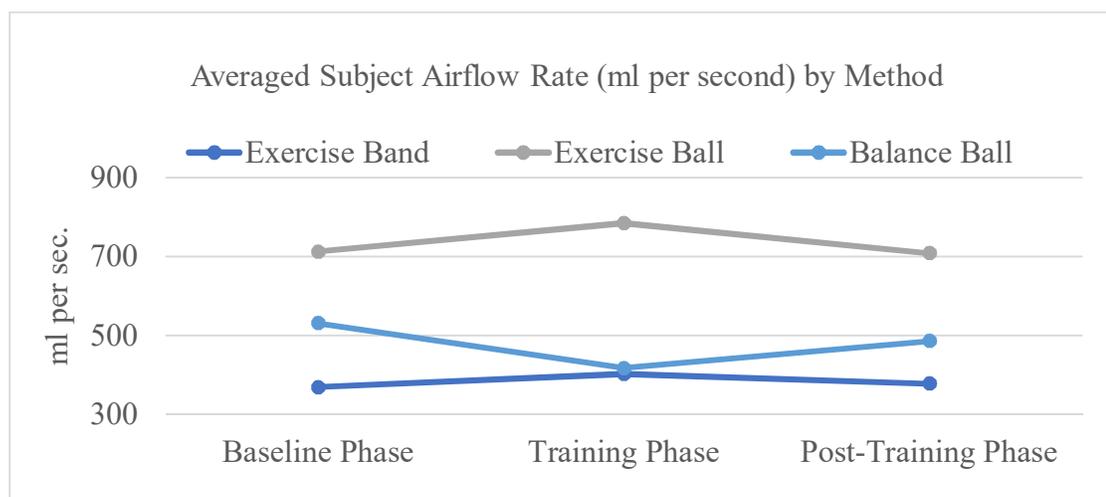


Figure 7.2 Averaged Subject Airflow Rate (ml per second) by Method

The glottal resistance averages for each training method have the inverse pattern of subglottal pressure and airflow results (Figure 7.3). Despite the increase in subglottal pressure, all training method averages showed a decrease in glottal resistance between the baseline and training phases. Glottal resistance was higher again in the post-training phases when subglottal pressure was lower. Despite the increase during the post-training phase, only subjects using the exercise band had an overall increase in glottal resistance.

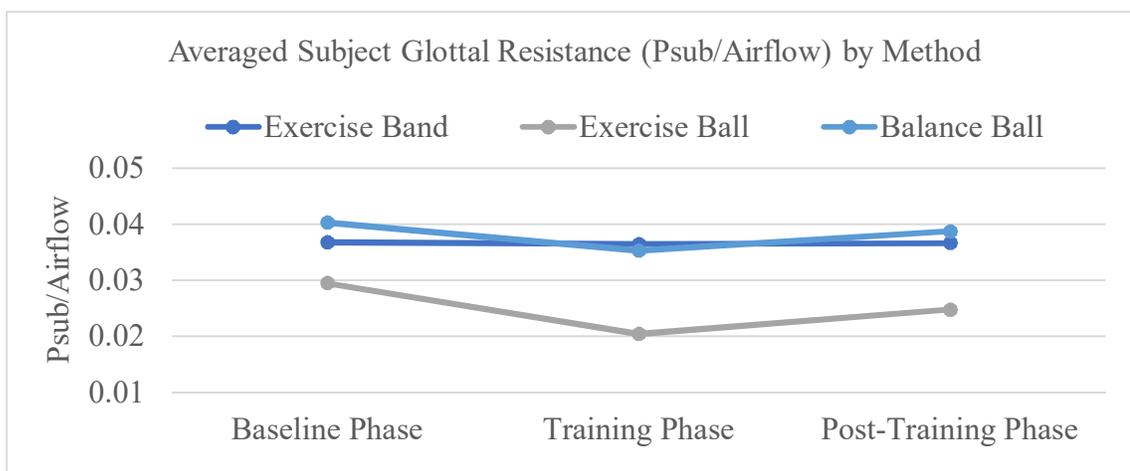


Figure 7.3 Averaged Subject Glottal Resistance ($P_{sub}/Airflow$) by Method

Subjects who used the exercise band were, like with glottal resistance, the only group to show an average increase in vocal efficiency (Figure 7.4). The increase in both measures indicates that the exercise band may have had more beneficial, persisting effect on subjects' aerodynamic measures than the exercise ball or balance ball.

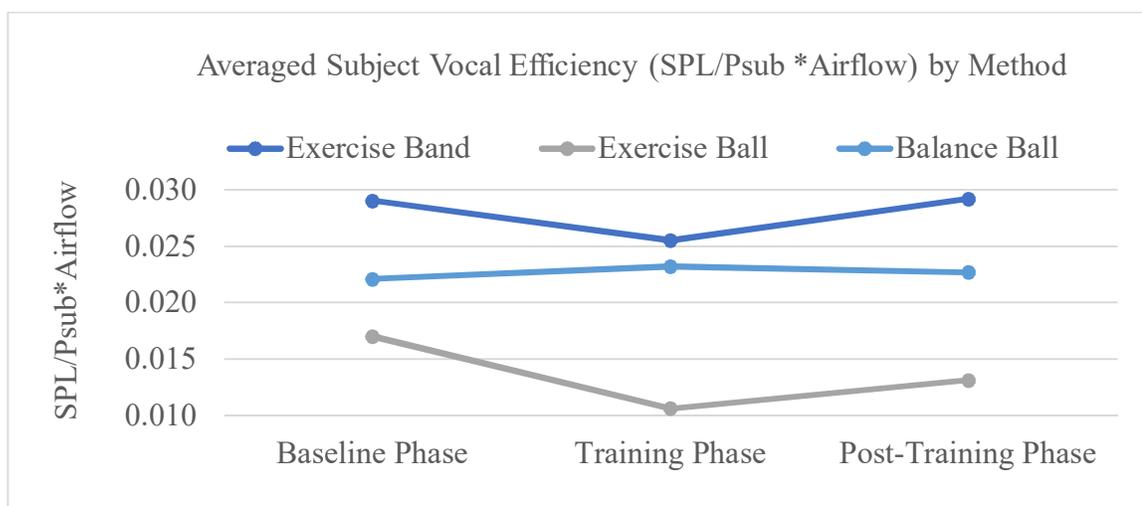


Figure 7.4 Averaged Subject Vocal Efficiency ($SPL/P_{sub} * Airflow$) by Method

Acoustic Measures Comparison

Subjects' acoustic measures varied more than their aerodynamic measures. In maximum intensity between 0 and 2 kHz subjects showed an overall increase of persisting intensity with all training aids (Figure 7.5).

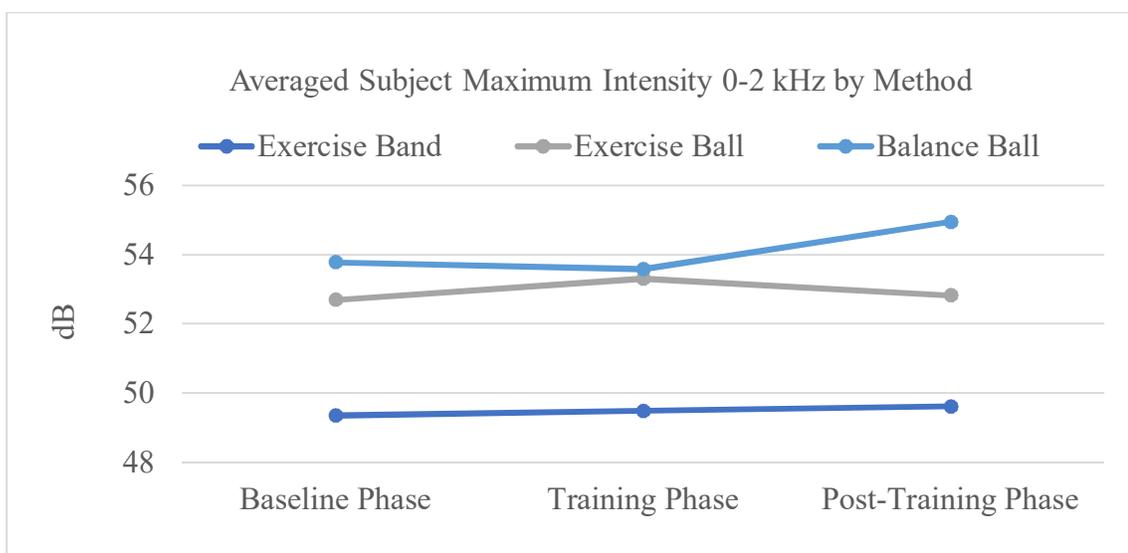


Figure 7.5 Averaged Subject Maximum Intensity 0-2 kHz by Method

Only subjects who used the exercise band showed both an increase during the training phase and during the post-training phase. This is the first example of how exercise band aerodynamic measure patterns align with acoustic patterns. The consistent, often largest favorable changes in aerodynamic measures appear to be related to acoustic change.

While there was an increase in maximum intensity between 2 and 4 kHz overall with all three training aids, subjects who used the balance ball had the smallest increase (Figure 7.6). They showed an increase again during the post-training phase, but it was smaller in this region than below 2 kHz.

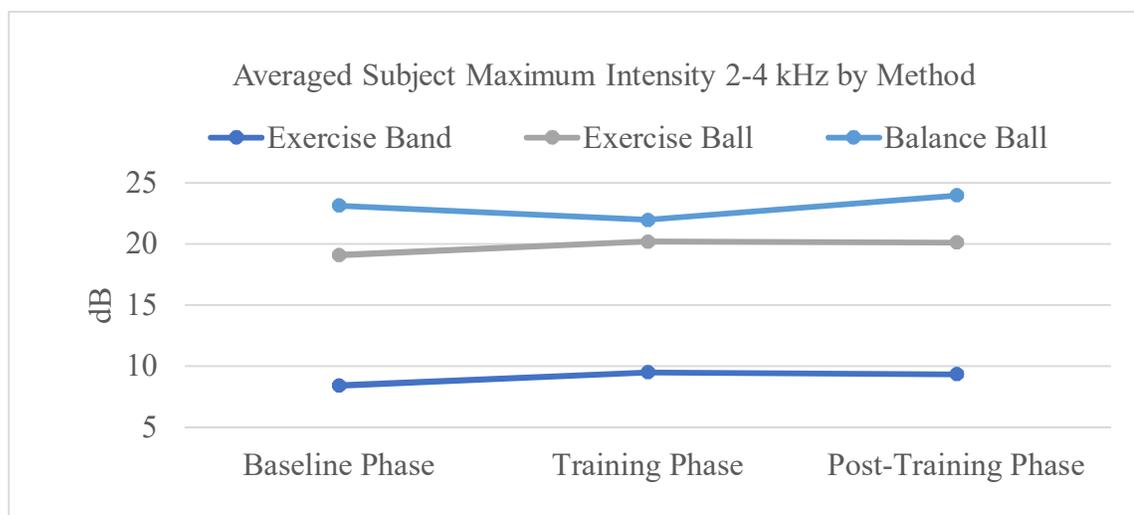


Figure 7.6 Averaged Subject Maximum Intensity 2-4 kHz by Method

The small overall increase in maximum intensity between 2 and 4 kHz for subjects using the balance ball was not enough to lower Singing Power Ratio (SPR), the objective measure of peak spectral energy. The Long-Term Average Spectrum (LTAS) between 2 and 4 kHz for the balance ball, however, shows that SPR did not measure the impact of increasing intensity outside of the maximum intensity peaks (Figure 7.7). Another peak around 3.3 kHz clearly shows that subjects using the balance ball experienced an increase in spectral energy in this region during the post-training phase. Subjects also showed an increase in average intensity between 2 and 4 kHz that is reflected in the slight widening of the peaks during the post-training phase.

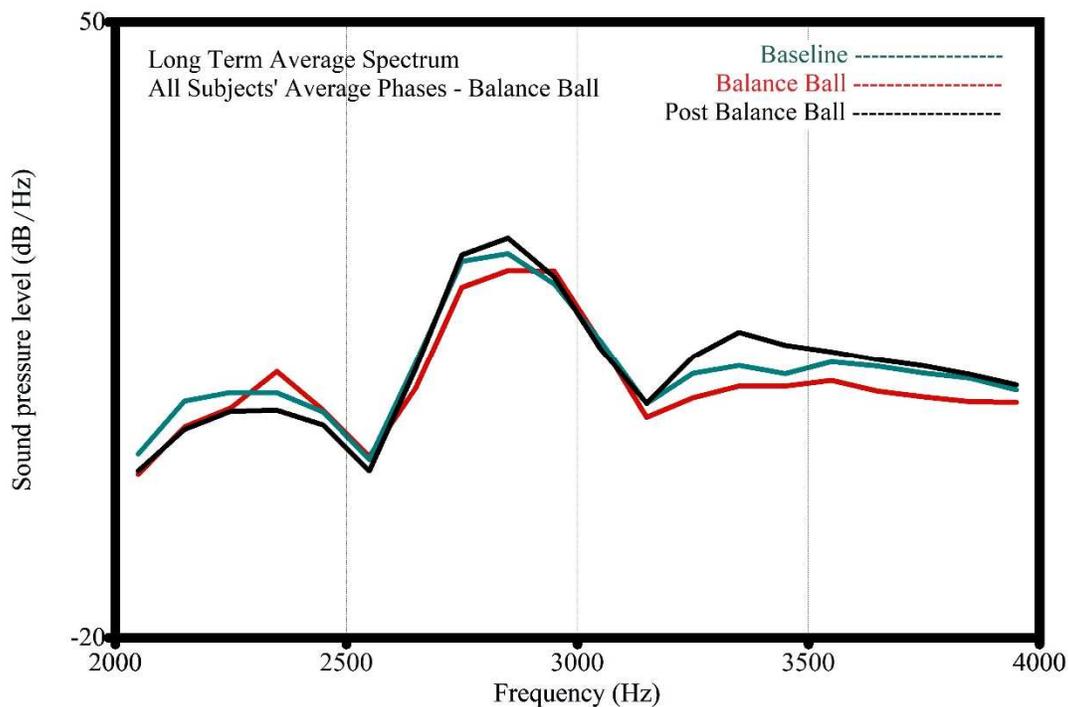


Figure 7.7 All Balance Ball Subjects' Long-Term Average Spectra 2-4 kHz of Three Averaged Phases

Subjects who used the exercise ball during testing showed a small increase in maximum intensity between 2 and 4 kHz in the training phase. During the post-training phase this measure was slightly lower, but because of the decrease in maximum intensity below 2 kHz, SPR showed a decrease as well. Again, the LTAS for the exercise ball shows that SPR does not completely account for acoustic energy above 2 kHz (Figure 7.8). In this case, peaks around 3.6 kHz show that intensity was lower during the post-training phase indicating that at least some of the change that occurs with the exercise ball did not persist.

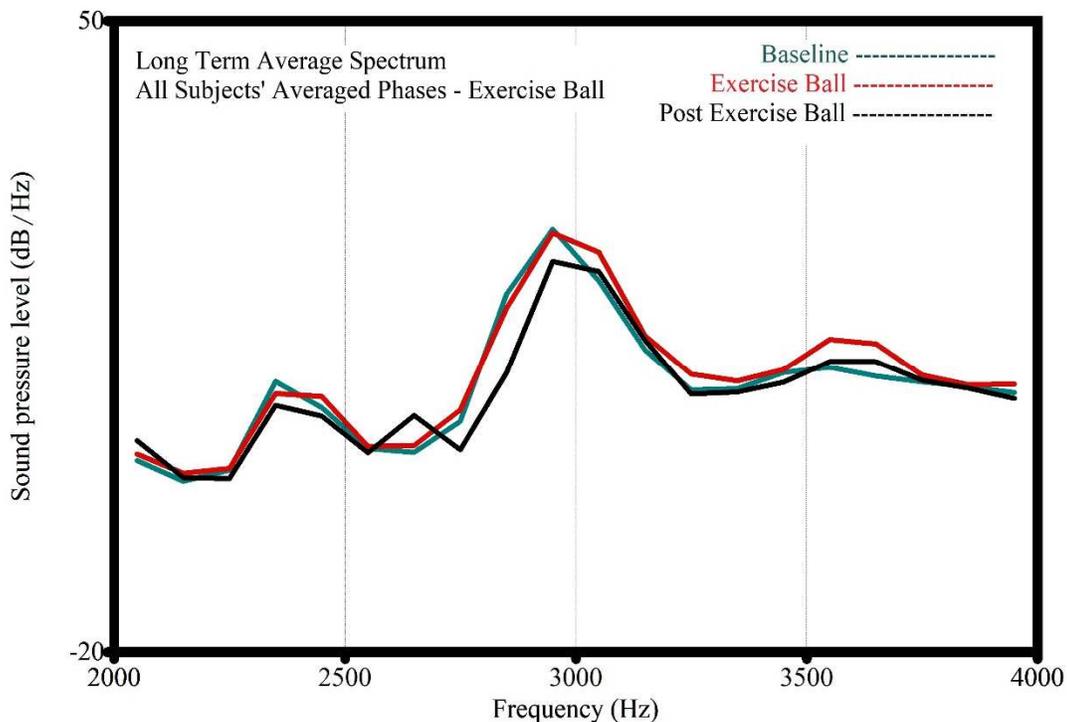


Figure 7.8 All Exercise Ball Subjects' Long-Term Average Spectra 2-4 kHz of Three Averaged Phases

The LTAS also shows that subjects' average intensity between 2 and 4 kHz was higher during the training phase for the exercise ball. The peaks widen during the training phase, but then narrow during the post-training phase. This loss of energy during the post-training phase is another indication that the greatest beneficial change occurred when subjects used the exercise ball and did not show persisting measures. The increase in average intensity above 2 kHz also accounts for the decrease in Energy Ratio (ER). While subjects show an average decrease in both SPR and ER in the post-training phase, the LTAS shows that the spectral tilt declined at the same rate as the baseline measure. This is another indication any increase in acoustic energy dissipated quickly after subjects used the exercise ball.

Subjects who used the exercise band also showed a decrease in SPR because the increase in maximum intensity between 2 and 4 kHz was large enough to offset the

increase in maximum intensity between 0 and 2 kHz. While maximum intensity between 2 and 4 kHz was 10% higher than the baseline measure in the post-training phase for subjects using the exercise band, average intensity in this region was nearly 30% higher. The tallest peak around 3.1 kHz on the LTAS shows that maximum intensity in training phase and post-training were virtually the persisting level (Figure 7.9). The LTAS also clearly shows the subjects' average intensity increase in the widening of the intensity peaks and decreasing spectral title above 3.5 kHz, especially in the post-training phase.

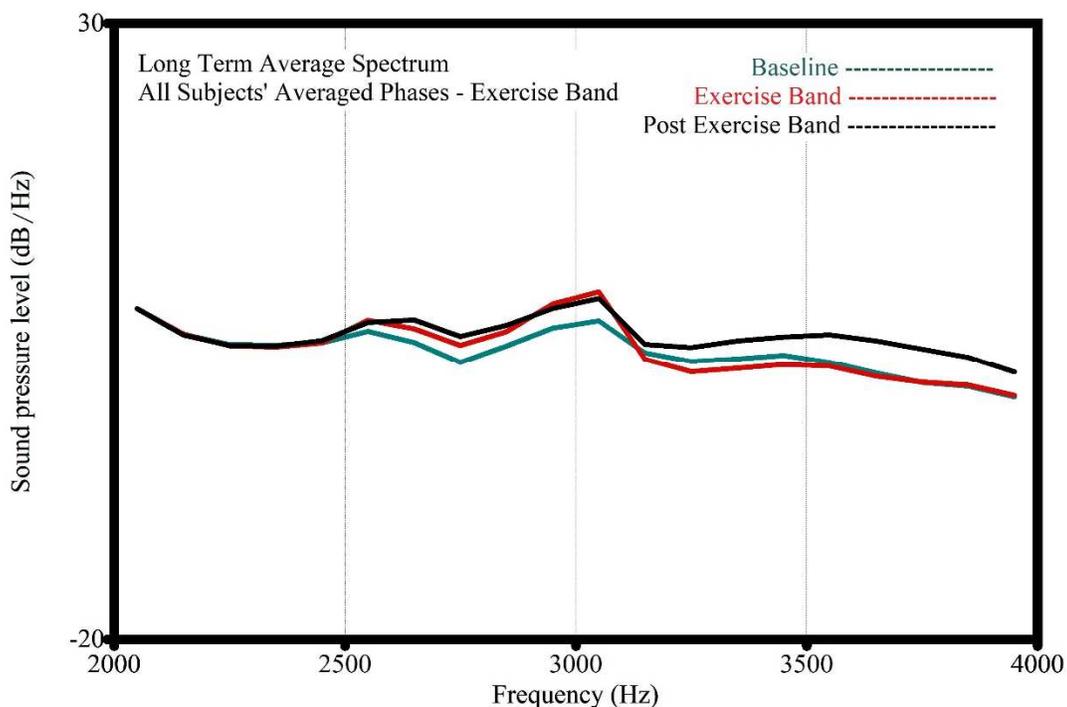


Figure 7.9 All Exercise Band Subjects' Long-Term Average Spectra 2-4 kHz of Three Averaged Phases

Average intensity between 600 and 800 Hz, or in the region of the first formant, did not have regular overall increases for each training aid (Figure 7.10). Subjects who used the balance ball showed an increase in the training phase and post-training phase likely adding warmth or depth to their tone quality. Subjects using the other two training aids showed an increase in the training phase and a decrease to a level lower than the

baseline in the post-training phase. It should be noted, however, that this is the only acoustic measure for which subjects using the exercise band did not show an overall increase.

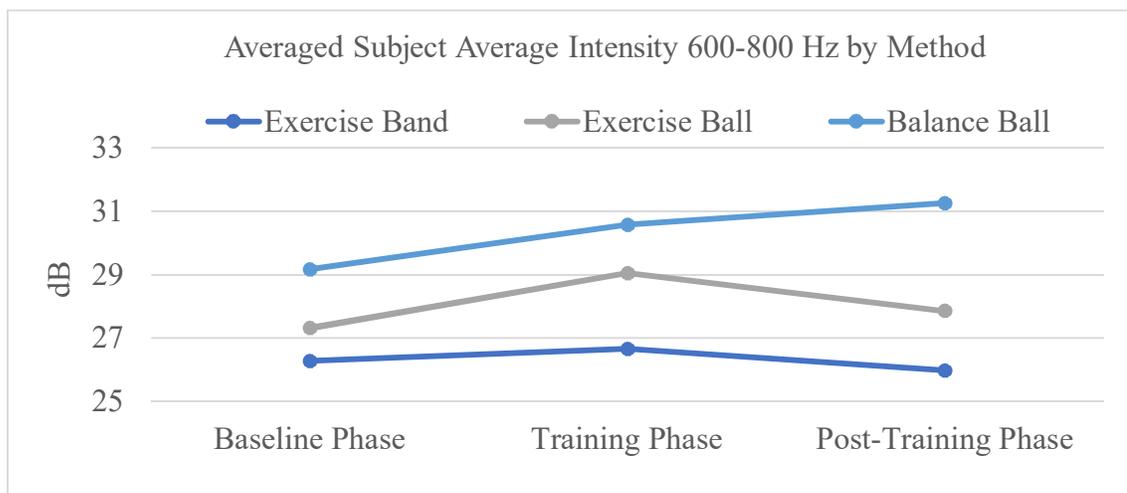


Figure 7.10 Averaged Subject Average Intensity 600- 800 Hz by Method

Change between phases for average intensity between 900 and 1400 Hz did not have a consistent pattern. Subjects using the balance ball again showed the most increase, possibly brightening and adding clarity to the tone.

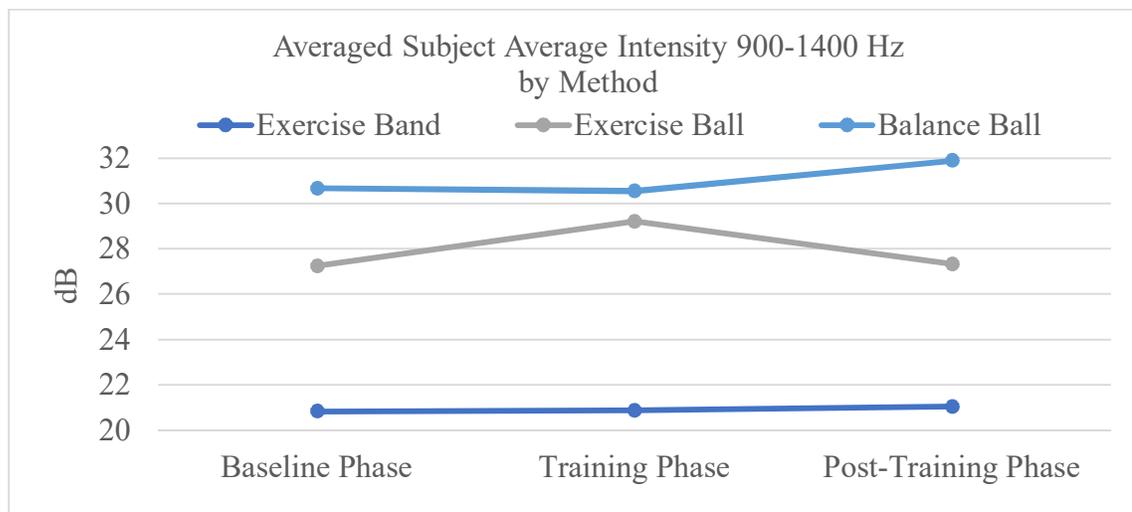


Figure 7.11 Averaged Subject Average Intensity 900-1400 Hz by Method

What Each Training Aid May Affect Most

The balance ball had inconsistent results in affecting subjects' aerodynamic and acoustic measures. The inconsistency may be due to the difficulty some have comfortably standing on the balance ball. Still, subjects did experience beneficial change with the balance ball. It appears to affect airflow rate most in aerodynamic measures. In testing, it seemed to be involved in increasing a low airflow rate and decreasing a high airflow rate.

In acoustic measures, subjects had overall increasing intensities both below 2 kHz and above without any consistent pattern, suggesting that standing on the balance ball may help increase acoustic energy in multiple ways. The balance ball did not appear to affect peak frequency. A singer may not move peaks for improved resonance because of standing on the balance ball.

The exercise ball clearly affected subjects' aerodynamic measures most during testing. Like the balance ball, the exercise ball appeared to be involved when subjects with low airflow rates show an increase and subjects with high airflow rates show a decrease. The airflow rate increases were comparatively very high, however. It may provide some singers who have not developed consistent habits an inaccurate model for engaging respiration muscles. The high airflow rates also adversely affected glottal resistance causing subjects to have less vocal efficiency. In acoustic measures, the exercise ball seemed to effect favorable change during the training phase. This change often reverted to near or even beyond the baseline level during the post-training phase.

The exercise band seemed to positively affect both aerodynamic and acoustic measures during the training phase. The changes persisted or increased in the post-training phase. While only two subjects participated in this study, they repeated the

testing procedure three times. The averaged results, that include a baseline, training and post-training phase, provide reliable evidence that these two subjects had consistent, repeatable results. Subjects showed an increase in all acoustic intensity measures except for one. SPR and ER both decreased indicating more spectral energy above 2 kHz. Subjects also showed more peak frequency movement that could have improved resonance. In aerodynamic measures, subjects who used the exercise band showed increased and persisting subglottal pressure and airflow rates. These changes in turn increased or held glottal resistance steady and increased vocal efficiency. The exercise band created the most favorable change on average for all measures and appears to have the most potential as a training aid for singers.

Why Training Aids May Have Affected Aerodynamic and Acoustic Measures

Alignment of the body can affect respiration and articulators. When a singer properly aligns the body, they may open space in the thorax for larger lung expansion, allow certain muscles to engage more and free other muscles from activating at all during respiration. A well-aligned body may also adjust the placement of the tongue, jaw and larynx, giving a singer the proper space in the pharynx and mouth for improved resonance.

The training aids may have improved the subjects' alignment in different ways. Using the exercise ball required the subjects to sit with a well-aligned upper body so that they would balance well enough to gently bounce without falling. The balance ball likewise required subjects to stand with weight evenly distributed between the legs and feet while allowing the head to be between the shoulders so that they could remain on the balance ball. The exercise band required subjects to stand on the middle of the band and

pull up of the ends of the bands until their forearms were parallel to the floor. This action was difficult to do without aligning the upper body over the hips and feet.

When the body is more aligned, as already noted respiration muscles may more freely engage. When a singer is in alignment the rib cage does not rest on muscles below it, freely them to engage more. The intercostal muscles involved in inhalation and exhalation can also engage more freely when the ribcage is hanging from the spine rather than resting on the lower body.

Sitting on the exercise ball and gently bouncing possibly directly engaged subjects' respiration muscles. The repeated movement also possibly prevented over-engagement that could create unwanted tension and not allow for respiration control. Standing on the balance ball, although not as active as the exercise ball method, also likely activated respiration muscles as subjects balanced. To pull up on the exercise band ends, subjects also possibly engaged respiration muscles more than without it. Subjects may have experienced better proprioception, or improved sensory information, that would also enhance muscle coordination and alignment. When muscles engage, their antagonistic muscle pair releases; therefore, if each of the training aids better engaged certain muscles, they also provided some tension release during the training phase of testing.

During the post-training phase of testing, it is possible that the Kohnstamm phenomenon was at work (Ivanenko *et al*, 2006). The Kohnstamm phenomenon describes how involuntary muscle engagement may occur after an extended forceful muscle contraction (Ivanenko *et al*, 2006). The most familiar example of this phenomenon is standing in a doorway and pushing arms into the frame for 30 or 40 seconds. After the

exertion the arms float up involuntarily. It is possible that after using a training aid with repeated sustained effort that the muscles that engaged during the training phase continued to engage during the post-training phase.

Finally, using any of the training aids may have affected subjects' mental attitude. If a subject felt that a training aid was easy to use and creating change, they may have better engaged in testing. If they felt that it was difficult or strenuous to use a training aid, they may have increased tension that would affect their articulators or respiration.

Conclusion

It appears that each of these training aids can effect some persistent change in a singer's aerodynamic and acoustic measures. Subjects showed beneficial change in some measures when using each of the training aids. The exercise band appeared to affect the most aerodynamic and acoustic measures. Further investigation of how other factors, such as training duration or training repetitions, may influence effectiveness would enhance the understanding of when and how to use training aids for the best results in the voice studio.

CHAPTER 8: CASE STUDY

Choice of the Exercise Band for the Case Study

The exercise band showed the most potential for aerodynamic and acoustic measure change after the three preliminary training aid studies. While all three had varying degrees of success changing these measures for study subjects, the exercise band had the largest percentage of change overall. The exercise band has added benefits of being inexpensive and very portable.

Averaging the absolute values of all changes in the preliminary studies showed that subjects who used the exercise band had the highest total change between averaged phase data (Table 8.1). The subjects who used the exercise ball showed more change in aerodynamic measures than those who used the exercise band, but they did not change acoustic measures at the same rate.

Table 8.1
Training Aids' Average Percentage Change

| Method | Total | Acoustic | Aerodynamic |
|---------|-------|----------|-------------|
| Balance | 16% | 17% | 16% |
| Band | 23% | 21% | 27% |
| Ball | 17% | 10% | 43% |

Similarity of Case Study to Preliminary Studies

The preliminary studies tested subjects once a week, three weeks in a row. The case study also tested subjects three times with the same protocol, but at one-month intervals. After the baseline testing session, subjects practiced daily using the exercise band for part of the practice time. They logged their practice as described below. Subjects were tested after the month of training with the exercise band. Subjects were then asked to stop using the exercise band during practice of the following month. They then tested

the third time to record whether any change shown in the second testing session persisted without regular exercise band use.

| Practice Tracker | | Subject Number: |
|---|------------------|------------------|
| Date: | Time: | Length Band Use: |
| Begin each practice session with your usual warm-ups without the exercise band. Then, compare how you perceived your breath, tone and ease felt at the beginning to when you use the exercise band (for 5 to 10 minutes) and 10 minutes after you used the exercise band. Please use a straight tic line () to mark your perception you are using the exercise band and use an “x” to mark your perception of each area during the 10 minutes after you have used the exercise band. | | |
| Breath Energy: | | |
| Shorter | Same as baseline | Longer |
| Tone Quality: | | |
| Duller | Same as baseline | More Resonant |
| Ease in Singing: | | |
| More Difficult | Same as baseline | Easier |

Figure 8.1 Sample Daily Practice Tracker used by Case Study Subjects during Training

Practice Tracker Design

The practice tracker is a simple tool that subjects used to rate their perception of change through the month-long training period (Figure 8.1). Subjects logged the first rating immediately after using the exercise band for five minutes. They compared how they perceived breath energy, tone quality and ease of singing while singing a brief warm-up to singing while using the exercise band. After the initial comparison, they practiced without the exercise band for ten minutes and then compared their perceptions of that time to the warm-up.

Besides being easy to use, the visual analog scale has long been cited as a reliable scoring tool because many intervals can be used without challenging subjects to decide what the correct interval to choose is (Cook *et al*, 2001). Practice tracker data marked

immediately after training with the exercise band was compared to data marked from the ten-minute post training practice. A line graph for each practice period displays a data point for both marks made during each practice session. The visual analog scale lines are 165 mm long. Each rating has a possible 165 data points adding to the reliability of the tool. Each line was measured with a data point recorded at the closest millimeter.

Data Analysis

Because statistical significance was often seen in the phase models for the preliminary studies, averaged phases were compared with a paired samples t-test for the case study. Because subjects had significant negative and positive change from the baseline, the test was two-tailed. The subjects' practice tracker responses and observed results provided data for visual analysis of both trend and variability.

Subjects

The case study had five total subjects. Subject 1 is a soprano. Subject 2 is a baritone. Subject 3 is a soprano. Subject 4 is a tenor. Subject 5 is soprano. All were in their second year of college voice study ages 19 through 20. All five subjects were music majors who reported having studied voice between one and two years.

Data Overview

The following is a comparison of the results from the three case study testing sessions. Session 1 took place before each subject trained with the exercise band over one month. Session 2 took place just after subjects completed the month of training. Session 3 took place one month after session 2. Subjects did not use the exercise band at all during the intervening time between sessions 2 and 3 in order to test for persisting aerodynamic and acoustic change.

All Case Study Subjects' Average Aerodynamic Results

In aerodynamic measures, case study subjects on average showed an increase in subglottal pressure in the training phase that persisted or increased in the post-training phase (Table 8.2). Subglottal pressure was lower in session 2 overall. This testing session occurred just after subjects trained with the exercise band regularly. The lower subglottal pressure levels suggest that the subjects did not need as much subglottal pressure after gaining muscular strength or improved alignment during the training period.

Table 8.2

All Case Study Subjects Averaged Phase Results of Subglottal Pressure (cm of H₂O) for All Three Testing Sessions

| Phase | Before Extended Training | Immediately After Extended Training | After 1 Month of No Training |
|---------------|--------------------------|-------------------------------------|------------------------------|
| Baseline | 10.83 | 8.28 | 10.55 |
| Training | 11.33 | 8.73 | 10.82 |
| Post-Training | 12.30 | 8.97 | 10.50 |

Subjects showed an increase in airflow rate when using the exercise band in the training phase of session 1 (Table 8.3). During sessions 2 and 3, however, subjects reversed this trend, showing a decrease while they used the exercise band in testing. The average decrease during the training and post-training phases of session 3 initially appears to indicate that the subjects were not able to maintain either muscular strength or proper alignment during the month-long training break. The reversal in the third testing session could also reflect the increased subglottal pressure overall that would restrict the airflow rate (Table 8.2 & 8.3).

Table 8.3

All Case Study Subjects Averaged Phase Results of Airflow Rate (ml per second) for All Three Testing Sessions

| Phase | Before Extended Training | Immediately After Extended Training | After 1 Month of No Training |
|---------------|--------------------------|-------------------------------------|------------------------------|
| Baseline | 354 | 365 | 381 |
| Training | 374 | 354 | 368 |
| Post-Training | 356 | 373 | 354 |

Glottal resistance, the ratio of subglottal pressure over airflow rate, was also lowest during session 2 (Table 8.4). The sustained glottal resistance rates during the post-training phases in both session 2 and 3 suggest that subjects did not use as firm glottal closure after regular training with the exercise band.

Table 8.4

All Case Study Subjects Averaged Phase Results of Glottal Resistance (Subglottal Pressure/Airflow Rate) for All Three Testing Sessions

| Phase | Before Extended Training | Immediately After Extended Training | After 1 Month of No Training |
|---------------|--------------------------|-------------------------------------|------------------------------|
| Baseline | 0.0306 | 0.0227 | 0.0277 |
| Training | 0.0303 | 0.0247 | 0.0295 |
| Post-Training | 0.0346 | 0.0241 | 0.0296 |

When glottal resistance was lower, vocal efficiency, the ratio of sound pressure level (SPL) over subglottal pressure times airflow rate, was higher on average (Table 8.5). When SPL, or the loudness of the sung tone, was lowest, however, subjects showed an increase in vocal efficiency. The increase occurred even when glottal resistance was higher and thus not allowing airflow to move as easily (Table 8.4). Glottal resistance and vocal efficiency did not have a perfect inverse relationship due to the variability of SPL.

Table 8.5

All Case Study Subjects Averaged Phase Results of Vocal Efficiency (SPL/Subglottal Pressure*Airflow Rate) for All Three Testing Sessions

| Phase | Before Extended Training | Immediately After Extended Training | After 1 Month of No Training |
|---------------|--------------------------|-------------------------------------|------------------------------|
| Baseline | 0.0246 | 0.0306 | 0.0243 |
| Training | 0.0224 | 0.0302 | 0.0244 |
| Post-Training | 0.0216 | 0.0279 | 0.0260 |

All Case Study Subjects Averaged Phase Results of Sound Pressure Level (SPL) (dB) for All Three Testing Sessions

| Phase | Before Extended Training | Immediately After Extended Training | After 1 Month of No Training |
|---------------|--------------------------|-------------------------------------|------------------------------|
| Baseline | 94.18 | 92.23 | 97.79 |
| Training | 95.04 | 93.16 | 97.15 |
| Post-Training | 94.44 | 93.53 | 96.87 |

Although change between phases within each session and between sessions occurred, aerodynamic change for all case study subjects was not significant in paired samples t-test analysis.

All Case Study Subjects' Average Acoustic Results

When averaging the change for all subjects, every acoustic intensity except average intensity between 2 and 4 kHz in session 3 was higher than the first session. Maximum intensity between 0 and 2 kHz and between 2 and 4 kHz generally was higher during the training phase and lower during the post-training phase (Table 8.6). This led to a decrease in Singing Power Ratio (SPR) in session 1 and 3 when all three phases were averaged (Table 8.6).

Table 8.6

All Case Study Subjects Averaged Phases Maximum Intensity 0-2 kHz (dB) for All Three Testing Sessions

| Phase | Before Extended Training | Immediately After Extended Training | After 1 Month of No Training |
|---------------|--------------------------|-------------------------------------|------------------------------|
| Baseline | 52.80 | 52.92 | 55.67 |
| Training | 52.43 | 53.93 | 56.01 |
| Post-Training | 52.04 | 53.21 | 54.87 |

All Case Study Subjects Averaged Phases Maximum Intensity 2-4 kHz (dB) for All Three Testing Sessions

| Phase | Before Extended Training | Immediately After Extended Training | After 1 Month of No Training |
|---------------|--------------------------|-------------------------------------|------------------------------|
| Baseline | 16.50 | 18.36 | 19.10 |
| Training | 17.00 | 18.57 | 20.29 |
| Post-Training | 16.66 | 17.40 | 19.88 |

All Case Study Subjects Averaged Phases SPR (Maximum Intensity 0-2 kHz – Maximum Intensity 2-4 kHz) for All Three Testing Sessions

| Phase | Before Extended Training | Immediately After Extended Training | After 1 Month of No Training |
|---------------|--------------------------|-------------------------------------|------------------------------|
| Baseline | 36.30 | 34.56 | 36.56 |
| Training | 35.43 | 35.37 | 35.72 |
| Post-Training | 35.38 | 35.81 | 34.99 |

Average intensity between 0 and 2 kHz and between 2 and 4 kHz was also, on average, mostly higher during the training phase with a drop off in the post-training phase (Table 8.7). ER was higher on average in the post-training phase due to the decrease in acoustic energy above 2 kHz (Table 8.7).

Table 8.7

All Case Study Subjects Averaged Average Intensity 0-2 kHz (dB) for All Three Testing Sessions

| Phase | Before Extended Training | Immediately After Extended Training | After 1 Month of No Training |
|---------------|--------------------------|-------------------------------------|------------------------------|
| Baseline | 22.20 | 21.63 | 23.67 |
| Training | 22.19 | 22.39 | 24.60 |
| Post-Training | 21.82 | 21.99 | 23.42 |

All Case Study Subjects Averaged Average Intensity 2-4 kHz (dB) for All Three Testing Sessions

| Phase | Before Extended Training | Immediately After Extended Training | After 1 Month of No Training |
|---------------|--------------------------|-------------------------------------|------------------------------|
| Baseline | 6.70 | 7.09 | 6.46 |
| Training | 6.68 | 7.48 | 7.29 |
| Post-Training | 6.70 | 6.87 | 6.79 |

All Case Study Subjects Averaged ER (Average Intensity 0-2 kHz – Average Intensity 2-4 kHz) for All Three Testing Sessions

| Phase | Before Extended Training | Immediately After Extended Training | After 1 Month of No Training |
|---------------|--------------------------|-------------------------------------|------------------------------|
| Baseline | 15.50 | 14.54 | 17.22 |
| Training | 15.51 | 14.91 | 17.31 |
| Post-Training | 15.12 | 15.12 | 16.62 |

Average intensity between 600 and 800 Hz and between 900 and 1400 Hz was higher in the training phase on average and again lower during the post-training phase, but never lower than the baseline measure (Table 8.8). The subjects on average showed persisting increased acoustic energy especially below 2 kHz.

Table 8.8

All Case Study Subjects Averaged Average Intensity 600-800 Hz (dB) for All Three Testing Sessions

| Phase | Before Extended Training | Immediately After Extended Training | After 1 Month of No Training |
|---------------|--------------------------|-------------------------------------|------------------------------|
| Baseline | 28.13 | 28.24 | 32.06 |
| Training | 28.57 | 30.02 | 33.00 |
| Post-Training | 28.65 | 29.38 | 31.01 |

All Case Study Subjects Averaged Average Intensity 900-1400 Hz (dB) for All Three Testing Sessions

| Phase | Before Extended Training | Immediately After Extended Training | After 1 Month of No Training |
|---------------|--------------------------|-------------------------------------|------------------------------|
| Baseline | 25.75 | 25.33 | 27.98 |
| Training | 26.04 | 26.28 | 29.15 |
| Post-Training | 25.90 | 25.81 | 28.21 |

All Case Study Subjects' Acoustic Measures Paired Samples T-Tests

Paired samples t-tests revealed that many of these differences between phases were significant both between the baseline phase and training phase and again between the baseline phase and post-training phase (Table 8.9). As indicated in the observed results, the significant differences were mostly in the intensity measures below 2 kHz. All significant results had large effect sizes indicating that these intensity increases were perceivable. Increases between average intensity between 600 and 800 Hz indicate added warmth or depth to the tone quality. Increases between average intensity between 900 and 1400 Hz indicate added vowel clarity or brightness to the tone quality.

Table 8.9

Significant Results of All Averaged Case Study Subject's Acoustic Measures Paired Samples T-Test between Baseline Phase and Training Phase, $n=15$, $df=14$

| Variable | Paired Differences | | | Cohen's d | t | p |
|-----------------|--------------------|------|-----------------|-------------|------|---------|
| | Mean | SD | CI Lower, Upper | | | |
| SPR | 5.19 | 6.44 | 1.62, 8.75 | 1.11 | 3.12 | 0.007 |
| ER | 3.62 | 2.63 | 2.16, 5.08 | 1.67 | 5.33 | <0.0001 |
| Avg 600-800 Hz | 8.17 | 6.22 | 4.73, 11.61 | 1.9 | 5.09 | <0.0001 |
| Avg 900-1400 Hz | 3.5 | 3.94 | 1.32, 5.68 | 1.11 | 3.45 | 0.004 |
| Avg 0-2 kHz | 3.62 | 6.86 | -0.17, 7.42 | 0.88 | 2.05 | 0.06 |
| Max 0-2 kHz | 4.83 | 4.42 | 2.39, 7.28 | 1.26 | 4.24 | 0.001 |

Significant Results of All Averaged Case Study Subject's Acoustic Measures Paired Samples T-Test between Baseline Phase and Post-Training Phase, $n=15$, $df=14$

| Variable | Paired Differences | | | Cohen's d | t | p |
|-----------------|--------------------|------|-----------------|-------------|------|---------|
| | Mean | SD | CI Lower, Upper | | | |
| ER | 3.03 | 3.1 | 1.31, 4.75 | 1.44 | 3.78 | 0.002 |
| Avg 600-800 Hz | 7.06 | 4.18 | 4.74, 9.37 | 1.75 | 6.54 | <0.0001 |
| Avg 900-1400 Hz | 4.27 | 3.74 | 2.2, 6.36 | 1.49 | 4.42 | 0.001 |
| Avg 0-2 kHz | 3.1 | 3.69 | 1.06, 5.14 | 0.90 | 3.25 | 0.006 |

Note: SD = standard deviation; CI = confidence interval; Cohen's d = effect level; $p < 0.05$ = significant (2-tailed).

All Case Study Subjects' Average Practice Tracking Results

Subjects had varying reactions to using the exercise band during practice (Figure 8.2). Some subjects felt more favorable change during the training time than during the post-training time and vice versa. Only case study subjects 3 and 4 had an increasing trend over the month in all perception categories. The other three subjects showed static or slightly decreasing trends overall in at least two categories. When subjects' variance between the training and post-training ratings decreased in the last ten days, they showed more change in both aerodynamic and acoustic measures in testing after the month-long training period.

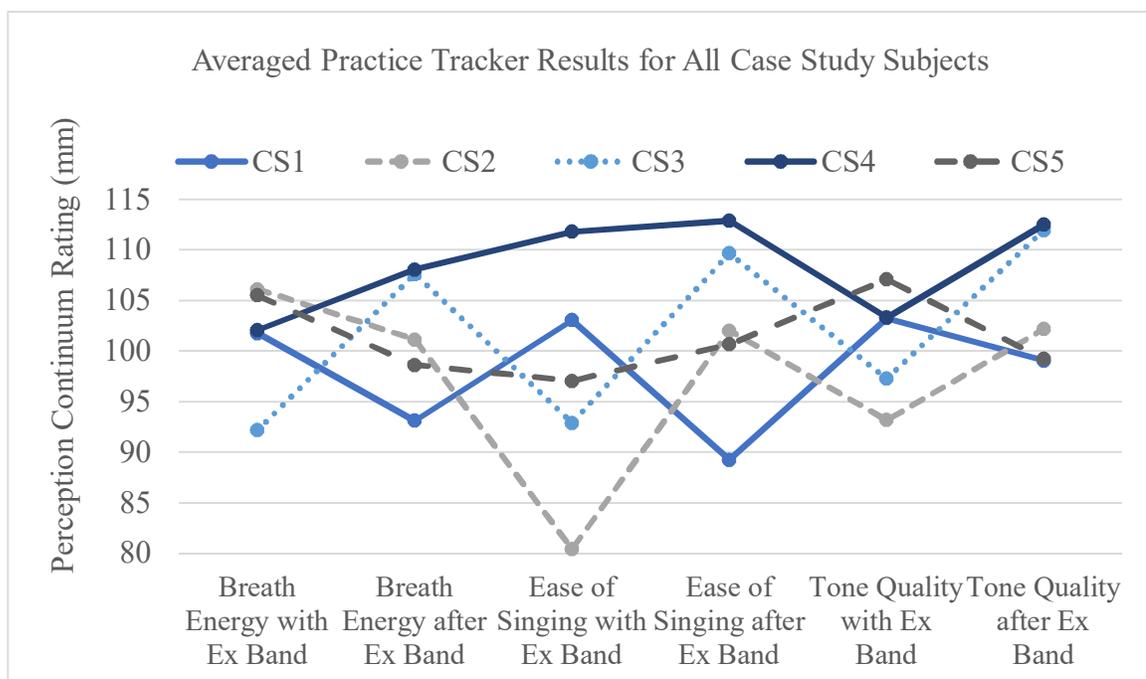


Figure 8.2 Averaged Practice Tracker Results for All Case Study Subjects

Individual Case Study Subject Data Overview

Below are the results of two subjects who showed both aerodynamic and acoustic change after practicing with the exercise band for one month and again after ceasing to use the exercise band for another month. Both subjects indicated on their practice trackers that their perceived breath energy, ease of singing and tone quality while practicing with exercise band and just after felt similar in the last week of training. Case study subject 1 is a soprano in her second year of study. Case study subject 4 is a tenor in his second year of study.

Case Study Subject 1's Practice Tracking Results

At the beginning of the month-long training period, subject 1 perceived that her breath energy seemed to last longer when she used the exercise band. (Figure 8.3). She did not perceive that increased breath energy continued when she practiced without the

band. The difference between these two ratings had decreased by the last week of training. She had the same decrease in variance between the two ratings in perceived ease of singing and tone quality (Figures 8.4 and 8.5).

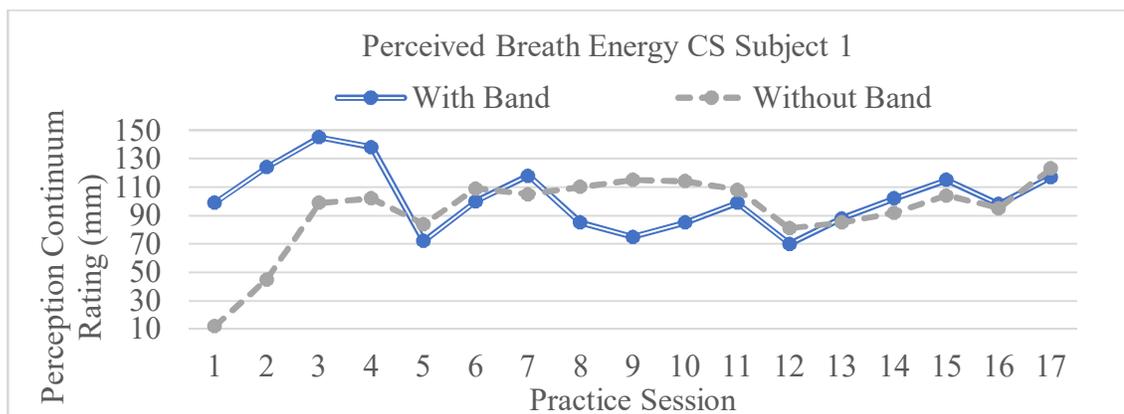


Figure 8.3 Perceived Breath Energy Case Study Subject 1

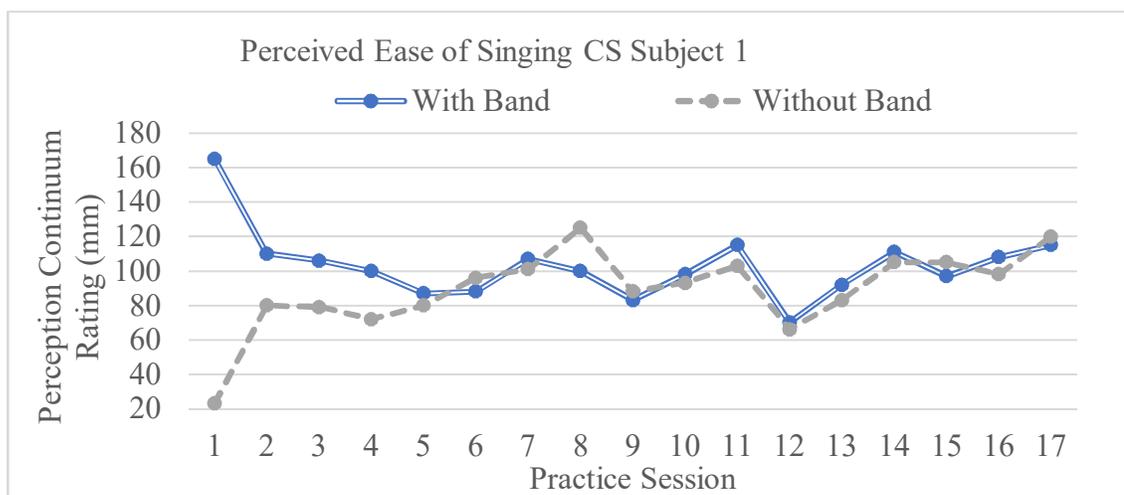


Figure 8.4 Perceived Ease of Singing Case Study Subject 1

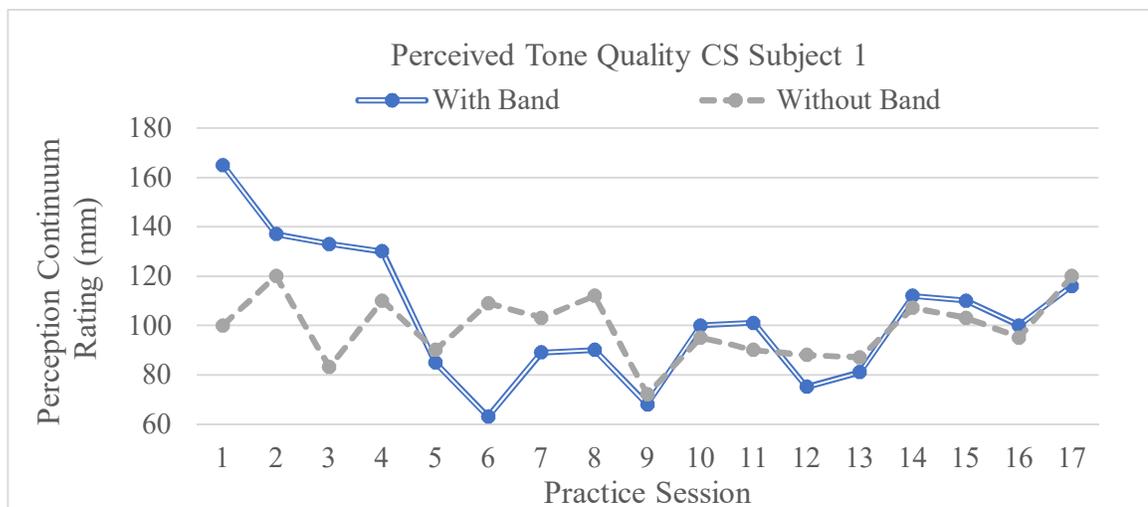


Figure 8.5 Perceived Tone Quality CS Subject 1

The small amount of variability between measures suggests that subject 1 felt that she was gaining muscular strength or improved control during training that would persist after she used the exercise band. The perception changes appear to match her significant changes in aerodynamic and acoustic measures outlined in the following sections.

Case Study Subject 1's Aerodynamic Results

Subject 1 had relatively large increases in both subglottal pressure and airflow between session 1 and session 2 (Table 8.10). The increases persisted in session 3 after subject 1 had not trained with the exercise band for a month.

Table 8.10

Case Study Subject 1 Averaged Phase Results of Subglottal Pressure (cm of H₂O) for Three Testing Sessions

| Phase | Before Extended Training | Immediately After Extended Training | After 1 Month of No Training |
|---------------|--------------------------|-------------------------------------|------------------------------|
| Baseline | 13.46 | 17.85 | 20.09 |
| Training | 15.27 | 18.86 | 20.11 |
| Post-Training | 14.78 | 17.56 | 17.85 |

Case Study Subject 1 Averaged Phase Results of Airflow Rate (ml per second) for Three Testing Sessions

| Phase | Before Extended Training | Immediately After Extended Training | After 1 Month of No Training |
|---------------|--------------------------|-------------------------------------|------------------------------|
| Baseline | 233 | 404.8 | 392.0 |
| Training | 278 | 384.8 | 403.1 |
| Post-Training | 178 | 354.9 | 328.9 |

Glottal resistance (GR) and vocal efficiency (VE) changed as well due to the large increases in subglottal pressure (P_{sub}) and airflow rate. Subject 1 showed a decrease in glottal resistance and vocal efficiency between sessions 1 and 2 that persisted or decreased further in session 3 (Table 8.11). Subject 1's airflow rate increase was large enough to counterbalance her subglottal pressure increase accounting for the decrease in glottal resistance. Vocal efficiency was half as large as session 1 in session 2 and 3 due to the increases in both subglottal pressure and airflow.

Table 8.11
Case Study Subject 1 Averaged Phase Results of Glottal Resistance (Psub/Airflow) for Three Testing Sessions

| Phase | Average Glottal Resistance (Psub/Airflow) | | |
|---------------|---|-------------------------------------|------------------------------|
| | Before Extended Training | Immediately After Extended Training | After 1 Month of No Training |
| Baseline | 0.061 | 0.047 | 0.052 |
| Training | 0.055 | 0.050 | 0.050 |
| Post-Training | 0.088 | 0.052 | 0.054 |

Case Study Subject 1 Averaged Phase Results of Vocal Efficiency (SPL/Psub*Airflow) for Three Testing Sessions

| Phase | Average Vocal Efficiency (SPL/Psub*Airflow) | | |
|---------------|---|-------------------------------------|------------------------------|
| | Before Extended Training | Immediately After Extended Training | After 1 Month of No Training |
| Baseline | 0.0303 | 0.0145 | 0.0123 |
| Training | 0.0224 | 0.0149 | 0.0124 |
| Post-Training | 0.0357 | 0.0175 | 0.0170 |

Case Study Subject 1's Acoustic Results

Subject 1 showed large changes in aerodynamic measures that may relate to the following acoustic measure changes. She showed a decrease in maximum intensity between 0 and 2 kHz in the training phase and post-training phase of all three sessions (Table 8.12). Subject 1's levels were highest overall in session 3, but it does not appear that subject 1 strengthened maximum intensity between 0 and 2 kHz when using the exercise band and after. Subject 1's maximum intensity between 2 and 4 kHz is higher overall in session 2 and session 3 after she trained with the exercise band. The resulting SPR the difference between maximum intensity between 0 and 2 kHz and maximum intensity between 2 and 4 kHz, was lower on average in the training phase. It was higher, however, in the post-training phase on average and showed inconsistent levels during each session. The varying change suggests that subject 1 would need further training with

the exercise band to regularly make any resonance or respiratory adjustments she began to make during the month of training.

Table 8.12

Case Study Subject 1 Average Phase Maximum Intensity 0-2 kHz (dB) Measure for All Three Testing Sessions

| Phase | Before Extended Training | Immediately After Extended Training | After 1 Month of No Training |
|---------------|--------------------------|-------------------------------------|------------------------------|
| Baseline | 53.31 | 50.49 | 59.35 |
| Training | 52.17 | 50.34 | 58.90 |
| Post-Training | 50.44 | 50.84 | 55.24 |

Case Study Subject 1 Average Phase Maximum Intensity 2-4 kHz (dB) Measure for All Three Testing Sessions

| Phase | Before Extended Training | Immediately After Extended Training | After 1 Month of No Training |
|---------------|--------------------------|-------------------------------------|------------------------------|
| Baseline | 15.19 | 17.59 | 17.48 |
| Training | 17.85 | 16.30 | 18.88 |
| Post-Training | 12.90 | 17.11 | 15.66 |

Case Study Subject 1 Average Phase Singing Power Ratio (Max 0-2 kHz – Max 2-4 kHz) Measure for All Three Testing Sessions

| Phase | Before Extended Training | Immediately After Extended Training | After 1 Month of No Training |
|---------------|--------------------------|-------------------------------------|------------------------------|
| Baseline | 38.12 | 32.90 | 41.87 |
| Training | 34.32 | 34.03 | 40.02 |
| Post-Training | 37.54 | 33.73 | 39.58 |

Like maximum intensity between 0 and 2 kHz, subject 1's average intensity in this region was lower on average in both the training phase and post-training phase. Subject 1 showed an increase in average intensity between 2 and 4 kHz during the training phase followed by a decrease in the post-training phase (Table 8.13). Despite the decreasing intensity above 2 kHz, subject 1 showed a decrease in ER that indicates some increased spectral energy in this region.

Table 8.13

Case Study Subject 1 Average Phase Average Intensity 0-2 kHz (dB) Measure for All Three Testing Sessions

| Phase | Before Extended Training | Immediately After Extended Training | After 1 Month of No Training |
|---------------|--------------------------|-------------------------------------|------------------------------|
| Baseline | 21.4 | 18.82 | 23.47 |
| Training | 20.9 | 18.78 | 23.59 |
| Post-Training | 19.6 | 18.81 | 21.77 |

Case Study Subject 1 Average Phase Average Intensity 2-4 kHz (dB) Measure for All Three Testing Sessions

| Phase | Before Extended Training | Immediately After Extended Training | After 1 Month of No Training |
|---------------|--------------------------|-------------------------------------|------------------------------|
| Baseline | 5.48 | 5.69 | 3.84 |
| Training | 6.01 | 4.93 | 4.75 |
| Post-Training | 4.50 | 5.59 | 4.28 |

Case Study Subject 1 Average Phase Energy Ratio (Avg 0-2 kHz – Avg 2-4 kHz) Measure for All Three Testing Sessions

| Phase | Before Extended Training | Immediately After Extended Training | After 1 Month of No Training |
|---------------|--------------------------|-------------------------------------|------------------------------|
| Baseline | 15.93 | 13.13 | 19.63 |
| Training | 14.86 | 13.84 | 18.84 |
| Post-Training | 15.06 | 13.22 | 17.49 |

Between 600 and 800 Hz and between 900 and 1400 Hz, subject 1 showed a decrease in average intensity in both the training phase and post-training phase (Table 8.14). These decreases confirm that subject 1 did not gain acoustic strength below 2 kHz from using the exercise band.

Table 8.14

Case Study Subject 1 Average Phase Average Intensity 600-800 Hz (dB) Measure for All Three Testing Sessions

| Phase | Before Extended Training | Immediately After Extended Training | After 1 Month of No Training |
|---------------|--------------------------|-------------------------------------|------------------------------|
| Baseline | 30.63 | 27.34 | 35.47 |
| Training | 29.18 | 26.45 | 34.84 |
| Post-Training | 27.46 | 25.68 | 31.32 |

Case Study Subject 1 Average Phase Average Intensity 900-1400 Hz (dB) Measure for All Three Testing Sessions

| Phase | Before Extended Training | Immediately After Extended Training | After 1 Month of No Training |
|---------------|--------------------------|-------------------------------------|------------------------------|
| Baseline | 28.821 | 26.769 | 22.352 |
| Training | 29.144 | 26.228 | 22.419 |
| Post-Training | 26.783 | 24.113 | 22.265 |

Subject 1's long-term average spectra (LTAS) (bandwidth 100) show the increases in maximum and average intensities between 2 and 4 kHz (Figure 8.7). She showed consistent peak frequencies above 2 kHz with small adjustments occurring in the post training phase of session 3. The static peak frequencies between 2 and 4 kHz suggest that subject 1 had little apparent acoustic boost when moving the peak frequency closer to the location of a harmonic of the sung pitch.

The intensities in session 1 are highest during the training phase and close to those shown for all three phases in session 2 (Figure 8.6). The LTAS for session 2 demonstrates that subject 1 had relatively constant levels in the baseline, training and post-training phases. The LTAS for session 3 shows that subject 1 had lost some of the ability to keep intensity levels higher even when not using the exercise band.

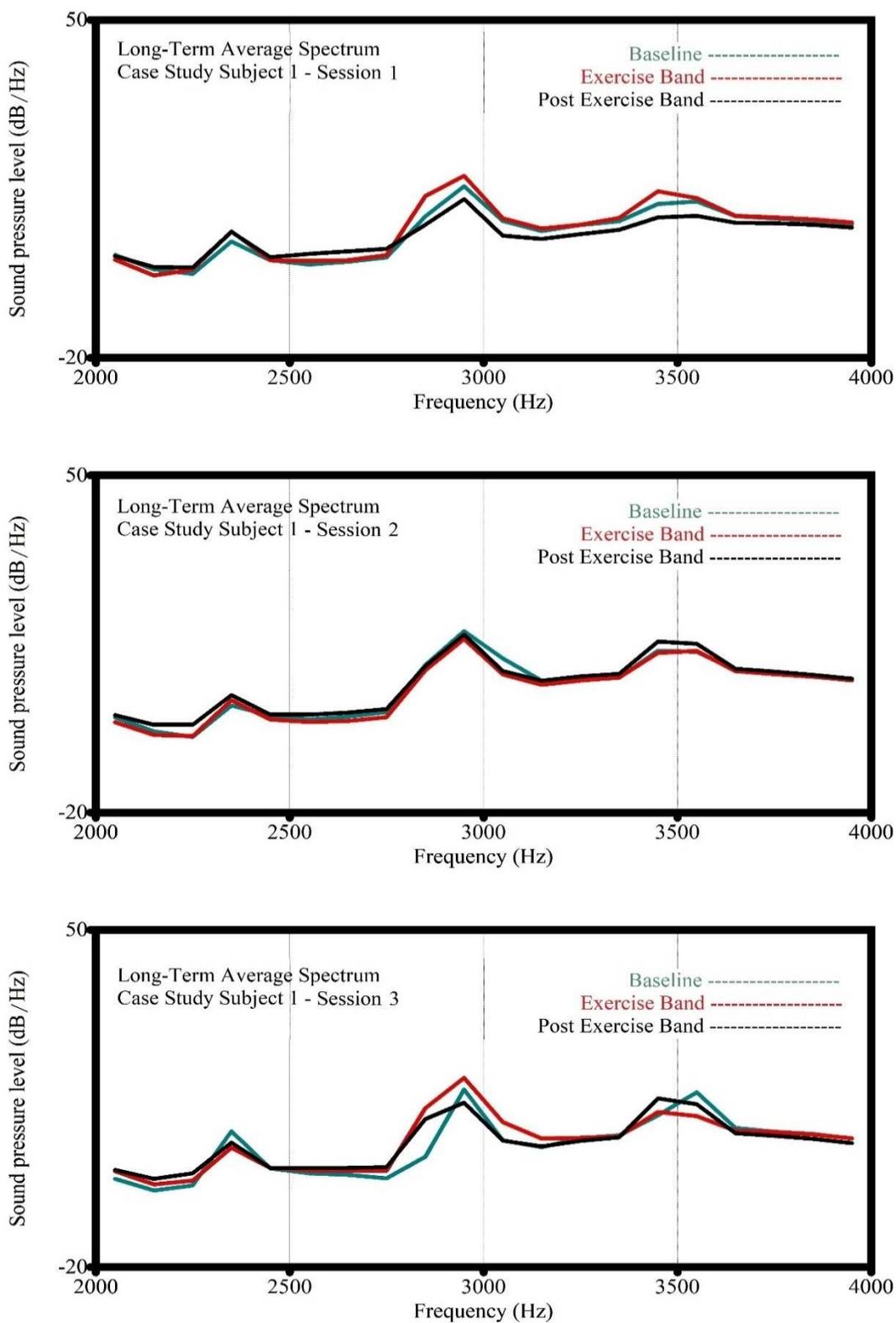


Figure 8.6 Case Study Subject 1's Long-Term Average Spectra 2-4 kHz for All Three Testing Sessions

The persistence of the aerodynamic changes after the second month of practice without the exercise band could relate to subject 1's growing muscular strength and improving ability to adjust alignment as needed. Acoustically subject 1 did not experience the same persistence of change, but she did experience overall increases in nearly every acoustic intensity measure. Subject 1's perception of her tone quality showed the least amount of increase which could be reflective of the decreasing intensity that occurred within testing sessions rather than the gains she made more gradually.

Case Study Subject 4 Practice Tracking Results

At the beginning of the month-long training period, subject 4 perceived more beneficial change in breath energy when he used the exercise band than when he continued to sing without the band (Figure 8.7). By the second week of training, his perceptions switched as he sensed more favorable change after he used the exercise band than while he used it. This trend continued until the end of the practice tracking and aligned with the beneficial changes in aerodynamic measures seen in testing after the training period.

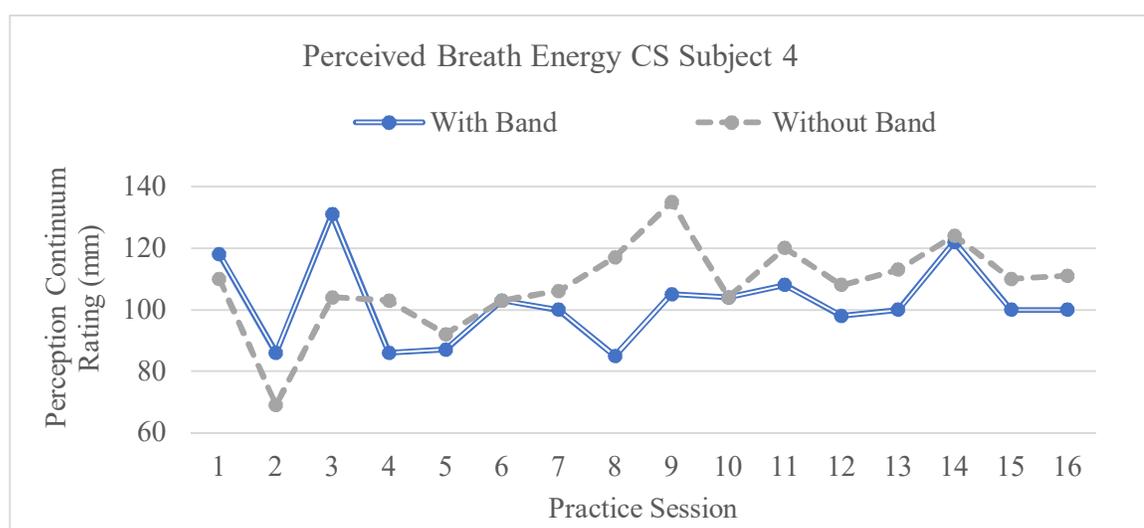


Figure 8.7 Perceived Breath Energy Case Study Subject 4

Subject 4's perception of tone quality improvement also switched from initially occurring with the exercise band to occurring more after using the exercise band (Figure 8.8).

Again, this perception matched with the increasing intensity measures that occurred in testing. Subject 4 perceived that his ease of singing was more variable in both with-band and without-band daily ratings (Figure 8.9). Subject 4 favored singing without the band more as the month progressed.

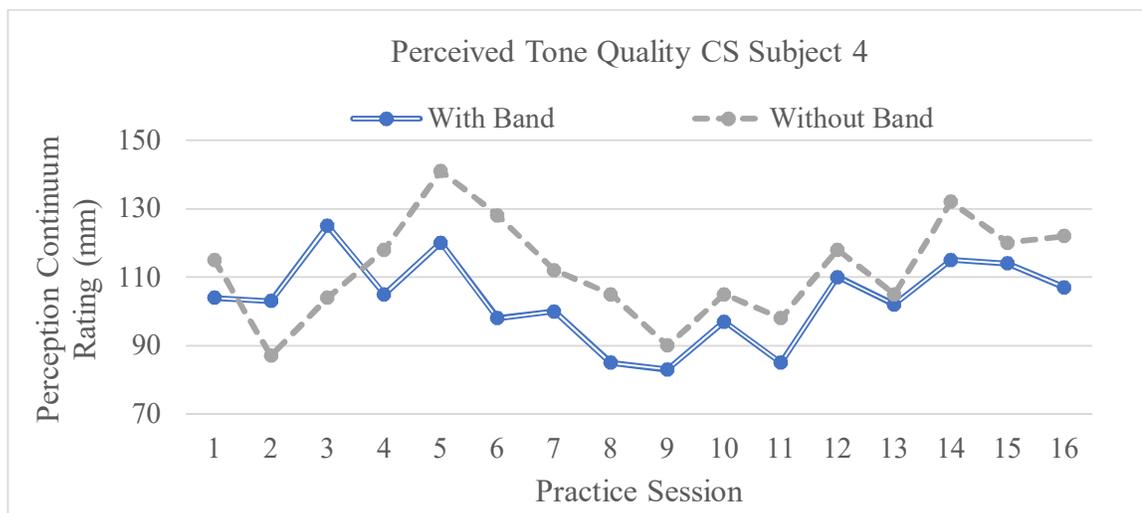


Figure 8.8 Perceived Tone Quality Case Study Subject 4

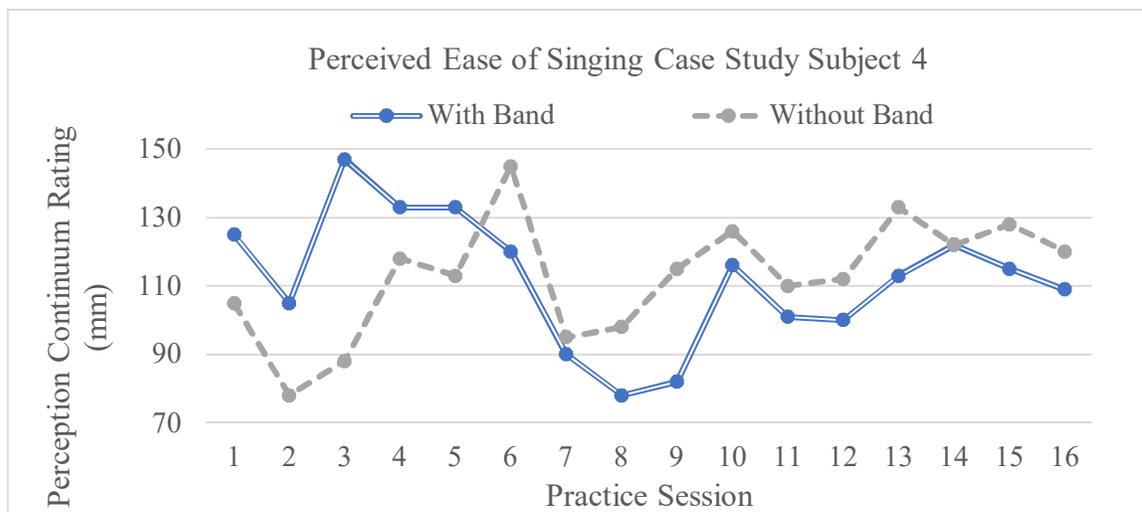


Figure 8.9 Perceived Ease of Singing Case Study Subject 4

Case Study Subject 4 Aerodynamic Results

Subject 4 experienced decreasing aerodynamic measures in sessions 2 and 3. His subglottal pressure and airflow was lower overall (Table 8.15). The largest decreases, however, occurred during the second testing session. Despite the decreases he showed in aerodynamic measures, subject 4 had many of the same acoustic increases that subject 1 had. It is possible that the exercise band provided resistance that affected body alignment and articulator position changing the tone quality, but did not directly change respiration.

Table 8.15

Case Study Subject 4 Average Phase Subglottal Pressure (cm of H₂O) Measure for All Three Testing Sessions

| Phase | Before Extended Training | Immediately After Extended Training | After 1 Month of No Training |
|---------------|--------------------------|-------------------------------------|------------------------------|
| Baseline | 12.13 | 7.87 | 9.75 |
| Training | 12.11 | 8.67 | 9.84 |
| Post-Training | 10.87 | 8.13 | 8.20 |

Case Study Subject 4 Average Phase Airflow Rate (ml per second) Measure for All Three Testing Sessions

| Phase | Before Extended Training | Immediately After Extended Training | After 1 Month of No Training |
|---------------|--------------------------|-------------------------------------|------------------------------|
| Baseline | 415 | 268 | 352 |
| Training | 398 | 211 | 334 |
| Post-Training | 313 | 251 | 330 |

Subject 4 showed an increase in glottal resistance (GR) during session 2 just after he had trained with the exercise band for a month (Table 8.16). The increase was likely due to the dramatic decrease in airflow in the same session. After taking a month off from using the exercise band, he lost any of the gains he made in glottal resistance.

Subject 4's vocal efficiency (VE) was also higher during session 2 because of the decreasing airflow (Table 8.16). He showed some continuing increased efficiency in session 3 after he had not used the exercise band for a month, but not at the same rate.

Table 8.16

Case Study Subject 1 Aerodynamic Measures Average Glottal Resistance (Psub/Airflow)

| Phase | Average GR (Psub/Airflow) | | |
|---------------|---------------------------|-------------------------------------|------------------------------|
| | Before Extended Training | Immediately After Extended Training | After 1 Month of No Training |
| Baseline | 0.0293 | 0.0294 | 0.0277 |
| Training | 0.0304 | 0.0411 | 0.0294 |
| Post-Training | 0.0347 | 0.0324 | 0.0249 |

Case Study Subject 1 Aerodynamic Measures Average Vocal Efficiency (SPL/Psub*Airflow)

| Phase | Average Vocal Efficiency (SPL/Psub*Airflow) | | |
|---------------|---|-------------------------------------|------------------------------|
| | Before Extended Training | Immediately After Extended Training | After 1 Month of No Training |
| Baseline | 0.0180 | 0.0462 | 0.0282 |
| Training | 0.0187 | 0.0529 | 0.0296 |
| Post-Training | 0.0261 | 0.0481 | 0.0360 |

Case Study Subject 4 Acoustic Results

Subject 4 was the only case study subject to increase every acoustic intensity measure from the first testing session to the last. These increases mirrored his overall decrease in aerodynamic measures. Subject 4's decreasing subglottal pressure and airflow appear to align with intensity increases between 2 and 4 kHz.

Subject 4 showed an increase in maximum intensity both below and above 2 kHz over all testing sessions (Table 8.17). His increase in maximum intensity between 2 and 4 kHz from the baseline phase of session 1 to the post-training phase of session 3 was

nearly double the rate. The extremely large intensity increase was responsible for the decreasing SPR. In this instance, the decrease is an indicator of increased spectral energy that will show in subject 4's LTAS as a shallower spectral tilt.

Table 8.17

Case Study Subject 4 Average Phase Maximum Intensity 0-2 kHz (dB) Measure for All Three Testing Sessions

| Phase | Before Extended Training | Immediately After Extended Training | After 1 Month of No Training |
|---------------|--------------------------|-------------------------------------|------------------------------|
| Baseline | 46.38 | 47.52 | 53.53 |
| Training | 47.82 | 48.42 | 55.15 |
| Post-Training | 48.22 | 48.66 | 54.82 |

Case Study Subject 4 Average Phase Maximum Intensity 2-4 kHz (dB) Measure for All Three Testing Sessions

| Phase | Before Extended Training | Immediately After Extended Training | After 1 Month of No Training |
|---------------|--------------------------|-------------------------------------|------------------------------|
| Baseline | 15.64 | 22.16 | 25.81 |
| Training | 16.63 | 24.17 | 29.12 |
| Post-Training | 18.01 | 23.73 | 30.65 |

Case Study Subject 4 Average Phase Singing Power Ratio (Max 0-2 kHz – Max 2-4 kHz) Measure for All Three Testing Sessions

| Phase | Before Extended Training | Immediately After Extended Training | After 1 Month of No Training |
|---------------|--------------------------|-------------------------------------|------------------------------|
| Baseline | 30.74 | 25.36 | 27.72 |
| Training | 31.19 | 24.26 | 26.03 |
| Post-Training | 30.22 | 24.92 | 24.17 |

Subject 4 increased average intensity below and above 2 kHz in each session (Table 8.18). Again, between the baseline phase of session 1 and the post-training phase of session 3, subject 4 showed an increase that was almost double the first measure. ER was lower due to this increase in energy above 2 kHz, confirming the increased spectral energy between 2 and 4 kHz.

Table 8.18

Case Study Subject 4 Average Phase Average Intensity 0-2 kHz (dB) Measure for All Three Testing Sessions

| Phase | Before Extended Training | Immediately After Extended Training | After 1 Month of No Training |
|---------------|--------------------------|-------------------------------------|------------------------------|
| Baseline | 22.06 | 22.33 | 26.06 |
| Training | 22.35 | 22.40 | 27.89 |
| Post-Training | 22.90 | 22.75 | 26.57 |

Case Study Subject 4 Average Phase Maximum Intensity 2-4 kHz (dB) Measure for All Three Testing Sessions

Average Intensity 2-4 kHz (dB) – Exercise Band

| Phase | Before Extended Training | Immediately After Extended Training | After 1 Month of No Training |
|---------------|--------------------------|-------------------------------------|------------------------------|
| Baseline | 7.530 | 11.19 | 11.47 |
| Training | 7.429 | 12.15 | 13.16 |
| Post-Training | 7.869 | 10.82 | 12.94 |

Case Study Subject 4 Average Phase Energy Ration (Average Intensity 0-2 kHz – Average Intensity 2-4 kHz) Measure for All Three Testing Sessions

| Phase | Before Extended Training | Immediately After Extended Training | After 1 Month of No Training |
|---------------|--------------------------|-------------------------------------|------------------------------|
| Baseline | 15.53 | 13.13 | 19.63 |
| Training | 14.86 | 13.84 | 18.84 |
| Post-Training | 15.06 | 13.22 | 17.49 |

Subject 4 also showed an increase in average intensity between 600 and 800 Hz and 900 and 1400 Hz (Table 8.19). Increasing intensity between 600 and 800 Hz likely caused subject 4's tone to gain depth or warmth. The increase in intensity between 900 and 1440 Hz also brightened the tone quality from session to session.

Table 8.19

Case Study Subject 4 Average Phase Average Intensity 600-800 Hz (dB) Measure for All Three Testing Sessions

| Phase | Before Extended Training | Immediately After Extended Training | After 1 Month of No Training |
|---------------|--------------------------|-------------------------------------|------------------------------|
| Baseline | 24.35 | 25.69 | 29.22 |
| Training | 24.87 | 27.55 | 31.92 |
| Post-Training | 25.51 | 27.30 | 29.84 |

Case Study Subject 4 Average Phase Average Intensity 900-1400 (dB) Measure for All Three Testing Sessions

| Phase | Before Extended Training | Immediately After Extended Training | After 1 Month of No Training |
|---------------|--------------------------|-------------------------------------|------------------------------|
| Baseline | 21.8 | 21.83 | 27.19 |
| Training | 21.7 | 22.23 | 29.60 |
| Post-Training | 23.2 | 22.98 | 28.80 |

Subject 4 LTAS for each session show the increasing maximum and average intensity measures between 2 and 4 kHz (Figure 8.10). The resonance peaks on the LTAS are higher as the maximum intensity was higher in each session. The peaks are wider as average intensity between 2 and 4 kHz increased. Subject 4 did not show change in peak frequency location, but the widening peaks indicate that the clustering together of the third, fourth and possibly the fifth formants was beginning to happen.

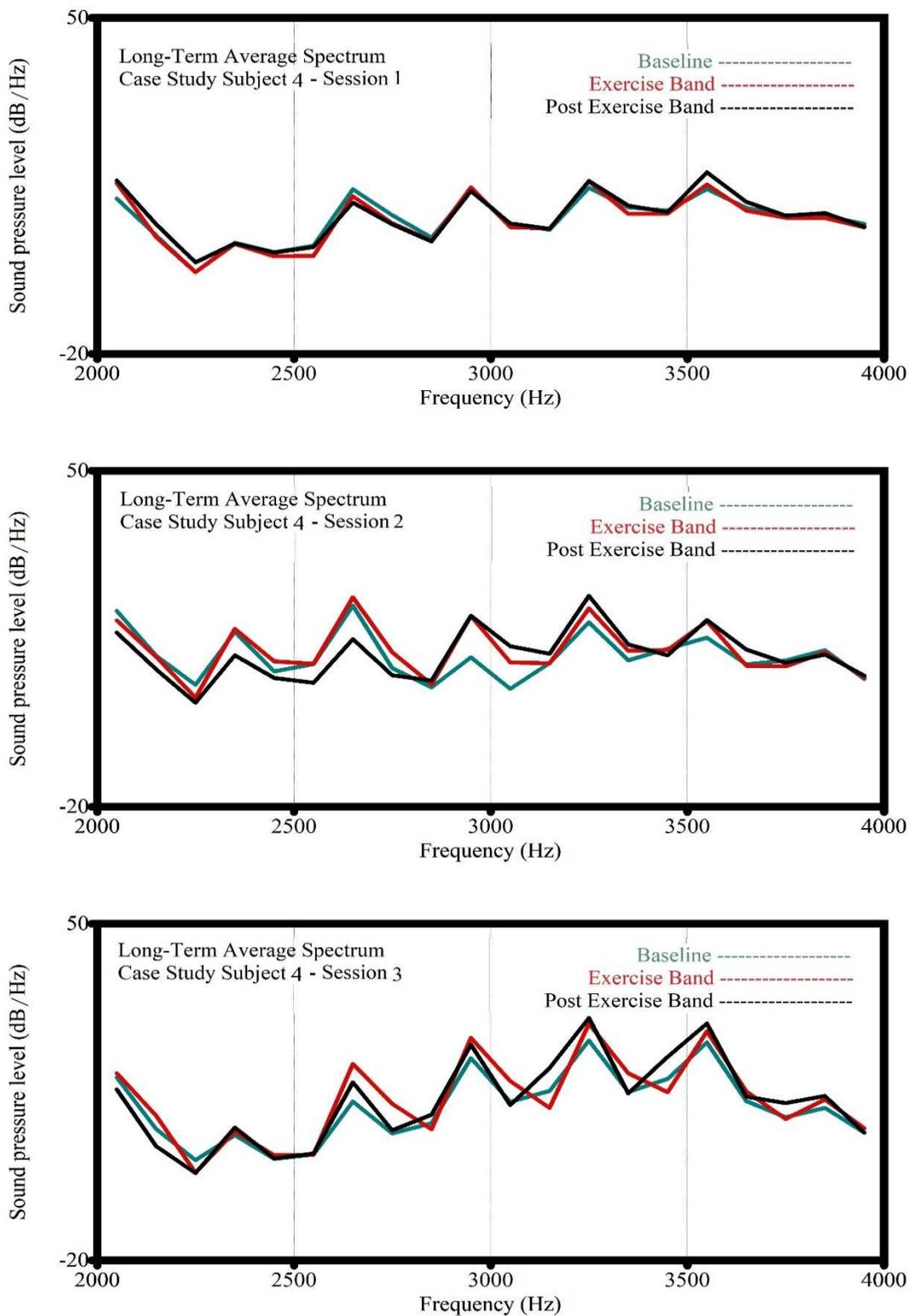


Figure 8.10 Case Study Subject 4's Long-Term Average Spectra 2-4 kHz for Testing Sessions 1-3

Conclusion

The opposite reactions that case study subject 1 and case study subject 4 had to training with the exercise band suggests that it may help influence singers' aerodynamic and acoustic measures in individually-suited ways. On average, subjects appeared to change measures most just after the month-long training period. Some of the change could be attributed to the regular, monitored practice alone. Some changes persisted or increased, however, after subjects did not use the exercise band for a month. The persisting and increasing change points to muscle strengthening and alignment adjustment that occurred during the training period with the exercise band.

CHAPTER 9 – DISCUSSION AND CONCLUSIONS

Possible Training Aid Outcomes

Training aids can engage singers physically, heighten their kinesthesia and proprioception and possibly help singers to address specific individual issues. Training with this equipment regularly can amplify a singer's sense of muscle tension, body alignment and coordinated articulation. Improved perceptions and engagement can enhance singers' ability to access effective and balanced respiration that supports a vibrant tone quality. As they become more aware, singers can release excess tension, strengthen muscles and develop a better cognitive connection to their bodies.

While the above positive outcomes occurred for almost all subjects in these studies to some degree, some had limited favorable reactions. It may be that some singers who use training aids may learn to over-engage muscles causing further excess tension or reinforcing a misunderstood technique. Singers who have not yet developed an accurate understanding of singing technique may only change during use of the training aid, subsequently forgetting what it felt like to engage or coordinate movement. These singers alternatively may not show change when using a training aid. If this occurs, it may be a sign that the singer has some fundamental misunderstanding about their body or singing technique that is not otherwise obvious.

Research Overview

The research reported in the previous chapters studied first if a singer made significant change to aerodynamic and acoustic measures in their singing when they used a training aid. The preliminary studies that investigated this question showed that the

exercise band, exercise ball and balance ball all helped subjects make changes in these measures.

Each training aid affected the subglottal pressure and airflow, but preliminary study subjects experienced individualized change. All six subjects in the preliminary studies who increased airflow overall began with an airflow rate that was lower than 400 cm of H₂O. Of the other six who lowered airflow rate overall, five began with airflow rates over 400 cm of H₂O. The sixth subject who lowered airflow and had an airflow rate below 400 cm of H₂O also began with the lowest subglottal pressure of any of the subjects. She showed more than double her baseline subglottal pressure level, increasing glottal resistance as well. With the increased glottal resistance, she lowered airflow.

The training aids generally had the same effect on subglottal pressure. Subjects often showed a higher subglottal pressure level in the training phase and post-training phase of testing even when their baseline measure was relatively high. While these subjects showed increasing subglottal pressure over already high levels, most experienced a decrease in airflow. Other subjects who decreased subglottal pressure also decreased airflow. One subject who showed the highest subglottal pressure of all subjects, had a decrease in subglottal pressure overall. This subject showed a higher airflow rate as a result of the decreased pressure that no longer impeded the air movement. The combinations of change seen indicate how subjects adjusted their respiration according to their individual need when using a training aid.

In acoustic measures six of the twelve subjects showed lower energy ratio (ER) and Omori's singing power ratio (SPR). Five of these subjects lowered ER and SPR by raising average and maximum intensity between 2 and 4 kHz respectively. They also

showed a decreasing spectral tilt on their long-term average spectra (LTAS) during the training and post-training phases. This decrease indicates the possible presence of the singer's formant. The subjects who lowered ER and SPR were likely more resonant above 2 kHz with a more ringing tone quality.

The subjects who did not experience decreases in ER or SPR often increased acoustic energy below 2 kHz. These increases affect the vowel and timbre of the tone. Again, though, the combinations of change measured

The direction of change does not appear to have any consistent relationship with each training method. The amount of change, however, does appear to relate to the methods. As reported earlier, use of the exercise band accounted for the largest amount of change in measures except for airflow. Subjects who used the exercise ball made the most total change to airflow rates, but in all other measures, these subjects made the least amount of change. Subjects who used the balance ball had moderate overall change in each measure.

Research Questions Revisited

The first question this research attempted to answer is whether singers who used these training aids showed change in aerodynamic and acoustic measures. The preliminary studies confirm that singers who use these training aids showed change in both measures. The second question that the research studied was whether any change persisted immediately after using a training aid. The averaged aerodynamic measures of each method showed persisting change in 50% of post-training phases. Paired samples t-tests revealed that 94% of the aerodynamic measures that appeared to show persisting change in the post-training phase had significant differences. The averaged acoustic

measures of each method showed persisting change in 88% in post-training phases. Paired samples t-tests showed less significant change in these observed changes, however. Only 50% of the acoustic measures that showed persisting change had statistically significant changes between the baseline phase and post-training phase.

A case study examined the third research question that asked whether change would persist or possibly increase over the course of regular training with the exercise band. The study also looked at whether the change persists if a singer stops using the exercise band after the extended training period. As already noted, preliminary study subjects who used the exercise band had the largest averaged overall change. The case study showed that four out five subjects had recurring statistically significant change in many aerodynamic and acoustic measures after training with the exercise band regularly for a month. It also indicated that the consistency of their practice tracker perceptual ratings aligned with the measured changes. When their perceptual ratings trended upwards, they regularly showed beneficial change in aerodynamic and acoustic measures. The case study subjects also experienced persisting or even increasing change during the third testing session following a month of not practicing with the exercise band.

Varied Subject Responses

Different changes for different singers could be occurring when they use the training aids. Subjects may have engaged various combinations of respiratory muscles in thoracic cage, abdomen or back. Muscular engagement may have also occurred in the shoulders or neck creating new excess tension that may have negatively influenced testing results. Subjects may have also released excess muscular tension leading to a

more appropriate laryngeal position or more open pharynx. Articulation adjustments then may have occurred that raised acoustic intensities in several frequency regions.

Using the training aids may have influenced the subjects in other ways as well. They may have experienced increased confidence that in turn added to the effectiveness of the training aid. All subjects in the preliminary and case studies may have learned how to do the testing and changed measures simply through skill acquirement. Case study subjects may have made these changes simply by following the month-long practice routine rather than the specific use of the exercise band during that practice. Both skill acquirement and regular practice, however, provide good outcomes of using a training aid even if the outcomes are not directly related to the training aid.

The changes observed in this research may have been the result of any of the above reasons, or a combination of these reasons. Analysis clearly revealed changes occurred when subjects used the training aids and persisted after they used the training aids. While this change is apparent, how using the training aids physically affected singers, if at all, could not be determined without monitoring muscular activity and body alignment.

How Each Method May Benefit Singers

All three training aids benefited singers in different ways, indicating that each method may be used to address different issues. Singers who perceive that their respiration or tone quality improved when using any of these training aids may benefit from their increased confidence. Perceived improvement can begin to change technique and habits so that any favorable change becomes automatic even when a singer is not using a training aid. The exercise band was most effective in changing both aerodynamic

and acoustic measures in this study. Subjects showed the most change in airflow when using the exercise ball. This result suggests that the exercise ball can be used in the voice studio to encourage increased airflow. It also showed potential as an airflow balancing device as it appeared to help one subject reduce a very high airflow level.

The balance ball showed the most potential to influence acoustic measures. Subjects in the balance ball study showed change both below and above 2 kHz. Based on this result, using the balance ball is recommended to both encourage warmth and depth of tone through increased intensity specifically in the first formant region between 600 and 800 Hz or add to the tone's ring through increased intensity above 2 kHz..

Subjects who used the exercise band favorably changed both aerodynamic and acoustic measures. In the voice studio, students could use the exercise band to regulate both airflow and subglottal pressure. The increases subjects showed especially in acoustic intensity above 2 kHz, indicate that the exercise band may also be beneficial to students in producing an increased ringing quality. The case study results also indicate that aerodynamic and acoustic changes become more stabilized and consistent when subjects trained longer with the exercise band. Establishing a regular practice routine with the exercise band could help students make longer lasting results.

Future Study

This research provided experience testing subjects, establishing protocols and procedures and dealing with research challenges with equipment, scheduling and data analysis. Subjects who used the exercise ball were expected to show the amount of change and those who used the balance ball to be the least successful. Because the subjects were both men and women, had widely varied singing experience and informally

reported that they had different preferences in singing styles, testing results were also expected to reflect these differences. In analyzing the data with these differences in mind, no clear relationship between any factors such as sex, experience, or style preference and favorable aerodynamic or acoustic change was found. These experiences will be a basis for designing future research.

While change occurred with each method in aerodynamic and acoustic measures, many questions remain. First, how do subjects make the changes? Muscular engagement, chest wall expansion, and body alignment adjustments are three possible factors that could be studied by monitoring a singer with video and motion capture sensors. Second, do listeners perceive change in resonant tone quality or vowel clarity? A perceptual study that asks other voice professionals to rate whether they perceive change in these factors could confirm change seen in analysis. Recordings of longer musical excerpts would provide a better sample for such a survey and for additional acoustic analysis that tracks change over a wider pitch range that uses different registrations and vowels. Third, do singers maintain or continue change if a training aid is used longer? A longer study that follows subjects for six months to a year or longer could answer how effective training aids might be if used as a consistent practice tool.

Voice teachers advocate for many training aid methods other than the three investigated here. Future research could follow these methods as well. In any of the future studies, researchers could use additional aerodynamic and acoustic measures. Research could also include other observational and statistical analyses to compare methods and subjects. In any future research a larger sample of singers is important to ascertain what singing styles and skill level may benefit most. Future research that

ultimately confirms what change is possible, how it can be achieved and whether it is generalizable to a wider population of singers would complete the research that began here.

Conclusion

Because of the beneficial changes in aerodynamic and acoustic measures, and because no maladaptive changes occurred during testing, this research supports the use of the exercise band, exercise ball and balance ball in the voice studio. Voice teachers should clearly identify the goals for using a training aid with students. Setting expectations will help singers recognize when they begin to achieve results and how to maintain them beyond the voice studio.

Well-defined expectations also establish boundaries that address how long to use a training aid and what warning signs would indicate it is not working well. Singers who experience muscle fatigue or pain should stop using the training aid. The teacher and student can then resolve any misunderstanding of the training method before using it again. If a student has widely varied responses to using a training aid from lesson to lesson, it is also a sign that change may not be occurring. Pressed phonation that develops while a student uses a training aid would be a sign that the student is over-exerting and creating too much subglottal pressure. Likewise, if a student develops a breathy quality while using a training aid, it could be an indication that the student is showing too much increased airflow and needs added glottal resistance. In both cases, stopping the training aid use would be the first course of action to address the unwanted tone quality changes, followed by evaluation of other changes in health or self-perception may have occurred.

Another warning that a training aid is not working is decreased respiratory efficiency and no increased acoustic energy after using the training aid multiple times.

The exercise band had the most beneficial effects, but the exercise ball and balance ball showed that they had also favorable effects in specific areas. The case study that followed subjects who used the exercise band in regular practice over a one-month period demonstrated that subjects favorably changed many measures and reported perceiving improved breath energy, ease of singing and tone quality over the practice month. The beneficial changes shown in testing after the practice period persisted and, in some cases, increased in testing done after the month in which subjects did not use an exercise band regularly.

This research concludes that beneficial change occurs when singers use training aids. The changes often persist immediately after training with them. Extended, regular practice with the exercise band shows more stabilized and consistent change. While further study will better define why and how they affect singers' aerodynamic and acoustic measures, the three training aids and the specific methods tested here are recommended for use in the voice studio.

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APPENDIX A

Institutional Review Board Approval Letters



Official Approval Letter for IRB project #16633 - New Project Form

January 19, 2017

Julie Grives
Glenn Korff School of Music

Kevin Hanrahan
Glenn Korff School of Music
WMB 215, UNL, 68588-0100

IRB Number: 20170116633EP
Project ID: 16633
Project Title: Engaging the Core: A study of an exercise band's benefits to breath regulation in singing

Dear Julie:

This letter is to officially notify you of the approval of your project by the Institutional Review Board (IRB) for the Protection of Human Subjects. It is the Board's opinion that you have provided adequate safeguards for the rights and welfare of the participants in this study based on the information provided. Your proposal is in compliance with this institution's Federal Wide Assurance 00002258 and the DHHS Regulations for the Protection of Human Subjects (45 CFR 46).

You are authorized to implement this study as of the Date of Final Approval: 01/19/2017. This approval is Valid Until: 01/18/2018.

- o Review conducted using expedited review categories 6 and 7 at 45 CFR 46.110
- o Date of Approval: 1/19/2017
- o Date of Expedited review: 1/2/2017
- o Date of Acceptance of Revisions: 1/19/2017
- o Funding: Internal funding
- o Consent waiver: N/A
- o Review of specific regulatory criteria (contingent on funding source): N/A
- o Subpart B, C or D review: N/A

We wish to remind you that the principal investigator is responsible for reporting to this Board any of the following events within 48 hours of the event:

- * Any serious event (including on-site and off-site adverse events, injuries, side effects, deaths, or other problems) which in the opinion of the local investigator was unanticipated, involved risk to subjects or others, and was possibly related to the research procedures;
- * Any serious accidental or unintentional change to the IRB-approved protocol that involves risk or has the potential to recur;
- * Any publication in the literature, safety monitoring report, interim result or other finding that indicates an unexpected change to the risk/benefit ratio of the research;
- * Any breach in confidentiality or compromise in data privacy related to the subject or others; or
- * Any complaint of a subject that indicates an unanticipated risk or that cannot be resolved by the research staff.

For projects which continue beyond one year from the starting date, the IRB will request continuing review and update of the research project. Your study will be due for continuing review as indicated above. The investigator must also advise the Board when this study is finished or discontinued by completing the enclosed Protocol Final Report form and returning it to the Institutional Review Board.

If you have any questions, please contact the IRB office at 402-472-6965.

Sincerely,

Rachel Wenzl, CIP
for the IRB





Official Approval Letter for IRB project #16633 - Change Request Form

November 2, 2017

Julie Grives
Glenn Korff School of Music

Kevin Hanrahan
Glenn Korff School of Music
WMB 215, UNL, 685880100

IRB Number: 20170116633EP
Project ID: 16633
Project Title: Engaging the Core: A study of an exercise band's benefits to breath regulation in singing

Dear Julie:

The Institutional Review Board for the Protection of Human Subjects has completed its review of the Request for Change in Protocol submitted to the IRB.

The change request form has been approved to include the following changes and procedures as described in the form:

Participants will wear a headset microphone during testing, in addition to the pneumatic mask, to record higher quality audio

Date of Expedited review and approval: 11/02/2017

We wish to remind you that the principal investigator is responsible for reporting to this Board any of the following events within 48 hours of the event:

- * Any serious event (including on-site and off-site adverse events, injuries, side effects, deaths, or other problems) which in the opinion of the local investigator was unanticipated, involved risk to subjects or others, and was possibly related to the research procedures;
- * Any serious accidental or unintentional change to the IRB-approved protocol that involves risk or has the potential to recur;
- * Any publication in the literature, safety monitoring report, interim result or other finding that indicates an unexpected change to the risk/benefit ratio of the research;
- * Any breach in confidentiality or compromise in data privacy related to the subject or others; or
- * Any complaint of a subject that indicates an unanticipated risk or that cannot be resolved by the research staff.

This letter constitutes official notification of the approval of the protocol change. You are therefore authorized to implement this change accordingly.

If you have any questions, please contact the IRB office at 402-472-6965.

Sincerely,

Rachel Wenzl, CIP
for the IRB





Official Approval Letter for IRB project #17835 - New Project Form

January 17, 2018

Julie Grives
Glenn Korff School of Music

Kevin Hanrahan
Glenn Korff School of Music
WMB 215, UNL, 685880100

IRB Number: 20180117835EP
Project ID: 17835
Project Title: Examining Training Aids' Benefits to Aerodynamic and Acoustic Measurements in Singing

Dear Julie:

This letter is to officially notify you of the approval of your project by the Institutional Review Board (IRB) for the Protection of Human Subjects. It is the Board's opinion that you have provided adequate safeguards for the rights and welfare of the participants in this study based on the information provided. Your proposal is in compliance with this institution's Federal Wide Assurance 00002258 and the DHHS Regulations for the Protection of Human Subjects (45 CFR 46).

- o Review conducted using expedited review categories 4 and 6 at 45 CFR 46.110
- o Date of Approval: 01/17/2018
- o Date of Expedited review: 12/26/2017
- o Date of Acceptance of Revisions: 01/10/2018
- o Funding (Grant congruency, OSP Project/Form ID and Funding Sponsor Award Number, if applicable): Glenn Korff School of Music Internal
- o Consent waiver : N/A
- o Review of specific regulatory criteria (contingent on funding source): 45 CFR 46
- o Subpart B, C or D review : N/A

You are authorized to implement this study as of the Date of Final Approval: 01/17/2018. This approval is Valid Until: 01/16/2019.

We wish to remind you that the principal investigator is responsible for reporting to this Board any of the following events within 48 hours of the event:

- * Any serious event (including on-site and off-site adverse events, injuries, side effects, deaths, or other problems) which in the opinion of the local investigator was unanticipated, involved risk to subjects or others, and was possibly related to the research procedures;
- * Any serious accidental or unintentional change to the IRB-approved protocol that involves risk or has the potential to recur;
- * Any publication in the literature, safety monitoring report, interim result or other finding that indicates an unexpected change to the risk/benefit ratio of the research;
- * Any breach in confidentiality or compromise in data privacy related to the subject or others; or
- * Any complaint of a subject that indicates an unanticipated risk or that cannot be resolved by the research staff.

For projects which continue beyond one year from the starting date, the IRB will request continuing review and update of the research project. Your study will be due for continuing review as indicated above. The investigator must also advise the Board when this study is finished or discontinued by completing the enclosed Protocol Final Report form and returning it to the Institutional Review Board.

If you have any questions, please contact the IRB office at 402-472-6965.

Sincerely,

Rachel Wenzl, CIP
for the IRB





Official Approval Letter for IRB project #18657 - New Project Form

September 26, 2018

Julie Grives
Glenn Korff School of Music

Kevin Hanrahan
Glenn Korff School of Music
WMB 215, UNL, 685880100

IRB Number: 20180918657EP
Project ID: 18657
Project Title: A Case Study of an Exercise Band's Effects on Aerodynamic and Acoustic Measurements in Singing

Dear Julie:

This letter is to officially notify you of the approval of your project by the Institutional Review Board (IRB) for the Protection of Human Subjects. It is the Board's opinion that you have provided adequate safeguards for the rights and welfare of the participants in this study based on the information provided. Your proposal is in compliance with this institution's Federal Wide Assurance 00002258 and the DHHS Regulations for the Protection of Human Subjects (45 CFR 46).

- o Review conducted using expedited review categories 6 and 7 at 45 CFR 46.110
- o Date of Approval: 09/26/2018
- o Date of Expedited review: 09/05/2018
- o Date of Acceptance of Revisions: 09/26/2018
- o Funding (Grant congruency, DSP Project/Form ID and Funding Sponsor Award Number, if applicable): Internal Department Funds: Hixson-Lied Research and Scholarly Activity Grant
- o Consent waiver: N/A
- o Review of specific regulatory criteria (contingent on funding source): 45 CFR 46
- o Subpart B, C or D review: N/A

You are authorized to implement this study as of the Date of Final Approval: 09/26/2018. This approval is Valid Until: 09/25/2019.

We wish to remind you that the principal investigator is responsible for reporting to this Board any of the following events within 48 hours of the event:

- * Any serious event (including on-site and off-site adverse events, injuries, side effects, deaths, or other problems) which in the opinion of the local investigator was unanticipated, involved risk to subjects or others, and was possibly related to the research procedures;
- * Any serious accidental or unintentional change to the IRB-approved protocol that involves risk or has the potential to recur;
- * Any publication in the literature, safety monitoring report, interim result or other finding that indicates an unexpected change to the risk/benefit ratio of the research;
- * Any breach in confidentiality or compromise in data privacy related to the subject or others; or
- * Any complaint of a subject that indicates an unanticipated risk or that cannot be resolved by the research staff.

For projects which continue beyond one year from the starting date, the IRB will request continuing review and update of the research project. Your study will be due for continuing review as indicated above. The investigator must also advise the Board when this study is finished or discontinued by completing the enclosed Protocol Final Report form and returning it to the Institutional Review Board.

If you have any questions, please contact the IRB office at 402-472-6965.

Sincerely,

Becky R. Freeman

Becky Freeman, CIP
for the IRB



APPENDIX B**Aerodynamic Results for All Studies****EXERCISE BAND SUBJECT 1 AERODYNAMIC DATA**

Subglottal Pressure (Psub), Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency (VE) Test Results for All Phases in All Test Sessions

| Session 1 | Baseline | | | | SPL Cal | 100 | |
|----------------|---------------|----------------|--------------|-------------------|---------------|-----------------|---------------|
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 11101 | 18.14 | 438 | 0.041 | 24.146 | 107 | 299 | 0.0135 |
| 11102 | 17.5 | 418 | 0.042 | 23.886 | 107 | 298 | 0.0146 |
| 11103 | 17.9 | 381 | 0.047 | 21.285 | 107 | 297.9 | 0.0157 |
| 11104 | 16 | 369 | 0.043 | 23.063 | 106 | 286.9 | 0.0180 |
| 11105 | 17.3 | 337 | 0.051 | 19.480 | 106 | 294.7 | 0.0182 |
| 11106 | 17.4 | 345 | 0.050 | 19.828 | 106 | 288.7 | 0.0177 |
| 11107 | 18.1 | 371 | 0.049 | 20.497 | 107 | 297.2 | 0.0159 |
| 11108 | 18 | 433 | 0.042 | 24.056 | 107 | 292 | 0.0137 |
| 11109 | 16.5 | 436 | 0.038 | 26.424 | 107 | 295.8 | 0.0149 |
| 11110 | 17.2 | 394 | 0.044 | 22.907 | 108 | 300.9 | 0.0159 |
| Average | 17.40 | 392.2 | 0.045 | 22.557 | 106.8 | 295.1 | 0.0158 |
| Session 1 | Training | | | | SPL | Pitch Hz | VE |
| | Psub | Airflow | GR | Flow/Press | | | |
| 11201 | 17.2 | 308 | 0.056 | 17.907 | 108 | 295.9 | 0.0204 |
| 11202 | 17.1 | 407 | 0.042 | 23.801 | 108 | 291 | 0.0155 |
| 11203 | 19.2 | 441 | 0.044 | 22.969 | 108 | 292.1 | 0.0128 |
| 11204 | 17.4 | 520 | 0.033 | 29.885 | 109 | 295.4 | 0.0120 |
| 11205 | 18.8 | 465 | 0.040 | 24.734 | 109 | 293.5 | 0.0125 |
| 11206 | 17.8 | 528 | 0.034 | 29.663 | 109 | 295 | 0.0116 |
| 11207 | 18.8 | 461 | 0.041 | 24.521 | 108 | 292.6 | 0.0125 |
| 11208 | 18.2 | 638 | 0.029 | 35.055 | 110 | 293.6 | 0.0095 |
| 11209 | 18.9 | 497 | 0.038 | 26.296 | 109 | 294.4 | 0.0116 |
| 11210 | 18.4 | 443 | 0.042 | 24.076 | 109 | 292.1 | 0.0134 |
| Average | 18.18 | 470.8 | 0.040 | 25.891 | 108.7 | 293.56 | 0.0132 |
| Session 1 | Post-Training | | | | SPL dB | Pitch Hz | VE |
| | Psub | Airflow | GR | Flow/Press | | | |
| 11301 | 17.9 | 374 | 0.048 | 20.894 | 108 | 289.7 | 0.0161 |
| 11302 | 18.3 | 498 | 0.037 | 27.213 | 109 | 292 | 0.0120 |
| 11303 | 18.3 | 490 | 0.037 | 26.776 | 109 | 294.1 | 0.0122 |
| 11304 | 17.1 | 468 | 0.037 | 27.368 | 108 | 294.2 | 0.0135 |
| 11305 | 18.8 | 373 | 0.050 | 19.840 | 108 | 293.7 | 0.0154 |
| 11306 | 17.9 | 412 | 0.043 | 23.017 | 108 | 287.6 | 0.0146 |
| 11307 | 16.3 | 335 | 0.049 | 20.552 | 107 | 279.9 | 0.0196 |
| 11308 | 17.8 | 375 | 0.047 | 21.067 | 107 | 288 | 0.0160 |
| 11309 | 17.9 | 423 | 0.042 | 23.631 | 109 | 286.3 | 0.0144 |
| 11310 | 17.9 | 418 | 0.043 | 23.352 | 108 | 287.6 | 0.0144 |
| Average | 17.82 | 416.6 | 0.043 | 23.371 | 108.1 | 289.3 | 0.0148 |

EXERCISE BAND SUBJECT 1 AERODYNAMIC DATA

Subglottal Pressure (Psub), Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency (VE) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | | SPL Cal | 96 | |
|-----------|---------------|----------------|-----------|-------------------|---------------|-----------------|-----------|
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 12101 | 15.3 | 310 | 0.049 | 20.261 | 95.9 | 289.7 | 0.0202 |
| 12102 | 13.4 | 467 | 0.029 | 34.851 | 97.5 | 298.7 | 0.0156 |
| 12103 | 17.1 | 914 | 0.019 | 53.450 | 108 | 287.7 | 0.0069 |
| 12104 | 14.2 | 426 | 0.033 | 30.000 | 103 | 286.4 | 0.0170 |
| 12105 | 13.2 | 330 | 0.040 | 25.000 | 103 | 287.6 | 0.0236 |
| 12106 | 14.9 | 471 | 0.032 | 31.611 | 103 | 289.3 | 0.0147 |
| 12107 | 13.4 | 450 | 0.030 | 33.582 | 103 | 289.3 | 0.0171 |
| 12108 | 14 | 454 | 0.031 | 32.429 | 103 | 293 | 0.0162 |
| 12109 | 15.5 | 388 | 0.040 | 25.032 | 103 | 290 | 0.0171 |
| 12110 | 12 | 345 | 0.035 | 28.750 | 102 | 286.5 | 0.0246 |
| Average | 14.3 | 455.5 | 0.034 | 31.497 | 102.14 | 289.8 | 0.0173 |
| Session 2 | Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 12201 | 14.4 | 459 | 0.031 | 31.875 | 103 | 289.2 | 0.0156 |
| 12202 | 14.4 | 321 | 0.045 | 22.292 | 103 | 295.1 | 0.0223 |
| 12203 | 13.5 | 485 | 0.028 | 35.926 | 104 | 295.5 | 0.0159 |
| 12204 | 15.5 | 784 | 0.020 | 50.581 | 107 | 290.7 | 0.0088 |
| 12205 | 14.9 | 804 | 0.019 | 53.960 | 108 | 290.1 | 0.0090 |
| 12206 | 17.9 | 776 | 0.023 | 43.352 | 109 | 289.6 | 0.0078 |
| 12207 | 17.5 | 762 | 0.023 | 43.543 | 108 | 290.3 | 0.0081 |
| 12208 | 16.8 | 846 | 0.020 | 50.357 | 108 | 288.1 | 0.0076 |
| 12209 | 15.5 | 917 | 0.017 | 59.161 | 108 | 293.7 | 0.0076 |
| 12210 | 17.9 | 925 | 0.019 | 51.676 | 108 | 290.2 | 0.0065 |
| Average | 15.83 | 707.9 | 0.024 | 44.272 | 106.6 | 291.25 | 0.0109 |
| Session 2 | Post-Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 12301 | 17.8 | 894 | 0.02 | 50.2 | 108 | 291.2 | 0.0068 |
| 12302 | 15.5 | 715 | 0.022 | 45.9 | 108 | 287.3 | 0.0097 |
| 12303 | 16.1 | 703 | 0.023 | 43.8 | 108 | 292.1 | 0.0095 |
| 12304 | 15.2 | 757 | 0.021 | 49.9 | 108 | 290.9 | 0.0094 |
| 12305 | 14.6 | 721 | 0.02 | 49.6 | 107 | 293.9 | 0.0102 |
| 12306 | 14 | 629 | 0.022 | 45.4 | 107 | 294 | 0.0122 |
| 12307 | 19 | 606 | 0.031 | 31.9 | 107 | 291.2 | 0.0093 |
| 12308 | 16.1 | 583 | 0.028 | 36.2 | 106 | 292.6 | 0.0113 |
| 12309 | 14.9 | 677 | 0.022 | 45.4 | 107 | 290 | 0.0106 |
| 12310 | 12.3 | 607 | 0.02 | 49.4 | 107 | 288.2 | 0.0143 |
| Average | 15.55 | 689.2 | 0.023 | 44.77 | 107.3 | 291.1 | 0.0103 |

EXERCISE BAND SUBJECT 1 AERODYNAMIC DATA

Subglottal Pressure (Psub), Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency (VE) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | | | SPL Cal | | 90 | |
|-----------|---------------|----------------|-----------|-------------------|------------|-----------------|-----------|-----------|--|
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE | VE | |
| 13101 | 15.3 | 321 | 0.048 | 20.980 | 97.4 | 292.6 | 0.0198 | 0.0202 | |
| 13102 | 12.1 | 494 | 0.022 | 40.826 | 99.2 | 294.6 | 0.0166 | 0.0156 | |
| 13103 | 14.4 | 455 | 0.032 | 31.597 | 98.4 | 291.6 | 0.0150 | 0.0069 | |
| 13104 | 14.2 | 472 | 0.030 | 33.239 | 98.5 | 288 | 0.0147 | 0.017 | |
| 13105 | 13.5 | 484 | 0.028 | 35.852 | 98.8 | 290 | 0.0151 | 0.0236 | |
| 13106 | 13.3 | 491 | 0.027 | 36.917 | 99.6 | 299.6 | 0.0153 | 0.0147 | |
| 13107 | 12.3 | 501 | 0.025 | 40.732 | 99.5 | 290.9 | 0.0161 | 0.0171 | |
| 13108 | 12.7 | 425 | 0.030 | 33.465 | 90.7 | 293.5 | 0.0168 | 0.0162 | |
| 13109 | 13.2 | 459 | 0.029 | 34.773 | 98.2 | 295.9 | 0.0162 | 0.0171 | |
| 13110 | 13.1 | 418 | 0.031 | 31.908 | 98.1 | 286.9 | 0.0179 | 0.0246 | |
| Average | 13.41 | 452 | 0.030 | 34.029 | 97.84 | 292.36 | 0.0164 | 0.0173 | |
| Session 3 | Training | | | | | SPL Cal | | 90 | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE | VE | |
| 13201 | 13.7 | 504 | 0.027 | 36.788 | 99.5 | 295.1 | 0.0144 | 0.0156 | |
| 13202 | 13.5 | 449 | 0.030 | 33.259 | 98.3 | 290.3 | 0.0162 | 0.0223 | |
| 13203 | 12.6 | 544 | 0.023 | 43.175 | 99.5 | 293.4 | 0.0145 | 0.0159 | |
| 13204 | 13 | 505 | 0.026 | 38.846 | 98.9 | 292.3 | 0.0151 | 0.0088 | |
| 13205 | 16 | 475 | 0.034 | 29.688 | 98.2 | 294.3 | 0.0129 | 0.009 | |
| 13206 | 15 | 395 | 0.038 | 26.333 | 97.8 | 290.9 | 0.0165 | 0.0078 | |
| 13207 | 15.9 | 448 | 0.035 | 28.176 | 98.6 | 289.9 | 0.0138 | 0.0081 | |
| 13208 | 15.6 | 476 | 0.033 | 30.513 | 98.6 | 290.2 | 0.0133 | 0.0076 | |
| 13209 | 12.4 | 462 | 0.027 | 37.258 | 99 | 289.5 | 0.0173 | 0.0076 | |
| 13210 | 16.9 | 513 | 0.033 | 30.355 | 98.7 | 286.4 | 0.0114 | 0.0065 | |
| Average | 14.46 | 477.1 | 0.031 | 33.439 | 98.71 | 291.23 | 0.0145 | 0.0109 | |
| Session 3 | Post-Training | | | | | SPL Cal | | 90 | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE | VE | |
| 13301 | 14.3 | 440 | 0.033 | 30.769 | 98.6 | 301 | 0.0157 | 0.0068 | |
| 13302 | 14.1 | 431 | 0.033 | 30.567 | 97.8 | 294.3 | 0.0161 | 0.0097 | |
| 13303 | 12.9 | 424 | 0.030 | 32.868 | 97.7 | 294.8 | 0.0179 | 0.0095 | |
| 13304 | 11.6 | 471 | 0.025 | 40.603 | 98.2 | 286.1 | 0.0180 | 0.0094 | |
| 13305 | 12 | 435 | 0.028 | 36.250 | 97.6 | 286.2 | 0.0187 | 0.0102 | |
| 13306 | 13.8 | 544 | 0.025 | 39.420 | 98.9 | 292.7 | 0.0132 | 0.0122 | |
| 13307 | 13.6 | 451 | 0.030 | 33.162 | 98.5 | 287.5 | 0.0161 | 0.0093 | |
| 13308 | 13.4 | 464 | 0.029 | 34.627 | 98.2 | 286.6 | 0.0158 | 0.0113 | |
| 13309 | 12.5 | 460 | 0.027 | 36.800 | 98 | 290.5 | 0.0170 | 0.0106 | |
| 13310 | 13.5 | 479 | 0.028 | 35.481 | 98.2 | 288.3 | 0.0152 | 0.0143 | |
| Average | 13.17 | 459.9 | 0.029 | 35.055 | 98.17 | 290.8 | 0.0164 | 0.0103 | |

EXERCISE BAND SUBJECT 2 AERODYNAMIC DATA

Subglottal Pressure, Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency Test Results for All Phases in All Test Sessions

| Session1 | Baseline | | | | SPL Cal | 82 | |
|-----------|---------------|----------------|-----------|-------------------|---------------|-----------------|-----------|
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 21101 | 15.4 | 202 | 0.076 | 13.3 | 85 | 293.6 | 0.0273 |
| 21102 | 14.9 | 203 | 0.073 | 13.6 | 84.1 | 293.5 | 0.0278 |
| 21103 | 14.5 | 148 | 0.098 | 10.2 | 83.1 | 296.1 | 0.0387 |
| 21104 | 13.8 | 108 | 0.128 | 7.82 | 81.8 | 295.8 | 0.0526 |
| 21105 | 14.4 | 121 | 0.119 | 8.4 | 82.3 | 296.5 | 0.0472 |
| 21106 | 13.2 | 353 | 0.037 | 26.9 | 87.6 | 297.7 | 0.0188 |
| 21107 | 15.3 | 321 | 0.048 | 21 | 86.8 | 297.3 | 0.0177 |
| 21108 | 14.2 | 310 | 0.046 | 21.8 | 86.7 | 296.5 | 0.0197 |
| 21109 | 14.2 | 271 | 0.052 | 19.1 | 85.6 | 295 | 0.0222 |
| 21110 | 15.8 | 356 | 0.044 | 22.5 | 89.4 | 295.4 | 0.0159 |
| Average | 14.57 | 239.3 | 0.061 | 16.462 | 85.24 | 295.74 | 0.0244 |
| Session 1 | Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 21201 | 13.5 | 298 | 0.045 | 22.1 | 86.3 | 295 | 0.0215 |
| 21202 | 12.4 | 189 | 0.067 | 15.3 | 83.3 | 297.3 | 0.0355 |
| 21203 | 11.6 | 171 | 0.069 | 14.8 | 82.7 | 299.7 | 0.0417 |
| 21204 | 12.3 | 199 | 0.062 | 16.3 | 83.5 | 294.5 | 0.0341 |
| 21205 | 13.4 | 184 | 0.074 | 13.9 | 83.3 | 296.5 | 0.0338 |
| 21206 | 15.3 | 406 | 0.038 | 26.6 | 88.6 | 297.9 | 0.0143 |
| 21207 | 15.5 | 345 | 0.045 | 22.3 | 87.2 | 296.3 | 0.0163 |
| 21208 | 16.4 | 341 | 0.048 | 20.9 | 87.4 | 293.1 | 0.0156 |
| 21209 | 14.8 | 290 | 0.051 | 19.6 | 86.1 | 295.7 | 0.0201 |
| 21210 | 15.4 | 284 | 0.055 | 18.4 | 86.1 | 293 | 0.0197 |
| Average | 14.06 | 270.7 | 0.052 | 19.02 | 85.45 | 295.9 | 0.0225 |
| Session 1 | Post-Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 21301 | 15.4 | 410 | 0.037 | 26.7 | 88.7 | 294.3 | 0.0140 |
| 21302 | 14.4 | 330 | 0.044 | 22.9 | 87.1 | 292.4 | 0.0183 |
| 21303 | 14.6 | 294 | 0.05 | 20.1 | 86.4 | 293.8 | 0.0201 |
| 21304 | 14.8 | 334 | 0.044 | 22.5 | 87.1 | 293.4 | 0.0176 |
| 21305 | 15.6 | 359 | 0.044 | 23.3 | 87.6 | 293.9 | 0.0156 |
| 21306 | 15.6 | 253 | 0.062 | 16.2 | 85.3 | 294.1 | 0.0216 |
| 21307 | 15.2 | 231 | 0.066 | 15.2 | 84.7 | 292.5 | 0.0241 |
| 21308 | 15 | 211 | 0.071 | 14 | 84.1 | 294 | 0.0266 |
| 21309 | 14 | 197 | 0.072 | 14.1 | 83.3 | 294.4 | 0.0302 |
| 21310 | 14 | 191 | 0.074 | 13.7 | 82.8 | 292 | 0.0310 |
| Average | 14.86 | 281 | 0.053 | 18.87 | 85.71 | 293.48 | 0.0205 |

EXERCISE BAND SUBJECT 2 AERODYNAMIC DATA

Subglottal Pressure (Psub), Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency (VE) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | | SPL Cal | 103 | |
|-----------|---------------|---------|-------|------------|---------|----------|--------|
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 22101 | 14.5 | 314 | 0.046 | 21.7 | 108 | 292.5 | 0.0237 |
| 22102 | 13.2 | 315 | 0.042 | 24.2 | 108 | 293.3 | 0.0260 |
| 22103 | 14.5 | 314 | 0.046 | 21.7 | 108 | 292.5 | 0.0237 |
| 22104 | 15.3 | 312 | 0.049 | 20.4 | 108 | 291.2 | 0.0226 |
| 22105 | 17.1 | 393 | 0.043 | 23.1 | 109 | 293.3 | 0.0162 |
| 22106 | 15.6 | 390 | 0.04 | 25 | 110 | 295.6 | 0.0181 |
| 22107 | 17.2 | 331 | 0.052 | 19.2 | 108 | 295.8 | 0.0190 |
| 22108 | 15.3 | 464 | 0.033 | 30.5 | 111 | 292.4 | 0.0156 |
| 22109 | 14.3 | 531 | 0.027 | 37.3 | 112 | 296.7 | 0.0147 |
| 22110 | 14.9 | 297 | 0.05 | 20 | 108 | 292 | 0.0244 |
| Average | 15.19 | 366.1 | 0.041 | 24.31 | 109 | 293.53 | 0.0196 |
| Session 2 | Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 22201 | 15 | 256 | 0.059 | 17.1 | 106 | 293.4 | 0.0276 |
| 22202 | 16.7 | 301 | 0.056 | 18 | 109 | 294.4 | 0.0217 |
| 22203 | 17.7 | 316 | 0.056 | 17.9 | 107 | 293.3 | 0.0191 |
| 22204 | 15 | 287 | 0.052 | 19.1 | 107 | 293.5 | 0.0249 |
| 22205 | 16.9 | 366 | 0.047 | 21.6 | 109 | 295.1 | 0.0176 |
| 22206 | 15.7 | 421 | 0.037 | 26.9 | 110 | 291.1 | 0.0166 |
| 22207 | 16.9 | 349 | 0.049 | 20.6 | 108 | 291.6 | 0.0183 |
| 22208 | 14.9 | 325 | 0.046 | 21.7 | 108 | 295.2 | 0.0223 |
| 22209 | 14.4 | 401 | 0.036 | 28 | 110 | 296.8 | 0.0190 |
| 22210 | 14.8 | 375 | 0.04 | 25.4 | 109 | 294.6 | 0.0196 |
| Average | 15.8 | 339.7 | 0.047 | 21.63 | 108.30 | 293.90 | 0.0202 |
| Session 2 | Post-Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 22301 | 16.4 | 241 | 0.068 | 14.7 | 106 | 292.8 | 0.0268 |
| 22302 | 15 | 429 | 0.035 | 28.6 | 110 | 297.2 | 0.0171 |
| 22303 | 14.4 | 156 | 0.094 | 10.8 | 104 | 291.2 | 0.0463 |
| 22304 | 15.3 | 312 | 0.049 | 20.4 | 108 | 291.2 | 0.0226 |
| 22305 | 15.2 | 321 | 0.048 | 21.1 | 108 | 290.9 | 0.0250 |
| 22306 | 14.3 | 299 | 0.048 | 20.9 | 107 | 295.7 | 0.0250 |
| 22307 | 15.3 | 250 | 0.061 | 16.3 | 107 | 294.6 | 0.0280 |
| 22308 | 16 | 478 | 0.034 | 30 | 111 | 291.6 | 0.0145 |
| 22309 | 16.2 | 430 | 0.038 | 26.6 | 110 | 293.1 | 0.0158 |
| 22310 | 15.5 | 206 | 0.075 | 13.4 | 105 | 289.8 | 0.0329 |
| Average | 15.36 | 312.20 | 0.049 | 20.28 | 107.60 | 292.81 | 0.0254 |

EXERCISE BAND SUBJECT 2 AERODYNAMIC DATA

Subglottal Pressure (Psub), Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency (VE) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | | SPL Cal | | 103 |
|-----------|---------------|---------|--------|------------|---------|----------|--------|
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 23101 | 16.5 | 363 | 0.046 | 22 | 110 | 297.3 | 0.0184 |
| 23102 | 16.7 | 275 | 0.061 | 16.6 | 101 | 297.4 | 0.0197 |
| 23103 | 17.6 | 321 | 0.055 | 18.3 | 102 | 299.1 | 0.0166 |
| 23104 | 16 | 324 | 0.05 | 20.2 | 102 | 300 | 0.0197 |
| 23105 | 17.8 | 366 | 0.049 | 20.7 | 108 | 303.7 | 0.0166 |
| 23106 | 17.2 | 333 | 0.052 | 19.3 | 107 | 302 | 0.0187 |
| 23107 | 17.7 | 295 | 0.06 | 16.7 | 106 | 301.6 | 0.0203 |
| 23108 | 18.1 | 315 | 0.058 | 17.4 | 107 | 302.2 | 0.0188 |
| 23109 | 17.7 | 332 | 0.053 | 18.8 | 107 | 302.7 | 0.0182 |
| 23110 | 17.2 | 335 | 0.052 | 19.4 | 107 | 300.7 | 0.0186 |
| Average | 17.25 | 325.9 | 0.0529 | 18.94 | 105.7 | 300.67 | 0.0188 |
| Session 3 | Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 23201 | 18.7 | 298 | 0.063 | 15.9 | 107 | 299.5 | 0.0192 |
| 23202 | 18.2 | 373 | 0.049 | 20.6 | 108 | 300 | 0.0159 |
| 23203 | 17.3 | 390 | 0.045 | 22.5 | 108 | 301.2 | 0.0160 |
| 23204 | 17.7 | 348 | 0.051 | 19.7 | 108 | 302.4 | 0.0175 |
| 23205 | 18.1 | 361 | 0.05 | 20 | 108 | 298.9 | 0.0165 |
| 23206 | 18.5 | 417 | 0.044 | 22.6 | 109 | 301.9 | 0.0141 |
| 23207 | 18.5 | 282 | 0.066 | 15.2 | 106 | 300.9 | 0.0203 |
| 23208 | 17.5 | 285 | 0.062 | 16.3 | 107 | 299.5 | 0.0215 |
| 23209 | 18.6 | 433 | 0.043 | 23.4 | 109 | 299.4 | 0.0135 |
| 23210 | 17.3 | 272 | 0.064 | 15.8 | 106 | 297 | 0.0135 |
| Average | 18.04 | 345.9 | 0.0522 | 19.2 | 107.6 | 300.07 | 0.0172 |
| Session 3 | Post-Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 23301 | 16.9 | 298 | 0.057 | 17.7 | 107 | 296.8 | 0.0212 |
| 23302 | 18.2 | 306 | 0.06 | 16.8 | 107 | 299.7 | 0.0192 |
| 23303 | 18.1 | 353 | 0.052 | 19.5 | 108 | 298 | 0.0169 |
| 23304 | 17.1 | 309 | 0.055 | 18.1 | 107 | 298.6 | 0.0203 |
| 23305 | 17.2 | 357 | 0.049 | 20.8 | 108 | 295 | 0.0176 |
| 23306 | 18.1 | 362 | 0.05 | 19.9 | 108 | 297.3 | 0.0165 |
| 23307 | 17.7 | 392 | 0.045 | 22.1 | 108 | 299.1 | 0.0156 |
| 23308 | 16.7 | 321 | 0.052 | 19.2 | 107 | 299.3 | 0.0200 |
| 23309 | 17.6 | 297 | 0.059 | 16.9 | 107 | 299.8 | 0.0205 |
| 23310 | 17.7 | 373 | 0.048 | 21.1 | 111 | 300 | 0.0168 |
| Average | 17.53 | 336.8 | 0.052 | 19.21 | 107.8 | 298.36 | 0.0183 |

EXERCISE BAND SUBJECT 3 AERODYNAMIC DATA

Subglottal Pressure, Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency Test Results for All Phases in All Test Sessions

| Session1 | Baseline | | | | SPL Cal | 90 | VE |
|-----------|---------------|----------------|-----------|-------------------|---------------|-----------------|--------|
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | |
| 31101 | 15.6 | 422 | 0.037 | 27.051 | 97.9 | 295.1 | 0.0149 |
| 31102 | 15.5 | 385 | 0.040 | 24.839 | 97.6 | 293.9 | 0.0164 |
| 31103 | 15.8 | 374 | 0.042 | 23.671 | 97.5 | 291.9 | 0.0165 |
| 31104 | 16 | 421 | 0.038 | 26.313 | 98 | 293.5 | 0.0145 |
| 31105 | 15.1 | 312 | 0.048 | 20.662 | 96.3 | 297.2 | 0.0204 |
| 31106 | 16.4 | 348 | 0.047 | 21.220 | 96.3 | 293.5 | 0.0169 |
| 31107 | 15.8 | 389 | 0.041 | 24.620 | 98 | 294.3 | 0.0159 |
| 31108 | 15.7 | 381 | 0.041 | 24.268 | 97.5 | 293.9 | 0.0163 |
| 31109 | 15.6 | 385 | 0.041 | 24.679 | 97.5 | 294.5 | 0.0162 |
| 31110 | 15.8 | 356 | 0.044 | 22.532 | 97.5 | 295.3 | 0.0173 |
| Average | 15.73 | 377.3 | 0.042 | 23.985 | 97.41 | 294.3 | 0.0164 |
| Session 1 | Training | | | | SPL | Pitch Hz | VE |
| | Psub | Airflow | GR | Flow/Press | | | |
| 31201 | 17.1 | 393 | 0.044 | 22.982 | 98 | 293.9 | 0.0146 |
| 31202 | 16.2 | 504 | 0.032 | 31.111 | 99.9 | 293.9 | 0.0122 |
| 31203 | 16.8 | 497 | 0.034 | 29.583 | 99.9 | 291.8 | 0.0120 |
| 31204 | 16.1 | 531 | 0.030 | 32.981 | 100 | 292.3 | 0.0117 |
| 31205 | 18.3 | 497 | 0.037 | 27.158 | 100 | 295.5 | 0.0110 |
| 31206 | 17.5 | 521 | 0.034 | 29.771 | 100 | 295.8 | 0.0110 |
| 31207 | 16.7 | 524 | 0.032 | 31.377 | 100 | 294.9 | 0.0114 |
| 31208 | 18.6 | 565 | 0.033 | 30.376 | 101 | 295.2 | 0.0096 |
| 31209 | 17.1 | 515 | 0.033 | 30.117 | 100 | 293.6 | 0.0114 |
| 31210 | 17.3 | 482 | 0.036 | 27.861 | 99.6 | 293.9 | 0.0119 |
| Average | 17.17 | 502.9 | 0.034 | 29.332 | 99.84 | 294.08 | 0.0116 |
| Session 1 | Post-Training | | | | SPL dB | Pitch Hz | VE |
| | Psub | Airflow | GR | Flow/Press | | | |
| 31301 | 14.7 | 440 | 0.033 | 29.932 | 98.8 | 294.4 | 0.0153 |
| 31302 | 17.2 | 525 | 0.033 | 30.523 | 100 | 291.1 | 0.0111 |
| 31303 | 17.4 | 517 | 0.034 | 29.713 | 100 | 293 | 0.0111 |
| 31304 | 17.4 | 463 | 0.038 | 26.609 | 99.1 | 292.9 | 0.0123 |
| 31305 | 16.3 | 444 | 0.037 | 27.239 | 99 | 291.4 | 0.0137 |
| 31306 | 16.3 | 478 | 0.034 | 29.325 | 99.6 | 297.7 | 0.0128 |
| 31307 | 16.8 | 513 | 0.033 | 30.536 | 100 | 291.9 | 0.0116 |
| 31308 | 17.6 | 533 | 0.033 | 30.284 | 100 | 292.9 | 0.0107 |
| 31309 | 16.4 | 486 | 0.034 | 29.634 | 99.6 | 293 | 0.0125 |
| 31310 | 16.7 | 435 | 0.038 | 26.048 | 98.7 | 291.5 | 0.0136 |
| Average | 16.68 | 483.4 | 0.035 | 28.984 | 99.48 | 293.1 | 0.0123 |

EXERCISE BAND SUBJECT 3 AERODYNAMIC DATA

Subglottal Pressure (Psub), Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency (VE) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | | SPL Cal | 95 | |
|-----------|---------------|----------------|-----------|-------------------|---------------|-----------------|-----------|
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 32101 | 14.5 | 270 | 0.054 | 18.621 | 100 | 288.5 | 0.0255 |
| 32102 | 13.4 | 281 | 0.048 | 20.970 | 100 | 290.7 | 0.0266 |
| 32103 | 14.2 | 323 | 0.044 | 22.746 | 101 | 290.6 | 0.0220 |
| 32104 | 14.4 | 272 | 0.053 | 18.889 | 100 | 290.5 | 0.0255 |
| 32105 | 13.6 | 250 | 0.054 | 18.382 | 100 | 290.1 | 0.0294 |
| 32106 | 14.5 | 343 | 0.042 | 23.655 | 102 | 291.2 | 0.0205 |
| 32107 | 12.6 | 298 | 0.042 | 23.651 | 101 | 290.1 | 0.0269 |
| 32108 | 13.5 | 268 | 0.050 | 19.852 | 100 | 292.5 | 0.0276 |
| 32109 | 13.5 | 275 | 0.049 | 20.370 | 101 | 288.9 | 0.0272 |
| 32110 | 13.8 | 209 | 0.066 | 15.145 | 98.7 | 291.7 | 0.0342 |
| Average | 13.8 | 278.9 | 0.049 | 20.228 | 100.37 | 290.48 | 0.0261 |
| Session 2 | Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 32201 | 14.6 | 250 | 0.058 | 17.123 | 100 | 291.4 | 0.0274 |
| 32202 | 14.6 | 344 | 0.042 | 23.562 | 102 | 294.3 | 0.0203 |
| 32203 | 19.7 | 388 | 0.051 | 19.695 | 102 | 294 | 0.0133 |
| 32204 | 20 | 333 | 0.060 | 16.650 | 101 | 294.6 | 0.0152 |
| 32205 | 19.9 | 345 | 0.058 | 17.337 | 101 | 291.5 | 0.0147 |
| 32206 | 20.3 | 401 | 0.051 | 19.754 | 102 | 291.2 | 0.0125 |
| 32207 | 19.3 | 329 | 0.059 | 17.047 | 101 | 296.6 | 0.0159 |
| 32208 | 18.8 | 382 | 0.049 | 20.319 | 102 | 294.4 | 0.0142 |
| 32209 | 18.9 | 380 | 0.050 | 20.106 | 102 | 294.1 | 0.0142 |
| 32210 | 18.8 | 406 | 0.046 | 21.596 | 103 | 293.7 | 0.0135 |
| Average | 18.49 | 355.8 | 0.052 | 19.319 | 101.6 | 293.58 | 0.0154 |
| Session 2 | Post-Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 32301 | 18.8 | 403 | 0.047 | 21.436 | 102 | 291.8 | 0.0135 |
| 32302 | 19.6 | 281 | 0.070 | 14.337 | 100 | 293.6 | 0.0182 |
| 32303 | 17.1 | 338 | 0.051 | 19.766 | 101 | 292 | 0.0175 |
| 32304 | 18.7 | 377 | 0.050 | 20.160 | 102 | 293 | 0.0145 |
| 32305 | 18.9 | 345 | 0.055 | 18.254 | 101 | 294.5 | 0.0155 |
| 32306 | 18.9 | 354 | 0.053 | 18.730 | 101 | 292.9 | 0.0151 |
| 32307 | 18.2 | 311 | 0.059 | 17.088 | 101 | 293.4 | 0.0178 |
| 32308 | 19.5 | 407 | 0.048 | 20.872 | 103 | 294.1 | 0.0130 |
| 32309 | 19.4 | 373 | 0.052 | 19.227 | 102 | 292.1 | 0.0141 |
| 32310 | 18.2 | 399 | 0.046 | 21.923 | 102 | 293 | 0.0140 |
| Average | 18.73 | 358.8 | 0.052 | 19.179 | 101.5 | 293.04 | 0.0151 |

EXERCISE BAND SUBJECT 3 AERODYNAMIC DATA

Subglottal Pressure (Psub), Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency (VE) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | | | SPL Cal | 95 |
|-----------|---------------|---------|-------|------------|-------|----------|--------|
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 33101 | 16.5 | 340 | 0.049 | 20.606 | 101 | 296.1 | 0.0180 |
| 33102 | 17.6 | 271 | 0.065 | 15.398 | 94 | 298.9 | 0.0197 |
| 33103 | 16.1 | 256 | 0.063 | 15.901 | 93.6 | 296.2 | 0.0227 |
| 33104 | 18.1 | 210 | 0.086 | 11.602 | 92.4 | 295.4 | 0.0243 |
| 33105 | 17.5 | 190 | 0.092 | 10.857 | 91.5 | 296 | 0.0275 |
| 33106 | 17.8 | 436 | 0.041 | 24.494 | 97.4 | 299 | 0.0126 |
| 33107 | 16.6 | 384 | 0.043 | 23.133 | 96.5 | 299.8 | 0.0151 |
| 33108 | 17.8 | 409 | 0.044 | 22.978 | 96.8 | 299.6 | 0.0133 |
| 33109 | 18.3 | 444 | 0.041 | 24.262 | 97.7 | 297 | 0.0120 |
| 33110 | 18 | 416 | 0.043 | 23.111 | 97.2 | 295.2 | 0.0130 |
| Average | 17.43 | 335.6 | 0.052 | 19.234 | 95.81 | 297.32 | 0.0164 |
| Session 3 | Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 33201 | 18.8 | 504 | 0.037 | 26.809 | 98.8 | 299.3 | 0.0104 |
| 33202 | 19.2 | 490 | 0.039 | 25.521 | 98.6 | 301.9 | 0.0105 |
| 33203 | 17.8 | 472 | 0.038 | 26.517 | 97.9 | 298.1 | 0.0117 |
| 33204 | 18.6 | 472 | 0.039 | 25.376 | 98.1 | 298.7 | 0.0112 |
| 33205 | 18.1 | 495 | 0.037 | 27.348 | 98.5 | 298.2 | 0.0110 |
| 33206 | 17.4 | 435 | 0.040 | 25.000 | 97.5 | 301.4 | 0.0129 |
| 33207 | 17 | 473 | 0.036 | 27.824 | 98.2 | 298.3 | 0.0122 |
| 33208 | 19 | 532 | 0.036 | 28.000 | 99.1 | 299.6 | 0.0098 |
| 33209 | 18.7 | 523 | 0.036 | 27.968 | 99.1 | 297.9 | 0.0101 |
| 33210 | 19 | 446 | 0.043 | 23.474 | 97.8 | 298.1 | 0.0115 |
| Average | 18.36 | 484.2 | 0.038 | 26.384 | 98.36 | 299.15 | 0.0111 |
| Session 3 | Post-Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 33301 | 19.3 | 449 | 0.043 | 23.264 | 97.8 | 298.1 | 0.0113 |
| 33302 | 17.5 | 473 | 0.037 | 27.029 | 98.3 | 299.4 | 0.0119 |
| 33303 | 19.1 | 489 | 0.039 | 25.602 | 98.4 | 296.8 | 0.0105 |
| 33304 | 18.9 | 442 | 0.043 | 23.386 | 97.6 | 297.4 | 0.0118 |
| 33305 | 19.4 | 421 | 0.046 | 21.701 | 97.5 | 296.8 | 0.0119 |
| 33306 | 17.9 | 399 | 0.045 | 22.291 | 96.9 | 293.6 | 0.0136 |
| 33307 | 17.3 | 481 | 0.036 | 27.803 | 98.3 | 294.4 | 0.0118 |
| 33308 | 17.2 | 458 | 0.038 | 26.628 | 98 | 296.2 | 0.0124 |
| 33309 | 18.7 | 428 | 0.044 | 22.888 | 97.6 | 295.4 | 0.0122 |
| 33310 | 17.9 | 424 | 0.042 | 23.687 | 97.2 | 296 | 0.0128 |
| Average | 18.32 | 446.4 | 0.041 | 24.428 | 97.76 | 296.41 | 0.0120 |

EXERCISE BAND SUBJECT 4 AERODYNAMIC DATA

Subglottal Pressure, Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency Test Results for All Phases in All Test Sessions

| Session 1 | Baseline | | | | SPL Cal | 84 | VE |
|-----------|---------------|---------|--------|------------|---------|----------|--------|
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | |
| 41101 | 9.66 | 577 | 0.017 | 60.9 | 95.5 | 574 | 0.0171 |
| 41102 | 8.5 | 424 | 0.02 | 50.3 | 93.4 | 580.4 | 0.0259 |
| 41103 | 7.93 | 316 | 0.025 | 40.1 | 91.9 | 578.8 | 0.0367 |
| 41104 | 7.75 | 301 | 0.028 | 39.3 | 91.1 | 582.2 | 0.0391 |
| 41105 | 12.8 | 294 | 0.045 | 23.3 | 91.4 | 584.5 | 0.0243 |
| 41106 | 12.8 | 286 | 0.046 | 23.8 | 91.5 | 571.6 | 0.0250 |
| 41107 | 11.8 | 312 | 0.039 | 28.3 | 92 | 586 | 0.0250 |
| 41108 | 11.8 | 324 | 0.037 | 27.7 | 92.3 | 584.4 | 0.0241 |
| 41109 | 9.54 | 321 | 0.03 | 33.9 | 92.1 | 583.2 | 0.0301 |
| 41110 | 11.9 | 300 | 0.041 | 25.4 | 92 | 586.5 | 0.0258 |
| Average | 10.448 | 345.5 | 0.030 | 35.3 | 92.32 | 581.16 | 0.0273 |
| Session 1 | Training | | | | SPL | Pitch Hz | VE |
| | Psub | Airflow | GR | Flow/Press | | | |
| 42101 | 13.9 | 338 | 0.041 | 24.3 | 98.4 | 580 | 0.0209 |
| 42102 | 15.2 | 222 | 0.068 | 4.6 | 96.8 | 581.7 | 0.0287 |
| 42103 | 14 | 273 | 0.051 | 19.5 | 97 | 585.6 | 0.0254 |
| 42104 | 13.9 | 268 | 0.053 | 19.3 | 96.3 | 578.1 | 0.0259 |
| 42105 | 13.7 | 251 | 0.055 | 18.3 | 97.1 | 579.9 | 0.0282 |
| 42106 | 13.9 | 248 | 0.057 | 17.8 | 96.9 | 585.9 | 0.0281 |
| 42107 | 14 | 264 | 0.053 | 18.9 | 97.2 | 593.3 | 0.0263 |
| 42108 | 14 | 350 | 0.040 | 24.9 | 98.7 | 582.9 | 0.0201 |
| 42109 | 14 | 317 | 0.044 | 22.7 | 97.9 | 575.4 | 0.0221 |
| 42110 | 13.7 | 282 | 0.050 | 20.2 | 97.4 | 583.7 | 0.0252 |
| Average | 13.92 | 292.2 | 0.048 | 20.9 | 97.62 | 584.24 | 0.0240 |
| Session 1 | Post-Training | | | | SPL dB | Pitch Hz | VE |
| | Psub | Airflow | GR | Flow/Press | | | |
| 43101 | 14.7 | 466 | 0.0310 | 31.8 | 110 | 586.2 | 0.0161 |
| 43102 | 15.1 | 460 | 0.0330 | 30.5 | 110 | 588.5 | 0.0158 |
| 43103 | 15.3 | 488 | 0.0310 | 31.9 | 111 | 587.1 | 0.0149 |
| 43104 | 13.4 | 523 | 0.0260 | 39.2 | 111 | 589.3 | 0.0158 |
| 43105 | 13.1 | 442 | 0.0300 | 32 | 109 | 592.2 | 0.0188 |
| 43106 | 13.1 | 459 | 0.0290 | 35.1 | 110 | 584.1 | 0.0183 |
| 43107 | 14 | 435 | 0.0320 | 31.2 | 109 | 590.3 | 0.0179 |
| 43108 | 13.4 | 434 | 0.0310 | 32.3 | 109 | 582.6 | 0.0187 |
| 43109 | 13.1 | 442 | 0.0300 | 32 | 109 | 592.2 | 0.0188 |
| 43110 | 12.4 | 470 | 0.0260 | 38.1 | 110 | 588 | 0.0189 |
| Average | 13.76 | 461.9 | 0.0298 | 33.41 | 109.8 | 588.05 | 0.0174 |

EXERCISE BAND SUBJECT 4 AERODYNAMIC DATA

Subglottal Pressure (Psub), Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency (VE) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | | SPL Cal | 90 | |
|-----------|---------------|---------|--------|------------|---------|----------|---------|
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 42101 | 13.9 | 338 | 0.041 | 24.3 | 98.4 | 580 | #DIV/0! |
| 42102 | 15.2 | 222 | 0.068 | 4.6 | 96.8 | 581.7 | #DIV/0! |
| 42103 | 14 | 273 | 0.051 | 19.5 | 97 | 585.6 | #DIV/0! |
| 42104 | 13.9 | 268 | 0.053 | 19.3 | 96.3 | 578.1 | #DIV/0! |
| 42105 | 13.7 | 251 | 0.055 | 18.3 | 97.1 | 579.9 | #DIV/0! |
| 42106 | 13.9 | 248 | 0.057 | 17.8 | 96.9 | 585.9 | 0.0281 |
| 42107 | 14 | 264 | 0.053 | 18.9 | 97.2 | 593.3 | 0.0263 |
| 42108 | 14 | 350 | 0.04 | 24.9 | 98.7 | 582.9 | 0.0201 |
| 42109 | 14 | 317 | 0.044 | 22.7 | 97.9 | 575.4 | 0.0221 |
| 42110 | 13.7 | 282 | 0.05 | 20.2 | 97.4 | 583.7 | 0.0252 |
| Average | 13.92 | 292.2 | 0.0488 | 20.9 | 97.62 | 584.24 | #DIV/0! |
| Session 2 | Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 42201 | 14.9 | 306 | 0.049 | 20.6 | 97.7 | 584.3 | 0.0214 |
| 42202 | 15.4 | 299 | 0.052 | 19.4 | 97.3 | 570 | 0.0211 |
| 42203 | 15.4 | 314 | 0.049 | 20.4 | 97.9 | 580.7 | 0.0202 |
| 42204 | 14.3 | 269 | 0.053 | 18.9 | 96.5 | 581.2 | 0.0251 |
| 42205 | 15.5 | 293 | 0.053 | 18.9 | 97.2 | 580.6 | 0.0214 |
| 42206 | 15.3 | 375 | 0.041 | 24.5 | 99 | 576.3 | 0.0173 |
| 42207 | 15.4 | 94.6 | 0.205 | 6.15 | 94.7 | 582.1 | 0.0650 |
| 42208 | 15.4 | 315 | 0.049 | 20.9 | 97.6 | 591.1 | 0.0201 |
| 42209 | 12.9 | 330 | 0.039 | 25.5 | 98.1 | 583.6 | 0.0230 |
| 42210 | 11.5 | 310 | 0.037 | 27 | 97.6 | 572.3 | 0.0274 |
| Average | 14.6 | 290.56 | 0.063 | 20.225 | 97.36 | 580.22 | 0.0262 |
| Session 2 | Post-Training | | | | SPL Cal | 90 | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 42301 | 11.5 | 310 | 0.037 | 27 | 97.6 | 572.3 | 0.0274 |
| 42302 | 13 | 286 | 0.046 | 22.1 | 96.9 | 578.3 | 0.0261 |
| 42303 | 12.9 | 316 | 0.042 | 24.6 | 97.2 | 572 | 0.0238 |
| 42304 | 13 | 279 | 0.047 | 21.4 | 86.8 | 578.6 | 0.0239 |
| 42305 | 13.1 | 293 | 0.045 | 22.4 | 97.8 | 571 | 0.0255 |
| 42306 | 13.1 | 294 | 0.045 | 22.5 | 96.9 | 581.3 | 0.0252 |
| 42307 | 13.1 | 325 | 0.04 | 24.7 | 98.3 | 579.4 | 0.0231 |
| 42308 | 13.1 | 268 | 0.049 | 20.5 | 97 | 586.1 | 0.0276 |
| 42309 | 13.1 | 281 | 0.047 | 21.5 | 97.2 | 581.2 | 0.0264 |
| 42310 | 11.8 | 302 | 0.039 | 25.6 | 97.7 | 587.1 | 0.0274 |
| Average | 12.77 | 295.40 | 0.04 | 23.23 | 96.34 | 578.73 | 0.0256 |

EXERCISE BAND SUBJECT 4 AERODYNAMIC DATA

Subglottal Pressure (Psub), Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency (VE) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | | | | SPL Cal | 100 |
|-----------|---------------|----------------|-----------|-------------------|------------|-----------------|-----------|-----|
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE | |
| 41301 | 12.7 | 293 | 0.043 | 23.2 | 91.8 | 585.8 | 0.0247 | |
| 41302 | 13 | 292 | 0.044 | 22.6 | 91.8 | 583.2 | 0.0242 | |
| 41303 | 7.65 | 324 | 0.024 | 43.7 | 92.3 | 586.9 | 0.0372 | |
| 41304 | 11.2 | 303 | 0.037 | 27.3 | 91.7 | 584.3 | 0.0270 | |
| 41305 | 8.62 | 323 | 0.027 | 37.4 | 92 | 574.3 | 0.0330 | |
| 41306 | 11.8 | 286 | 0.041 | 24.5 | 91.6 | 580.6 | 0.0271 | |
| 41307 | 17.1 | 321 | 0.053 | 18.9 | 92.2 | 585.3 | 0.0168 | |
| 41308 | 14.2 | 227 | 0.063 | 16.2 | 92.5 | 585.4 | 0.0287 | |
| 41309 | 11.9 | 315 | 0.038 | 26.8 | 92 | 585.6 | 0.0245 | |
| 41310 | 11.9 | 221 | 0.054 | 18.8 | 92 | 581.9 | 0.0245 | |
| Average | 12.007 | 290.5 | 0.041 | 25.94 | 91.99 | 583.33 | 0.0268 | |
| Session 3 | Training | | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE | |
| 43201 | 13.5 | 431 | 0.031 | 31.9 | 109 | 586.7 | 0.0187 | |
| 43202 | 14.1 | 451 | 0.031 | 31.9 | 110 | 588.4 | 0.0173 | |
| 43203 | 14.6 | 462 | 0.032 | 31.6 | 110 | 585.6 | 0.0163 | |
| 43204 | 13.6 | 468 | 0.029 | 34.5 | 110 | 585 | 0.0173 | |
| 43205 | 13.3 | 422 | 0.032 | 31.6 | 109 | 589.1 | 0.0194 | |
| 43206 | 14.7 | 430 | 0.034 | 29.3 | 110 | 583.7 | 0.0174 | |
| 43207 | 15 | 422 | 0.036 | 28.1 | 109 | 585.6 | 0.0172 | |
| 43208 | 15.1 | 425 | 0.036 | 28.1 | 109 | 591.8 | 0.0170 | |
| 43209 | 15.8 | 448 | 0.035 | 28.4 | 110 | 588.6 | 0.0155 | |
| 43210 | 12.3 | 468 | 0.026 | 38.1 | 110 | 594.4 | 0.0191 | |
| Average | 14.2 | 442.7 | 0.0321 | 31.35 | 109.6 | 587.89 | 0.0175 | |
| Session 3 | Post-Training | | | | | | SPL Cal | 90 |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE | |
| 43301 | 17.5 | 435 | 0.040 | 24.9 | 110 | 584.7 | 0.0144 | |
| 43302 | 13.1 | 435 | 0.030 | 33.3 | 110 | 584.7 | 0.0193 | |
| 43303 | 15.2 | 452 | 0.034 | 29.7 | 110 | 590.6 | 0.0160 | |
| 43304 | 14.1 | 450 | 0.031 | 31.9 | 110 | 584.3 | 0.0173 | |
| 43305 | 15.3 | 440 | 0.035 | 28.8 | 110 | 588.6 | 0.0163 | |
| 43306 | 13.2 | 462 | 0.029 | 35.2 | 110 | 589.8 | 0.0180 | |
| 43307 | 13.9 | 437 | 0.032 | 31.6 | 109 | 588.7 | 0.0179 | |
| 43308 | 11.3 | 479 | 0.024 | 43 | 110 | 588.8 | 0.0203 | |
| 43309 | 11.2 | 431 | 0.026 | 38.6 | 109 | 577.1 | 0.0226 | |
| 43310 | 12.2 | 423 | 0.029 | 34.6 | 110 | 578.7 | 0.0213 | |
| Average | 13.7 | 444.4 | 0.0308 | 33.16 | 109.8 | 585.6 | 0.0184 | |

EXERCISE BAND SUBJECT 5 AERODYNAMIC DATA

Subglottal Pressure, Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency Test Results for All Phases in All Test Sessions

| Session 1 | Baseline | | | | SPL Cal | 100 | |
|-----------|---------------|----------------|-----------|-------------------|---------------|-----------------|-----------|
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 51101 | 9.85 | 410 | 0.024 | 41.624 | 103 | 583 | 0.0255 |
| 51102 | 8.77 | 459 | 0.019 | 52.338 | 104 | 585.1 | 0.0258 |
| 51103 | 12.5 | 511 | 0.024 | 40.880 | 104 | 580.1 | 0.0163 |
| 51104 | 12.4 | 498 | 0.025 | 40.161 | 104 | 582 | 0.0168 |
| 51105 | 12.8 | 459 | 0.028 | 35.859 | 103 | 581 | 0.0175 |
| 51106 | 12.9 | 478 | 0.027 | 37.054 | 104 | 578.9 | 0.0169 |
| 51107 | 12 | 530 | 0.023 | 44.167 | 104 | 583.16 | 0.0164 |
| 51108 | 12.9 | 360 | 0.036 | 27.907 | 102 | 588.2 | 0.0220 |
| 51109 | 13.2 | 406 | 0.033 | 30.758 | 103 | 589.4 | 0.0192 |
| 51110 | 12.2 | 383 | 0.032 | 31.393 | 102 | 585.3 | 0.0218 |
| Average | 11.952 | 449.4 | 0.027 | 37.600 | 103.3 | 583.62 | 0.0192 |
| Session 1 | Training | | | | SPL | Pitch Hz | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 51201 | 14.6 | 500 | 0.029 | 34.247 | 104 | 581.6 | 0.0142 |
| 51202 | 13 | 461 | 0.028 | 35.5 | 104 | 575.4 | 0.0174 |
| 51203 | 12.5 | 436 | 0.029 | 34.880 | 103 | 581.1 | 0.0189 |
| 51204 | 14.3 | 432 | 0.033 | 30.210 | 104 | 591.8 | 0.0168 |
| 51205 | 16.1 | 457 | 0.035 | 28.385 | 104 | 581.8 | 0.0141 |
| 51206 | 15.1 | 515 | 0.029 | 34.106 | 104 | 574.5 | 0.0134 |
| 51207 | 14.5 | 460 | 0.032 | 31.724 | 104 | 582.1 | 0.0156 |
| 51208 | 15.5 | 486 | 0.032 | 31.355 | 104 | 588 | 0.0138 |
| 51209 | 16.3 | 429 | 0.038 | 26.319 | 104 | 582 | 0.0149 |
| 51210 | 16.1 | 504 | 0.032 | 31.304 | 104 | 587.3 | 0.0128 |
| Average | 14.8 | 468 | 0.032 | 31.799 | 103.9 | 582.56 | 0.0150 |
| Session 1 | Post-Training | | | | SPL dB | Pitch Hz | |
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 51301 | 15.3 | 471 | 0.032 | 30.784 | 104 | 579.7 | 0.0144 |
| 51302 | 14.7 | 482 | 0.030 | 32.789 | 104 | 581.4 | 0.0147 |
| 51303 | 13.1 | 499 | 0.026 | 38.092 | 104 | 583.3 | 0.0157 |
| 51304 | 13.7 | 482 | 0.028 | 35.182 | 104 | 586 | 0.0157 |
| 51305 | 13.4 | 509 | 0.026 | 37.985 | 104 | 582 | 0.0152 |
| 51306 | 13.2 | 501 | 0.026 | 37.955 | 104 | 583.1 | 0.0157 |
| 51307 | 11.4 | 463 | 0.025 | 40.614 | 102 | 578.7 | 0.0193 |
| 51308 | 11.9 | 506 | 0.024 | 42.521 | 104 | 588.9 | 0.0173 |
| 51309 | 13.7 | 440 | 0.031 | 32.117 | 103 | 587 | 0.0171 |
| 51310 | 13.3 | 408 | 0.033 | 30.677 | 102 | 587.4 | 0.0188 |
| Average | 13.37 | 476.1 | 0.028 | 35.872 | 103.5 | 583.75 | 0.0163 |

EXERCISE BAND SUBJECT 5 AERODYNAMIC DATA

Subglottal Pressure (Psub), Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency (VE) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | | SPL Cal | 100 | |
|-----------|---------------|----------------|-----------|-------------------|---------------|-----------------|-----------|
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 52101 | 9.43 | 483 | 0.02 | 51.3 | 111 | 581.4 | 0.0244 |
| 52102 | 9.44 | 399 | 0.024 | 42.6 | 109 | 586.2 | 0.0289 |
| 52103 | 11.1 | 407 | 0.027 | 36.7 | 111 | 588.4 | 0.0246 |
| 52104 | 9.94 | 403 | 0.025 | 40.6 | 111 | 588.5 | 0.0277 |
| 52105 | 8.88 | 440 | 0.02 | 49.7 | 111 | 587.2 | 0.0277 |
| 52106 | 11.9 | 507 | 0.024 | 42.5 | 112 | 590.3 | 0.0284 |
| 52107 | 10.3 | 496 | 0.021 | 48.2 | 112 | 587.8 | 0.0186 |
| 52108 | 12 | 476 | 0.025 | 40 | 111 | 590.2 | 0.0219 |
| 52109 | 12.3 | 475 | 0.026 | 38.6 | 112 | 586 | 0.0194 |
| 52110 | 10.9 | 433 | 0.025 | 39.6 | 111 | 591.1 | 0.0192 |
| Average | 10.62 | 451.9 | 0.0237 | 42.98 | 111.1 | 587.71 | 0.0232 |
| Session 2 | Training | | | | SPL Cal | 96 | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 52201 | 13.2 | 460 | 0.029 | 34.9 | 111 | 581.4 | 0.0183 |
| 52202 | 12.7 | 444 | 0.029 | 35 | 110 | 583.1 | 0.0195 |
| 52203 | 12.2 | 401 | 0.032 | 33 | 109 | 581.88 | 0.0223 |
| 52204 | 13.8 | 432 | 0.033 | 31.6 | 110 | 584.7 | 0.0185 |
| 52205 | 12.5 | 408 | 0.032 | 32.7 | 108 | 577.9 | 0.0212 |
| 52206 | 12.4 | 493 | 0.025 | 39.8 | 112 | 582.2 | 0.0183 |
| 52207 | 11.7 | 432 | 0.027 | 37.1 | 111 | 588.92 | 0.0220 |
| 52208 | 14.6 | 479 | 0.031 | 32.9 | 111 | 586.6 | 0.0159 |
| 52209 | 13.1 | 490 | 0.027 | 37.4 | 112 | 587 | 0.0174 |
| 52210 | 12.6 | 413 | 0.03 | 33 | 110 | 584.8 | 0.0211 |
| Average | 12.88 | 445.20 | 0.03 | 34.74 | 110.40 | 583.85 | 0.0193 |
| Session 2 | Post-Training | | | | SPL Cal | 90 | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 52301 | 12.4 | 496 | 0.025 | 40.1 | 112 | 581.6 | 0.0182 |
| 52302 | 13.1 | 525 | 0.025 | 40.2 | 112 | 583.4 | 0.0163 |
| 52303 | 11.5 | 478 | 0.024 | 41.8 | 111 | 584.2 | 0.0202 |
| 52304 | 12 | 471 | 0.026 | 39.1 | 111 | 583 | 0.0196 |
| 52305 | 12.3 | 503 | 0.024 | 40.9 | 112 | 584.9 | 0.0181 |
| 52306 | 11.9 | 502 | 0.024 | 42.7 | 112 | 589 | 0.0187 |
| 52307 | 14 | 463 | 0.03 | 33.1 | 111 | 587.4 | 0.0171 |
| 52308 | 12 | 370 | 0.033 | 30.8 | 108 | 589 | 0.0243 |
| 52309 | 13.3 | 449 | 0.03 | 33.8 | 110 | 584.2 | 0.0184 |
| 52310 | 13.2 | 463 | 0.029 | 34.9 | 109 | 586.2 | 0.0178 |
| Average | 12.71 | 458.59 | 0.03 | 36.30 | 110.60 | 585.29 | 0.0190 |

EXERCISE BAND SUBJECT 5 AERODYNAMIC DATA

Subglottal Pressure (Psub), Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency (VE) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | | | | SPL Cal | 100 |
|-----------|---------------|----------------|-----------|-------------------|------------|-----------------|-----------|-----|
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE | |
| 53101 | 13.9 | 450 | 0.031 | 32.4 | 100 | 582.2 | 0.0160 | |
| 53102 | 12.3 | 491 | 0.025 | 40.1 | 101 | 577.2 | 0.0167 | |
| 53103 | 13.3 | 461 | 0.029 | 34.8 | 100 | 584.6 | 0.0163 | |
| 53104 | 14.4 | 431 | 0.033 | 34 | 100 | 591.2 | 0.0161 | |
| 53105 | 13.7 | 368 | 0.038 | 26.8 | 98.7 | 590.8 | 0.0196 | |
| 53106 | 13.5 | 465 | 0.029 | 24.6 | 100 | 559.2 | 0.0159 | |
| 53107 | 12.2 | 486 | 0.025 | 39.9 | 100 | 578.8 | 0.0169 | |
| 53108 | 14.3 | 463 | 0.031 | 32.3 | 100 | 588.2 | 0.0151 | |
| 53109 | 14.2 | 486 | 0.029 | 34.5 | 101 | 581.6 | 0.0146 | |
| 53110 | 13.4 | 460 | 0.029 | 34.3 | 101 | 588 | 0.0164 | |
| Average | 13.52 | 456.10 | 0.03 | 33.37 | 100.17 | 582.18 | 0.0162 | |
| Session 3 | Training | | | | | | SPL Cal | 96 |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE | |
| 53201 | 15.7 | 440 | 0.036 | 28 | 101 | 590.4 | 0.0146 | |
| 53202 | 15.2 | 460 | 0.033 | 30.6 | 101 | 581.34 | 0.0144 | |
| 53203 | 14.6 | 319 | 0.062 | 21.7 | 96.4 | 584.2 | 0.0207 | |
| 53204 | 14.2 | 420 | 0.034 | 29.7 | 100 | 581.8 | 0.0168 | |
| 53205 | 15.4 | 430 | 0.036 | 28.1 | 101 | 552.6 | 0.0153 | |
| 53206 | 16.9 | 424 | 0.04 | 25 | 101 | 581.2 | 0.0141 | |
| 53207 | 16 | 413 | 0.039 | 25.9 | 100 | 579 | 0.0151 | |
| 53208 | 15.2 | 391 | 0.039 | 25.9 | 100 | 581.4 | 0.0168 | |
| 53209 | 14.4 | 389 | 0.037 | 27.1 | 101 | 593.9 | 0.0180 | |
| 53210 | 14.9 | 441 | 0.034 | 29.6 | 101 | 580.2 | 0.0154 | |
| Average | 15.25 | 412.7 | 0.039 | 27.16 | 100.24 | 580.60 | 0.0159 | |
| Session 3 | Post-Training | | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE | |
| 53301 | 15.2 | 422 | 0.036 | 27.8 | 101 | 574.7 | 0.0157 | |
| 53302 | 15.3 | 427 | 0.036 | 27.9 | 101 | 581.58 | 0.0155 | |
| 53303 | 14.2 | 388 | 0.037 | 27.4 | 99.2 | 583.2 | 0.0180 | |
| 53304 | 14.3 | 447 | 0.032 | 31.4 | 100 | 585 | 0.0156 | |
| 53305 | 15.2 | 400 | 0.038 | 26.4 | 99.7 | 587.4 | 0.0164 | |
| 53306 | 13.9 | 388 | 0.036 | 27.9 | 98.2 | 588.4 | 0.0182 | |
| 53307 | 13.3 | 450 | 0.029 | 34.1 | 101 | 578.3 | 0.0169 | |
| 53308 | 14.4 | 445 | 0.033 | 31.2 | 101 | 575.4 | 0.0158 | |
| 53309 | 14.8 | 412 | 0.036 | 27.9 | 100 | 585.2 | 0.0164 | |
| 53310 | 12.3 | 415 | 0.029 | 34 | 100 | 559.7 | 0.0196 | |
| Average | 14.29 | 419.4 | 0.0342 | 29.6 | 100.11 | 579.89 | 0.0167 | |

EXERCISE BAND SUBJECT 6 AERODYNAMIC DATA

Subglottal Pressure, Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency Test Results for All Phases in All Test Sessions

| Session1 | Baseline | | | | SPL Cal | 83 | |
|-----------|---------------|----------------|-----------|-------------------|---------------|-----------------|-----------|
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 61101 | 2.81 | 335 | 0.008 | 119.217 | 93.1 | 587 | 0.0989 |
| 61102 | 3.25 | 386 | 0.008 | 118.769 | 88.6 | 596.22 | 0.0706 |
| 61103 | 2.99 | 147 | 0.020 | 49.164 | 83.7 | 589.8 | 0.1904 |
| 61104 | 4.54 | 367 | 0.012 | 80.837 | 85.4 | 589.6 | 0.0513 |
| 61105 | 2.88 | 173 | 0.017 | 60.069 | 85.2 | 587 | 0.1710 |
| 61106 | 2.91 | 407 | 0.007 | 139.863 | 89.8 | 590.4 | 0.0758 |
| 61107 | 3.07 | 404 | 0.008 | 131.596 | 91.1 | 593.94 | 0.0735 |
| 61108 | 4.54 | 387 | 0.012 | 85.242 | 89.8 | 594.88 | 0.0511 |
| 61109 | 3.05 | 242 | 0.013 | 79.344 | 89.1 | 590.8 | 0.1207 |
| 61110 | 2.8 | 335 | 0.008 | 119.643 | 93.1 | 593.02 | 0.0993 |
| Average | 3.284 | 318.3 | 0.010 | 98.374 | 88.89 | 591.27 | 0.0850 |
| Session1 | Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 61201 | 4.45 | 318 | 0.014 | 71.461 | 78.2 | 593.0 | 0.0553 |
| 61202 | 2.71 | 198 | 0.014 | 73.063 | 75.2 | 593.2 | 0.1401 |
| 61203 | 4.92 | 58.4 | 0.084 | 11.870 | 77.4 | 598.0 | 0.2694 |
| 61204 | 3.02 | 140 | 0.022 | 46.358 | 81 | 592.4 | 0.1916 |
| 61205 | 4.99 | 291 | 0.017 | 58.317 | 80.6 | 596.2 | 0.0555 |
| 61206 | 4.63 | 179 | 0.041 | 36.900 | 76.7 | 593.8 | 0.0925 |
| 61207 | 3.07 | 404 | 0.008 | 131.596 | 89.9 | 594.0 | 0.0725 |
| 61208 | 4.51 | 216 | 0.021 | 47.894 | 83.5 | 592.8 | 0.0857 |
| 61209 | 6.45 | 281 | 0.023 | 43.566 | 88.8 | 593.3 | 0.0490 |
| 61210 | 5.75 | 266 | 0.022 | 46.261 | 83.3 | 596.8 | 0.0545 |
| Average | 4.45 | 235.140 | 0.019 | 56.7284 | 81.460 | 594.3 | 0.0778 |
| Session 1 | Post-Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 61301 | 5.2 | 217 | 0.024 | 41.731 | 84.4 | 595.3 | 0.0748 |
| 61302 | 2.99 | 147 | 0.020 | 49.164 | 83.6 | 596.2 | 0.1902 |
| 61303 | 2.97 | 184 | 0.016 | 61.953 | 84.2 | 589.8 | 0.1541 |
| 61304 | 4.14 | 367 | 0.011 | 88.647 | 85.4 | 589.6 | 0.0562 |
| 61305 | 2.96 | 229 | 0.013 | 77.365 | 69.7 | 592.4 | 0.1028 |
| 61306 | 2.81 | 289 | 0.010 | 102.847 | 76.8 | 594.0 | 0.0946 |
| 61307 | 3.08 | 404 | 0.008 | 131.169 | 76.1 | 595.7 | 0.0612 |
| 61308 | 4.54 | 387 | 0.012 | 85.242 | 74.8 | 590.6 | 0.0426 |
| 61309 | 3.06 | 241 | 0.013 | 78.758 | 74.7 | 590.4 | 0.1013 |
| 61310 | 2.78 | 328 | 0.008 | 117.986 | 78.4 | 593.0 | 0.0860 |
| Average | 3.453 | 279.300 | 0.012 | 83.486 | 78.810 | 592.7 | 0.0817 |

EXERCISE BAND SUBJECT 6 AERODYNAMIC DATA

Subglottal Pressure (Psub), Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency (VE) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | | SPL Cal | 72 | |
|-----------|---------------|----------------|-----------|-------------------|---------------|-----------------|-----------|
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 62101 | 4.66 | 80.5 | 0.058 | 17.275 | 66.3 | 599.6 | 0.1767 |
| 62102 | 5.1 | 197 | 0.026 | 38.627 | 68.5 | 587.4 | 0.0682 |
| 62103 | 5.43 | 222 | 0.024 | 40.884 | 76 | 594.0 | 0.0630 |
| 62104 | 5.45 | 251 | 0.022 | 46.055 | 72.2 | 590.6 | 0.0528 |
| 62105 | 4.86 | 372 | 0.013 | 76.543 | 79.6 | 591.0 | 0.0440 |
| 62106 | 3.58 | 371 | 0.010 | 103.631 | 78 | 592.0 | 0.0587 |
| 62107 | 4.6 | 292 | 0.016 | 63.478 | 70.7 | 592.8 | 0.0526 |
| 62108 | 4.89 | 61.9 | 0.079 | 12.658 | 70.7 | 593.4 | 0.2336 |
| 62109 | 4.73 | 241 | 0.020 | 50.951 | 69.7 | 596.0 | 0.0611 |
| 62110 | 4.69 | 172 | 0.027 | 36.674 | 72.3 | 597.6 | 0.0896 |
| Average | 4.799 | 226.04 | 0.021 | 48.678 | 72.4 | 593.44 | 0.0667 |
| Session 2 | Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 62201 | 5.99 | 198 | 0.030 | 33.055 | 64.8 | 593.8 | 0.0546 |
| 62202 | 4.27 | 167 | 0.026 | 39.110 | 66.4 | 591.4 | 0.0931 |
| 62203 | 6.98 | 214 | 0.033 | 30.659 | 71.1 | 592.0 | 0.0476 |
| 62204 | 5.4 | 253 | 0.021 | 46.852 | 63 | 592.4 | 0.0461 |
| 62205 | 9.15 | 203 | 0.045 | 22.186 | 76 | 591.6 | 0.0409 |
| 62206 | 5.93 | 388 | 0.015 | 65.430 | 78 | 592.9 | 0.0339 |
| 62207 | 4.42 | 236 | 0.019 | 53.394 | 74.6 | 593.6 | 0.0715 |
| 62208 | 7.21 | 180 | 0.040 | 24.965 | 73.1 | 592.8 | 0.0563 |
| 62209 | 4.01 | 221 | 0.018 | 55.112 | 70.3 | 586.8 | 0.0793 |
| 62210 | 6.15 | 454 | 0.014 | 73.821 | 76.7 | 592.0 | 0.0275 |
| Average | 5.951 | 251.40 | 0.024 | 44.46 | 71.40 | 591.93 | 0.0477 |
| Session 2 | Post-Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 62301 | 7.19 | 339 | 0.021 | 47.149 | 77.6 | 582.6 | 0.0476 |
| 62302 | 5.17 | 329 | 0.016 | 63.636 | 77.4 | 591.4 | 0.0455 |
| 62303 | 3.78 | 168 | 0.023 | 44.444 | 75.3 | 592.8 | 0.1186 |
| 62304 | 4.42 | 176 | 0.025 | 39.819 | 70.9 | 584.6 | 0.0911 |
| 62305 | 5.75 | 249 | 0.023 | 43.304 | 73.7 | 587.1 | 0.0515 |
| 62306 | 4.37 | 179 | 0.024 | 40.961 | 77.8 | 591.2 | 0.0995 |
| 62307 | 5.67 | 161 | 0.035 | 28.395 | 65.2 | 589.8 | 0.0714 |
| 62308 | 7.85 | 197 | 0.040 | 25.096 | 73.2 | 594.6 | 0.0473 |
| 62309 | 3.91 | 209 | 0.019 | 53.453 | 75 | 597.2 | 0.0918 |
| 62310 | 4.99 | 229 | 0.022 | 45.892 | 76 | 598.9 | 0.0665 |
| Average | 5.70 | 244.02 | 0.023 | 44.69 | 73.49 | 591.01 | 0.0528 |

EXERCISE BAND SUBJECT 6 AERODYNAMIC DATA

Subglottal Pressure (Psub), Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency (VE) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | | SPL Cal | 79 | |
|-----------|---------------|----------------|-----------|-------------------|------------|-----------------|-----------|
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 63101 | 7.33 | 445 | 0.016 | 60.709 | 74.7 | 583.8 | 0.0229 |
| 63102 | 7.62 | 157 | 0.049 | 20.604 | 73.6 | 590.5 | 0.0615 |
| 63103 | 6.83 | 163 | 0.042 | 23.865 | 74.4 | 592.7 | 0.0668 |
| 63104 | 7.46 | 121 | 0.062 | 67.800 | 73.9 | 592.7 | 0.0819 |
| 63105 | 7.94 | 311 | 0.026 | 39.169 | 75.4 | 588.0 | 0.0305 |
| 63106 | 5.62 | 227 | 0.025 | 27.100 | 75.2 | 588.2 | 0.0589 |
| 63107 | 7.75 | 244 | 0.032 | 31.484 | 70.9 | 592.3 | 0.0375 |
| 63108 | 7.31 | 241 | 0.030 | 32.969 | 80.2 | 587.6 | 0.0455 |
| 63109 | 8.12 | 359 | 0.023 | 44.212 | 80.7 | 591.8 | 0.0277 |
| 63110 | 4.99 | 213 | 0.023 | 42.685 | 75.3 | 590.0 | 0.0708 |
| Average | 7.10 | 248.10 | 0.029 | 39.06 | 75.43 | 589.76 | 0.0428 |
| Session 3 | Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 63201 | 5.62 | 177 | 0.032 | 31.495 | 75.4 | 587.2 | 0.0758 |
| 63202 | 9.04 | 484 | 0.019 | 53.540 | 79.5 | 598.3 | 0.0182 |
| 63203 | 6.68 | 278 | 0.024 | 41.617 | 73.1 | 595.2 | 0.0394 |
| 63204 | 6.12 | 254 | 0.024 | 41.503 | 75.3 | 593.3 | 0.0484 |
| 63205 | 8.39 | 310 | 0.027 | 36.949 | 74.1 | 591.0 | 0.0285 |
| 63206 | 6.5 | 224 | 0.029 | 34.462 | 75.5 | 594.0 | 0.0519 |
| 63207 | 5.19 | 810 | 0.006 | 156.069 | 83.8 | 588.6 | 0.0199 |
| 63208 | 7.81 | 185 | 0.042 | 23.688 | 75.2 | 594.4 | 0.0520 |
| 63209 | 9.65 | 281 | 0.034 | 29.119 | 72.4 | 588.0 | 0.0267 |
| 63210 | 5.8 | 307 | 0.019 | 52.931 | 78.7 | 592.2 | 0.0442 |
| Average | 7.08 | 331 | 0.021 | 50.1372 | 76.3 | 592.21 | 0.0326 |
| Session 3 | Post-Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 63301 | 4.34 | 147 | 0.030 | 33.871 | 79.3 | 586.1 | 0.1243 |
| 63302 | 7.32 | 292 | 0.025 | 39.891 | 72.9 | 596.7 | 0.0341 |
| 63303 | 5.32 | 150 | 0.035 | 28.195 | 78.7 | 597.4 | 0.0986 |
| 63304 | 4.37 | 152 | 0.029 | 34.783 | 86 | 593.9 | 0.1295 |
| 63305 | 3.22 | 301 | 0.011 | 93.478 | 85.2 | 589.9 | 0.0879 |
| 63306 | 6.44 | 480 | 0.013 | 74.534 | 78.3 | 592.0 | 0.0222 |
| 63307 | 4.93 | 424 | 0.012 | 86.004 | 79.2 | 594.4 | 0.0379 |
| 63308 | 4.71 | 73.5 | 0.064 | 15.605 | 71.6 | 595.8 | 0.2068 |
| 63309 | 7.76 | 543 | 0.014 | 69.974 | 83.4 | 590.4 | 0.0198 |
| 63310 | 9.91 | 386 | 0.026 | 38.951 | 84.8 | 591.8 | 0.0222 |
| Average | 5.832 | 294.85 | 0.020 | 51.52861 | 79.94 | 592.85 | 0.0465 |

EXERCISE BAND SUBJECT 7 AERODYNAMIC DATA

Subglottal Pressure, Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency Test Results for All Phases in All Test Sessions

| Session1 | Baseline | | | | SPL Cal | 69 | |
|----------------|---------------|----------------|-----------|-------------------|---------------|-----------------|-----------|
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 71101 | 10.4 | 342 | 0.030 | 32.885 | 74.6 | 297.8 | 0.0210 |
| 71102 | 10.6 | 460 | 0.023 | 43.396 | 76.8 | 301.6 | 0.0158 |
| 71103 | 10.7 | 525 | 0.020 | 49.065 | 78.1 | 297.7 | 0.0139 |
| 71104 | 11.1 | 443 | 0.025 | 39.910 | 76.7 | 298.5 | 0.0156 |
| 71105 | 10.5 | 428 | 0.025 | 40.762 | 76.2 | 294.5 | 0.0170 |
| 71106 | 10.6 | 432 | 0.025 | 40.755 | 76.4 | 297.2 | 0.0167 |
| 71107 | 10.6 | 467 | 0.023 | 44.057 | 77.1 | 294.5 | 0.0156 |
| 71108 | 10.2 | 488 | 0.021 | 47.843 | 77.4 | 297.8 | 0.0155 |
| 71109 | 10 | 231 | 0.043 | 23.100 | 72.7 | 294 | 0.0315 |
| 71110 | 10.6 | 187 | 0.057 | 17.642 | 72.1 | 295.8 | 0.0364 |
| Average | 10.53 | 400.3 | 0.026 | 37.941 | 75.81 | 296.94 | 0.0180 |
| Session 1 | Training | | | | SPL | Pitch Hz | VE |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 71201 | 11 | 568 | 0.019 | 51.636 | 78.8 | 299.2 | 0.0126 |
| 71202 | 10.5 | 464 | 0.023 | 44.190 | 76.9 | 297.5 | 0.0158 |
| 71203 | 10.6 | 392 | 0.027 | 36.981 | 75.6 | 270.9 | 0.0182 |
| 71204 | 10.5 | 358 | 0.029 | 34.095 | 75.2 | 296.9 | 0.0200 |
| 71205 | 10.6 | 370 | 0.029 | 34.906 | 75.7 | 298.3 | 0.0193 |
| 71206 | 10.4 | 251 | 0.041 | 24.135 | 73.8 | 296.5 | 0.0283 |
| 71207 | 10.9 | 576 | 0.019 | 52.844 | 78.7 | 298.9 | 0.0125 |
| 71208 | 10.5 | 490 | 0.021 | 46.667 | 77.5 | 297.2 | 0.0151 |
| 71209 | 10.8 | 559 | 0.019 | 51.759 | 78.4 | 296.5 | 0.0130 |
| 71210 | 10.8 | 575 | 0.019 | 53.241 | 78.7 | 292.6 | 0.0127 |
| Average | 10.66 | 460.30 | 0.023 | 43.05 | 76.93 | 294.45 | 0.0157 |
| Session 1 | Post-Training | | | | SPL dB | Pitch Hz | VE |
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 71301 | 11.1 | 380 | 0.029 | 34.234 | 75.6 | 296.5 | 0.0179 |
| 71302 | 10.5 | 299 | 0.035 | 28.476 | 74.3 | 295.6 | 0.0237 |
| 71303 | 11 | 439 | 0.025 | 39.909 | 76.7 | 295.9 | 0.0159 |
| 71304 | 11.2 | 414 | 0.027 | 36.964 | 76.1 | 296.5 | 0.0164 |
| 71305 | 10.3 | 206 | 0.050 | 20.000 | 72.2 | 298.8 | 0.0340 |
| 71306 | 10.4 | 265 | 0.039 | 25.481 | 73.3 | 299.1 | 0.0266 |
| 71307 | 9.74 | 249 | 0.039 | 25.565 | 73.5 | 297.7 | 0.0303 |
| 71308 | 10.3 | 533 | 0.019 | 51.748 | 78 | 296.3 | 0.0142 |
| 71309 | 9.87 | 431 | 0.023 | 43.668 | 76.6 | 298.3 | 0.0180 |
| 71310 | 9.58 | 451 | 0.021 | 47.077 | 76.9 | 294 | 0.0178 |
| Average | 10.40 | 366.70 | 0.028 | 35.312 | 75.32 | 296.9 | 0.0198 |

EXERCISE BAND SUBJECT 7 AERODYNAMIC DATA

Subglottal Pressure (Psub), Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency (VE) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | | SPL Cal | 87 | |
|-----------|---------------|----------------|-----------|-------------------|---------------|-----------------|-----------|
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 72101 | 10.5 | 177 | 0.059 | 16.857 | 89.7 | 297.2 | 0.0483 |
| 72102 | 10.5 | 409 | 0.026 | 38.952 | 94.8 | 299.3 | 0.0221 |
| 72103 | 10.6 | 494 | 0.021 | 46.604 | 96.5 | 299 | 0.0184 |
| 72104 | 11 | 420 | 0.026 | 38.182 | 95.1 | 297.8 | 0.0206 |
| 72105 | 10.6 | 380 | 0.028 | 35.849 | 94.2 | 292 | 0.0234 |
| 72106 | 10.5 | 385 | 0.027 | 36.667 | 94.3 | 297.3 | 0.0233 |
| 72107 | 9.7 | 415 | 0.023 | 42.784 | 95.1 | 295.5 | 0.0236 |
| 72108 | 10.3 | 433 | 0.024 | 42.039 | 95.4 | 296.6 | 0.0214 |
| 72109 | 10.2 | 205 | 0.050 | 20.098 | 90.7 | 295.3 | 0.0434 |
| 72110 | 10.5 | 164 | 0.064 | 15.619 | 90.1 | 294.7 | 0.0523 |
| Average | 10.44 | 348.2 | 0.030 | 33.365 | 93.59 | 296.47 | 0.0257 |
| Session 2 | Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 72201 | 11.1 | 505 | 0.022 | 45.495 | 96.8 | 300.4 | 0.0173 |
| 72202 | 10.5 | 412 | 0.025 | 39.238 | 94.9 | 297.5 | 0.0219 |
| 72203 | 10.8 | 391 | 0.028 | 36.204 | 94.7 | 297.2 | 0.0224 |
| 72204 | 10.7 | 319 | 0.034 | 29.813 | 92.9 | 298.2 | 0.0272 |
| 72205 | 10.5 | 329 | 0.032 | 31.333 | 93.5 | 295.3 | 0.0271 |
| 72206 | 10.3 | 223 | 0.046 | 21.650 | 91.8 | 295.5 | 0.0400 |
| 72207 | 9.65 | 222 | 0.043 | 23.005 | 91.5 | 296.5 | 0.0427 |
| 72208 | 10.4 | 436 | 0.024 | 41.923 | 95.4 | 292.2 | 0.0210 |
| 72209 | 10.7 | 498 | 0.021 | 46.542 | 97.3 | 297.8 | 0.0183 |
| 72210 | 10.3 | 512 | 0.020 | 49.709 | 96.7 | 293.4 | 0.0183 |
| Average | 10.495 | 384.70 | 0.027 | 36.49 | 94.55 | 296.40 | 0.0234 |
| Session 2 | Post-Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 72301 | 11 | 338 | 0.033 | 30.727 | 93.6 | 294 | 0.0252 |
| 72302 | 10.9 | 266 | 0.041 | 24.404 | 92.3 | 294.3 | 0.0318 |
| 72303 | 10.8 | 390 | 0.028 | 36.111 | 92.8 | 293.6 | 0.0220 |
| 72304 | 11 | 369 | 0.030 | 33.545 | 94.2 | 294.1 | 0.0232 |
| 72305 | 10.7 | 183 | 0.058 | 17.103 | 90.2 | 297.5 | 0.0461 |
| 72306 | 10.3 | 236 | 0.044 | 22.913 | 93.1 | 296.3 | 0.0383 |
| 72307 | 9.65 | 222 | 0.043 | 23.005 | 95.1 | 295.5 | 0.0444 |
| 72308 | 9.77 | 474 | 0.021 | 48.516 | 96.1 | 294.3 | 0.0208 |
| 72309 | 10.3 | 383 | 0.027 | 37.184 | 94.6 | 297.1 | 0.0240 |
| 72310 | 9.78 | 401 | 0.024 | 41.002 | 94.9 | 293.8 | 0.0242 |
| Average | 10.42 | 346.14 | 0.030 | 33.22 | 93.96 | 295.42 | 0.0260 |

EXERCISE BAND SUBJECT 7 AERODYNAMIC DATA

Subglottal Pressure (Psub), Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency (VE) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | SPL Cal 85 | | | | | |
|-----------|---------------|----------------|-----------|-------------------|------------|-----------------|-----------|
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 730101 | 9.94 | 443 | 0.022 | 44.567 | 93 | 303.4 | 0.0211 |
| 730102 | 9.28 | 522 | 0.018 | 56.250 | 94.1 | 298.3 | 0.0194 |
| 730103 | 8.53 | 524 | 0.016 | 61.430 | 93.9 | 298.8 | 0.0210 |
| 730104 | 9.34 | 486 | 0.019 | 52.034 | 93.1 | 294.1 | 0.0205 |
| 730105 | 8.51 | 514 | 0.017 | 60.400 | 93.6 | 297.8 | 0.0214 |
| 730106 | 8.46 | 550 | 0.015 | 65.012 | 94.2 | 298.9 | 0.0202 |
| 730107 | 8.33 | 593 | 0.014 | 71.188 | 94.6 | 297.4 | 0.0192 |
| 730108 | 7.94 | 564 | 0.014 | 71.033 | 94.5 | 295.7 | 0.0211 |
| 730109 | 8.45 | 593 | 0.014 | 70.178 | 94.6 | 298.4 | 0.0189 |
| 730110 | 7.96 | 513 | 0.016 | 64.447 | 93.5 | 293.4 | 0.0229 |
| Average | 8.67 | 530.20 | 0.016 | 61.654 | 93.91 | 297.62 | 0.0204 |
| Session 3 | Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 730201 | 9.15 | 494 | 0.019 | 53.989 | 93.3 | 296.6 | 0.0206 |
| 730202 | 8.08 | 348 | 0.023 | 43.069 | 90.4 | 294.3 | 0.0321 |
| 730203 | 9.5 | 451 | 0.021 | 47.474 | 92.6 | 293.1 | 0.0216 |
| 730204 | 9.32 | 432 | 0.022 | 46.352 | 92.2 | 295.2 | 0.0229 |
| 730205 | 10.1 | 564 | 0.018 | 55.842 | 94.2 | 293.7 | 0.0165 |
| 730206 | 9.26 | 491 | 0.019 | 53.024 | 93.2 | 296 | 0.0205 |
| 730207 | 9.56 | 409 | 0.023 | 42.782 | 91.4 | 300.1 | 0.0234 |
| 730208 | 9.03 | 422 | 0.021 | 46.733 | 91.1 | 297 | 0.0239 |
| 730209 | 9.71 | 459 | 0.021 | 47.271 | 92.7 | 296.8 | 0.0208 |
| 730210 | 7.77 | 435 | 0.018 | 55.985 | 92.1 | 297.6 | 0.0272 |
| Average | 9.15 | 450.5 | 0.020 | 49.252 | 92.32 | 296.04 | 0.0224 |
| Session 3 | Post-Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 730301 | 8.04 | 194 | 0.041 | 24.129 | 86.6 | 301.3 | 0.0555 |
| 730302 | 7.9 | 258 | 0.031 | 32.658 | 88.4 | 297 | 0.0434 |
| 730303 | 7.75 | 272 | 0.028 | 35.097 | 88.5 | 294.3 | 0.0420 |
| 730304 | 7.21 | 248 | 0.029 | 34.397 | 87.7 | 295.5 | 0.0490 |
| 730305 | 11.7 | 87.2 | 0.134 | 7.453 | 86.8 | 298.8 | 0.0851 |
| 730306 | 12.1 | 161 | 0.075 | 13.306 | 87.5 | 296.4 | 0.0449 |
| 730307 | 7.27 | 254 | 0.029 | 34.938 | 88.1 | 298.8 | 0.0477 |
| 730308 | 7.14 | 219 | 0.033 | 30.672 | 87.6 | 300.4 | 0.0560 |
| 730309 | 7.33 | 241 | 0.030 | 32.879 | 87.8 | 296.4 | 0.0497 |
| 730310 | 11.1 | 325 | 0.034 | 29.279 | 91.2 | 297.6 | 0.0253 |
| Average | 8.754 | 225.92 | 0.039 | 27.481 | 88.02 | 297.65 | 0.0445 |

EXERCISE BALL SUBJECT 8 AERODYNAMIC DATA

Subglottal Pressure, Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency Test Results for All Phases in All Test Sessions

| Session1 | Baseline | | | | SPL Cal | 79 | |
|-----------|---------------|----------------|-----------|-------------------|---------------|-----------------|-----------|
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 81101 | 11.4 | 299 | 0.038 | 26.228 | 90.8 | 579 | 0.0266 |
| 81102 | 12.7 | 250 | 0.051 | 19.685 | 90.4 | 579.7 | 0.0285 |
| 81103 | 10.2 | 345 | 0.030 | 33.824 | 90.7 | 581.1 | 0.0258 |
| 81104 | 12.1 | 277 | 0.044 | 22.893 | 90.2 | 585.1 | 0.0269 |
| 81105 | 11.6 | 205 | 0.057 | 17.672 | 89.4 | 580 | 0.0376 |
| 81106 | 12.3 | 288 | 0.043 | 23.415 | 89.6 | 571 | 0.0253 |
| 81107 | 12.6 | 68.1 | 0.185 | 5.405 | 85.1 | 544.7 | 0.0992 |
| 81108 | 10.2 | 271 | 0.038 | 26.569 | 89.6 | 576.3 | 0.0324 |
| 81109 | 10.4 | 147 | 0.071 | 14.135 | 88.1 | 575.5 | 0.0576 |
| 81110 | 10.3 | 147 | 0.070 | 14.272 | 88.4 | 575.4 | 0.0584 |
| Average | 11.38 | 229.7 | 0.050 | 20.410 | 89.23 | 574.78 | 0.0341 |
| Session 1 | Training | | | | SPL | Pitch Hz | VE |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 81201 | 11.5 | 461 | 0.025 | 40.087 | 92 | 573.8 | 0.0174 |
| 81202 | 14.6 | 289 | 0.051 | 19.795 | 91.3 | 574.7 | 0.0216 |
| 81203 | 13.4 | 483 | 0.028 | 36.045 | 92.7 | 579.6 | 0.0143 |
| 81204 | 11.9 | 458 | 0.026 | 38.487 | 93.1 | 583.4 | 0.0171 |
| 81205 | 12.5 | 293 | 0.043 | 23.440 | 91.3 | 575.8 | 0.0249 |
| 81206 | 13.2 | 290 | 0.046 | 21.970 | 91.1 | 575.2 | 0.0238 |
| 81207 | 12.4 | 388 | 0.032 | 31.290 | 92.4 | 577 | 0.0192 |
| 81208 | 10.9 | 315 | 0.035 | 28.899 | 91.2 | 571.7 | 0.0266 |
| 81209 | 9.21 | 293 | 0.031 | 31.813 | 90.3 | 574.6 | 0.0335 |
| 81210 | 12.5 | 164 | 0.076 | 13.120 | 90.6 | 579.8 | 0.0442 |
| Average | 12.2 | 343 | 0.036 | 28.122 | 91.6 | 576.6 | 0.0218 |
| Session 1 | Post-Training | | | | SPL dB | Pitch Hz | VE |
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 81301 | 12.8 | 310 | 0.041 | 24.219 | 90.9 | 571.1 | 0.0229 |
| 81302 | 16.6 | 317 | 0.052 | 19.096 | 91.5 | 570 | 0.0174 |
| 81303 | 13.1 | 299 | 0.044 | 22.824 | 90.2 | 580.7 | 0.0230 |
| 81304 | 16.3 | 358 | 0.046 | 21.963 | 92 | 587.9 | 0.0158 |
| 81305 | 15.2 | 319 | 0.048 | 20.987 | 90.1 | 575.9 | 0.0186 |
| 81306 | 13.1 | 322 | 0.041 | 24.580 | 90.8 | 578.5 | 0.0215 |
| 81307 | 12.8 | 268 | 0.048 | 20.938 | 90 | 582.3 | 0.0262 |
| 81308 | 13.7 | 289 | 0.047 | 21.095 | 89.2 | 579.1 | 0.0225 |
| 81309 | 9.69 | 311 | 0.031 | 32.095 | 89.6 | 579.1 | 0.0297 |
| 81310 | 11.5 | 197 | 0.058 | 17.130 | 88.5 | 581.4 | 0.0391 |
| Average | 13.5 | 299 | 0.045 | 22.493 | 90.3 | 578.6 | 0.0224 |

EXERCISE BALL SUBJECT 8 AERODYNAMIC DATA

Subglottal Pressure (Psub), Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency (VE) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | | SPL Cal | 74 | |
|-----------|---------------|----------------|-----------|-------------------|---------------|-----------------|-----------|
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 82101 | 19 | 569 | 0.033 | 29.947 | 85.4 | 582.5 | 0.0079 |
| 82102 | 10.5 | 290 | 0.036 | 27.619 | 84.4 | 628.6 | 0.0277 |
| 82103 | 12.3 | 262 | 0.047 | 21.301 | 79 | 584.4 | 0.0245 |
| 82104 | 11.8 | 222 | 0.053 | 18.814 | 84.6 | 579.3 | 0.0323 |
| 82105 | 17.2 | 351 | 0.049 | 20.407 | 77.4 | 578 | 0.0128 |
| 82106 | 19.8 | 546 | 0.036 | 27.576 | 79.6 | 580.8 | 0.0074 |
| 82107 | 14.7 | 517 | 0.028 | 35.170 | 78.9 | 578.6 | 0.0104 |
| 82108 | 18.5 | 564 | 0.033 | 30.486 | 78.6 | 571.1 | 0.0075 |
| 82109 | 18.7 | 163 | 0.115 | 8.717 | 74.3 | 549.5 | 0.0244 |
| 82110 | 17.9 | 527 | 0.034 | 29.441 | 79.1 | 586.1 | 0.0084 |
| Average | 16.04 | 401 | 0.040 | 24.948 | 80.1 | 581.89 | 0.0125 |
| Session 2 | Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 82201 | 14.6 | 533 | 0.027 | 36.507 | 85.1 | 574.4 | 0.0109 |
| 82202 | 21.4 | 899 | 0.024 | 42.009 | 87.4 | 577.3 | 0.0045 |
| 82203 | 16.3 | 521 | 0.031 | 31.963 | 84.6 | 578.9 | 0.0100 |
| 82204 | 18.2 | 779 | 0.023 | 42.802 | 87.6 | 570.3 | 0.0062 |
| 82205 | 23.1 | 555 | 0.042 | 24.026 | 86.3 | 575.1 | 0.0067 |
| 82206 | 19.7 | 591 | 0.033 | 30.000 | 86.3 | 573.9 | 0.0074 |
| 82207 | 19.8 | 746 | 0.027 | 37.677 | 87.4 | 577 | 0.0059 |
| 82208 | 18.5 | 351 | 0.053 | 18.973 | 85.8 | 579.6 | 0.0132 |
| 82209 | 18.9 | 849 | 0.022 | 44.921 | 88 | 586.7 | 0.0055 |
| 82210 | 18.2 | 955 | 0.019 | 52.473 | 87.2 | 573.7 | 0.0050 |
| Average | 18.87 | 678 | 0.028 | 36.135 | 86.6 | 576.7 | 0.0068 |
| Session 2 | Post-Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 82301 | 15.4 | 594 | 0.026 | 38.571 | 84.7 | 582 | 0.0093 |
| 82302 | 20 | 516 | 0.039 | 25.800 | 85.1 | 584.3 | 0.0082 |
| 82303 | 17.6 | 417 | 0.042 | 23.693 | 83.7 | 577.8 | 0.0114 |
| 82304 | 21.5 | 549 | 0.039 | 25.535 | 84.1 | 585.4 | 0.0071 |
| 82305 | 26 | 646 | 0.040 | 24.846 | 86.5 | 569.9 | 0.0052 |
| 82306 | 20.3 | 569 | 0.036 | 28.030 | 85 | 579.7 | 0.0074 |
| 82307 | 15.1 | 631 | 0.024 | 41.788 | 85.5 | 582 | 0.0090 |
| 82308 | 25.4 | 688 | 0.037 | 27.087 | 87 | 586.6 | 0.0050 |
| 82309 | 20.3 | 595 | 0.034 | 29.310 | 85.9 | 574.3 | 0.0071 |
| 82310 | 20.5 | 584 | 0.035 | 28.488 | 85.6 | 574.8 | 0.0072 |
| Average | 20.2 | 579 | 0.035 | 29.315 | 85.3 | 579.7 | 0.0073 |

EXERCISE BALL SUBJECT 8 AERODYNAMIC DATA

Subglottal Pressure (Psub), Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency (VE) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | | | | SPL Cal | 62 |
|-----------|---------------|----------------|-----------|-------------------|------------|-----------------|-----------|----|
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE | |
| 83101 | 11.3 | 560 | 0.020 | 49.558 | 73.5 | 578.5 | 0.0116 | |
| 83102 | 12.3 | 561 | 0.022 | 45.610 | 73.5 | 575.8 | 0.0107 | |
| 83103 | 9.95 | 633 | 0.016 | 63.618 | 73.3 | 582.4 | 0.0116 | |
| 83104 | 12.4 | 598 | 0.021 | 48.226 | 72.5 | 572.3 | 0.0098 | |
| 83105 | 11.4 | 411 | 0.028 | 36.053 | 72.3 | 582.7 | 0.0154 | |
| 83106 | 11.9 | 566 | 0.021 | 47.563 | 73.2 | 586.2 | 0.0109 | |
| 83107 | 12.3 | 99.7 | 0.123 | 8.106 | 68.1 | 580.7 | 0.0555 | |
| 83108 | 10.1 | 581 | 0.017 | 57.525 | 72.8 | 579.2 | 0.0124 | |
| 83109 | 10.2 | 308 | 0.033 | 30.196 | 71.3 | 575.4 | 0.0227 | |
| 83110 | 10.2 | 321 | 0.032 | 31.471 | 71.7 | 577.3 | 0.0219 | |
| Average | 11.21 | 463.87 | 0.024 | 41.79 | 72.22 | 579.05 | 0.0139 | |
| Session 3 | Training | | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE | |
| 83201 | 16.1 | 672 | 0.024 | 41.739 | 74.5 | 569.8 | 0.0069 | |
| 83202 | 12.6 | 640 | 0.020 | 50.794 | 73.3 | 581.2 | 0.0091 | |
| 83203 | 12.5 | 664 | 0.019 | 53.120 | 73.8 | 573.8 | 0.0089 | |
| 83204 | 16.1 | 758 | 0.021 | 47.081 | 74.7 | 588 | 0.0061 | |
| 83205 | 15.2 | 677 | 0.022 | 44.539 | 72.9 | 575.6 | 0.0071 | |
| 83206 | 13 | 690 | 0.019 | 53.077 | 73.6 | 572.5 | 0.0082 | |
| 83207 | 12.5 | 573 | 0.022 | 45.840 | 72.8 | 581.1 | 0.0102 | |
| 83208 | 13.3 | 644 | 0.021 | 48.421 | 72.5 | 582.5 | 0.0085 | |
| 83209 | 12.3 | 346 | 0.036 | 28.130 | 73.3 | 580.3 | 0.0172 | |
| 83210 | 9.09 | 621 | 0.015 | 68.317 | 72.4 | 576.5 | 0.0128 | |
| Average | 13.27 | 628.50 | 0.021 | 48.11 | 73.38 | 578.13 | 0.0088 | |
| Session 3 | Post-Training | | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE | |
| 83301 | 12.6 | 657 | 0.019 | 52.143 | 73.7 | 571.3 | 0.0089 | |
| 83302 | 16.1 | 678 | 0.024 | 42.112 | 74.4 | 570.9 | 0.0068 | |
| 83303 | 12.6 | 640 | 0.020 | 50.794 | 73.2 | 581.2 | 0.0091 | |
| 83304 | 16.1 | 758 | 0.021 | 47.081 | 74.8 | 587.8 | 0.0061 | |
| 83305 | 15.2 | 677 | 0.022 | 44.539 | 73 | 580.6 | 0.0071 | |
| 83306 | 12.9 | 691 | 0.019 | 53.566 | 83.6 | 630.5 | 0.0094 | |
| 83307 | 16 | 807 | 0.020 | 50.438 | 75.1 | 639.9 | 0.0058 | |
| 83308 | 13.4 | 642 | 0.021 | 47.910 | 72.3 | 581 | 0.0084 | |
| 83309 | 9.53 | 649 | 0.015 | 68.101 | 72.7 | 581.9 | 0.0118 | |
| 83310 | 10.8 | 470 | 0.023 | 43.519 | 71.8 | 581.3 | 0.0141 | |
| Average | 13.523 | 666.9 | 0.020 | 50.020 | 74.46 | 590.64 | 0.0083 | |

EXERCISE BALL SUBJECT 9 AERODYNAMIC DATA

Subglottal Pressure, Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency Test Results for All Phases in All Test Sessions

| Session 1 | Baseline | | | | SPL Cal | 69 | |
|-----------|---------------|----------------|-----------|-------------------|---------------|-----------------|-----------|
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 91101 | 6.41 | 1500 | 0.004 | 234.01 | 78.5 | 598 | 0.0082 |
| 91102 | 5.87 | 1440 | 0.004 | 245.32 | 80.2 | 597.4 | 0.0095 |
| 91103 | 6.41 | 1600 | 0.004 | 249.61 | 79.9 | 589.6 | 0.0078 |
| 91104 | 6.22 | 1480 | 0.004 | 237.94 | 80 | 603.38 | 0.0087 |
| 91105 | 6.44 | 1740 | 0.004 | 270.19 | 78.4 | 600.34 | 0.0070 |
| 91106 | 5.74 | 1630 | 0.004 | 283.97 | 78.3 | 596.4 | 0.0084 |
| 91107 | 9.38 | 1580 | 0.006 | 168.44 | 79.4 | 597.5 | 0.0054 |
| 91108 | 8.94 | 1530 | 0.006 | 171.14 | 80.6 | 597.6 | 0.0059 |
| 91109 | 9.52 | 1110 | 0.009 | 116.60 | 81.4 | 596.2 | 0.0077 |
| 91110 | 9.02 | 1190 | 0.008 | 131.93 | 79.1 | 588.4 | 0.0074 |
| Average | 7.395 | 1480.0 | 0.005 | 210.91 | 79.58 | 596.48 | 0.0073 |
| Session 1 | Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 91201 | 10.6 | 1650 | 0.006 | 155.66 | 81.2 | 597.72 | 0.0046 |
| 91202 | 9.32 | 1060 | 0.009 | 113.73 | 81 | 590.2 | 0.0082 |
| 91203 | 9.45 | 1350 | 0.007 | 142.86 | 82.8 | 590.6 | 0.0065 |
| 91204 | 10 | 1250 | 0.008 | 125.00 | 83 | 593 | 0.0066 |
| 91205 | 10.8 | 1300 | 0.008 | 120.37 | 81.5 | 595.8 | 0.0058 |
| 91206 | 10.4 | 1260 | 0.008 | 121.15 | 82 | 591.4 | 0.0063 |
| 91207 | 11 | 1330 | 0.008 | 120.91 | 82.2 | 597.6 | 0.0056 |
| 91208 | 11 | 1350 | 0.008 | 122.73 | 82.5 | 594.8 | 0.0056 |
| 91209 | 10.2 | 1470 | 0.007 | 144.12 | 81 | 590.4 | 0.0054 |
| 91210 | 9.37 | 1170 | 0.008 | 124.87 | 81.7 | 590 | 0.0075 |
| Average | 10.21 | 1319.00 | 0.008 | 129.14 | 81.89 | 593.15 | 0.0061 |
| Session 1 | Post-Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 91301 | 8.96 | 1080 | 0.008 | 120.54 | 80.9 | 587.6 | 0.0084 |
| 91302 | 10.1 | 1340 | 0.008 | 132.67 | 76.5 | 595 | 0.0057 |
| 91303 | 9.07 | 1480 | 0.006 | 163.18 | 79.4 | 597.8 | 0.0059 |
| 91304 | 9.57 | 1400 | 0.007 | 146.29 | 81.6 | 595.8 | 0.0061 |
| 91305 | 10.1 | 1250 | 0.008 | 123.76 | 83.1 | 594.6 | 0.0066 |
| 91306 | 9.19 | 1090 | 0.008 | 118.61 | 79.5 | 595.8 | 0.0079 |
| 91307 | 9.22 | 1120 | 0.008 | 121.48 | 80.6 | 598.2 | 0.0078 |
| 91308 | 9.17 | 1180 | 0.008 | 128.68 | 80.1 | 592.4 | 0.0074 |
| 91309 | 6.49 | 1320 | 0.005 | 203.39 | 80.9 | 589.2 | 0.0094 |
| 91310 | 6.66 | 1050 | 0.006 | 157.66 | 81.3 | 599.2 | 0.0116 |
| Average | 8.85 | 1231.00 | 0.007 | 141.62 | 80.39 | 594.6 | 0.0074 |

EXERCISE BALL SUBJECT 9 AERODYNAMIC DATA

Subglottal Pressure (Psub), Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency (VE) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | | SPL Cal | 87 | |
|-----------|---------------|----------------|-----------|-------------------|---------------|-----------------|-----------|
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 92101 | 9.87 | 1040 | 0.009 | 105.370 | 96.5 | 593.2 | 0.0094 |
| 92102 | 10.5 | 1280 | 0.008 | 121.905 | 96.9 | 588.6 | 0.0072 |
| 92103 | 9.4 | 1170 | 0.008 | 124.468 | 96.3 | 595.2 | 0.0088 |
| 92104 | 7.48 | 1250 | 0.006 | 167.112 | 93.4 | 589 | 0.0100 |
| 92105 | 9.09 | 1160 | 0.008 | 127.613 | 96.9 | 590.6 | 0.0092 |
| 92106 | 7.82 | 1270 | 0.006 | 162.404 | 94.4 | 591 | 0.0095 |
| 92107 | 7.69 | 1070 | 0.007 | 139.142 | 96.5 | 595 | 0.0117 |
| 92108 | 7.78 | 1110 | 0.007 | 142.674 | 94.2 | 591.2 | 0.0109 |
| 92109 | 8.54 | 1160 | 0.007 | 135.831 | 95.7 | 587 | 0.0097 |
| 92110 | 8.94 | 923 | 0.010 | 103.244 | 95.5 | 588.6 | 0.0116 |
| Average | 8.711 | 1143.3 | 0.008 | 132.976 | 95.63 | 590.94 | 0.0096 |
| Session 2 | Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 92201 | 10.5 | 1080 | 0.010 | 102.857 | 96.7 | 589 | 0.0085 |
| 92202 | 10.6 | 1170 | 0.009 | 110.377 | 97.4 | 588.4 | 0.0079 |
| 92203 | 10.6 | 1100 | 0.010 | 103.774 | 97.5 | 588 | 0.0084 |
| 92204 | 10.1 | 1090 | 0.009 | 107.921 | 97.4 | 589.6 | 0.0088 |
| 92205 | 10.5 | 1260 | 0.008 | 120.000 | 97.9 | 594 | 0.0074 |
| 92206 | 10.9 | 1280 | 0.009 | 117.431 | 97.9 | 596 | 0.0070 |
| 92207 | 9.74 | 1210 | 0.008 | 124.230 | 97.4 | 592.2 | 0.0083 |
| 92208 | 9.89 | 1170 | 0.008 | 118.301 | 96.5 | 586 | 0.0083 |
| 92209 | 9.61 | 1250 | 0.008 | 130.073 | 97.3 | 596 | 0.0081 |
| 92210 | 10.8 | 1200 | 0.009 | 111.111 | 96.8 | 589.6 | 0.0075 |
| Average | 10.324 | 1181.00 | 0.009 | 114.61 | 97.28 | 590.88 | 0.0080 |
| Session 2 | Post-Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 92301 | 9.32 | 1550 | 0.006 | 166.309 | 95 | 597.6 | 0.0066 |
| 92302 | 8.14 | 1340 | 0.006 | 164.619 | 97.6 | 596.6 | 0.0089 |
| 92303 | 8.41 | 1470 | 0.006 | 174.792 | 95.1 | 594.2 | 0.0077 |
| 92304 | 8.15 | 1250 | 0.007 | 153.374 | 97.1 | 595.4 | 0.0095 |
| 92305 | 8.39 | 1320 | 0.006 | 157.330 | 96.9 | 589.2 | 0.0087 |
| 92306 | 8.16 | 1220 | 0.007 | 149.510 | 94.9 | 596.8 | 0.0095 |
| 92307 | 8.9 | 1330 | 0.007 | 149.438 | 98 | 591 | 0.0083 |
| 92308 | 8.42 | 1170 | 0.007 | 138.955 | 97.6 | 597.2 | 0.0099 |
| 92309 | 9.35 | 1260 | 0.007 | 134.759 | 95.3 | 591.8 | 0.0081 |
| 92310 | 8.94 | 1380 | 0.006 | 154.362 | 97 | 594.8 | 0.0079 |
| Average | 9.40 | 1264.79 | 0.007 | 136.36 | 96.87 | 592.99 | 0.0081 |

EXERCISE BALL SUBJECT 9 AERODYNAMIC DATA

Subglottal Pressure (Psub), Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency (VE) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | | | | SPL Cal | 85 |
|-----------|---------------|----------------|-----------|-------------------|------------|-----------------|-----------|----|
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE | |
| 93101 | 9.54 | 747 | 0.013 | 78.302 | 91.1 | 584.4 | 0.0128 | |
| 93102 | 9.13 | 847 | 0.011 | 92.771 | 91.8 | 586.8 | 0.0119 | |
| 93103 | 8.66 | 993 | 0.009 | 114.665 | 91.9 | 589.8 | 0.0107 | |
| 93104 | 5.01 | 825 | 0.006 | 164.671 | 92.1 | 587 | 0.0223 | |
| 93105 | 6.99 | 993 | 0.007 | 142.060 | 92.5 | 587 | 0.0133 | |
| 93106 | 6.87 | 1210 | 0.006 | 176.128 | 91.8 | 584.8 | 0.0110 | |
| 93107 | 7.19 | 678 | 0.011 | 94.298 | 89.5 | 585.2 | 0.0184 | |
| 93108 | 8.66 | 1630 | 0.005 | 188.222 | 90 | 585.8 | 0.0064 | |
| 93109 | 9.74 | 1240 | 0.008 | 127.310 | 91.8 | 585.6 | 0.0076 | |
| 93110 | 9.32 | 843 | 0.011 | 90.451 | 91.7 | 589.8 | 0.0117 | |
| Average | 8.11 | 1000.60 | 0.008 | 126.89 | 91.42 | 586.62 | 0.0113 | |
| Session 3 | Training | | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE | |
| 93201 | 10.3 | 793 | 0.013 | 76.990 | 91.3 | 588.4 | 0.0112 | |
| 93202 | 12.3 | 607 | 0.020 | 49.350 | 88.9 | 583.4 | 0.0119 | |
| 93203 | 11.1 | 828 | 0.013 | 74.595 | 91.2 | 590.2 | 0.0099 | |
| 93204 | 9.48 | 886 | 0.011 | 93.460 | 91.1 | 589 | 0.0108 | |
| 93205 | 10.7 | 780 | 0.014 | 72.897 | 88.6 | 586.6 | 0.0106 | |
| 93206 | 11 | 579 | 0.019 | 52.636 | 89.7 | 584 | 0.0141 | |
| 93207 | 10.1 | 806 | 0.013 | 79.802 | 87.5 | 590 | 0.0107 | |
| 93208 | 10 | 520 | 0.019 | 52.000 | 87.2 | 583.4 | 0.0168 | |
| 93209 | 10.2 | 473 | 0.022 | 46.373 | 87.3 | 583.8 | 0.0181 | |
| 93210 | 9.49 | 496 | 0.019 | 52.266 | 86.9 | 586.4 | 0.0185 | |
| Average | 10.467 | 676.8 | 0.015 | 65.0368 | 88.97 | 586.52 | 0.0126 | |
| Session 3 | Post-Training | | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE | |
| 93301 | 9.05 | 678 | 0.013 | 74.917 | 86.6 | 585 | 0.0141 | |
| 93302 | 7.76 | 571 | 0.014 | 73.582 | 88.1 | 586.2 | 0.0199 | |
| 93303 | 7.63 | 544 | 0.014 | 71.298 | 87.4 | 592.8 | 0.0211 | |
| 93304 | 5.04 | 745 | 0.007 | 147.817 | 89.1 | 590.6 | 0.0237 | |
| 93305 | 4.81 | 712 | 0.007 | 148.025 | 88.4 | 588.8 | 0.0258 | |
| 93306 | 5.13 | 630 | 0.008 | 122.807 | 87.8 | 586.4 | 0.0272 | |
| 93307 | 7.42 | 653 | 0.011 | 88.005 | 89.1 | 592.2 | 0.0184 | |
| 93308 | 8.59 | 554 | 0.016 | 64.494 | 88 | 590.6 | 0.0185 | |
| 93309 | 9.09 | 527 | 0.017 | 57.976 | 86.4 | 592 | 0.0180 | |
| 93310 | 7.71 | 513 | 0.015 | 66.537 | 86.2 | 587.6 | 0.0218 | |
| Average | 7.223 | 612.7 | 0.0122 | 91.546 | 87.71 | 589.22 | 0.0198 | |

EXERCISE BALL SUBJECT 10 AERODYNAMIC DATA

Subglottal Pressure, Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency Test Results for All Phases in All Test Sessions

| Session1 | Baseline | | | | SPL Cal | 88 | | |
|-----------|-------------|----------------|-----------|-------------------|---------------|-----------------|-----------|--|
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE | |
| 101101 | 15 | 629 | 0.024 | 41.933 | 100 | 297.7 | 0.0106 | |
| 101102 | 16 | 733 | 0.022 | 45.813 | 101 | 298.4 | 0.0086 | |
| 101103 | 15.3 | 703 | 0.022 | 45.948 | 101 | 300.8 | 0.0094 | |
| 101104 | 15.8 | 713 | 0.022 | 45.127 | 101 | 297.3 | 0.0090 | |
| 101105 | 15.7 | 763 | 0.021 | 48.599 | 102 | 294.4 | 0.0085 | |
| 101106 | 15.4 | 823 | 0.019 | 53.442 | 102 | 296.6 | 0.0080 | |
| 101107 | 14.8 | 787 | 0.019 | 53.176 | 102 | 296.5 | 0.0088 | |
| 101108 | 15.7 | 819 | 0.019 | 52.166 | 102 | 297.1 | 0.0079 | |
| 101109 | 14.7 | 707 | 0.021 | 48.095 | 101 | 295.7 | 0.0097 | |
| 101110 | 15.1 | 643 | 0.023 | 42.583 | 100 | 295.1 | 0.0103 | |
| Average | 15.35 | 732.0 | 0.021 | 47.688 | 101.2 | 296.96 | 0.0090 | |
| Session 1 | Training | | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE | |
| 101201 | 16.1 | 801 | 0.020 | 49.752 | 102 | 296.3 | 0.0079 | |
| 101202 | 16.4 | 910 | 0.018 | 55.488 | 103 | 293.9 | 0.0069 | |
| 101203 | 16.2 | 907 | 0.018 | 55.988 | 103 | 297.5 | 0.0070 | |
| 101204 | 15.9 | 823 | 0.019 | 51.761 | 102 | 297.6 | 0.0078 | |
| 101205 | 17.3 | 915 | 0.019 | 52.890 | 103 | 296.5 | 0.0065 | |
| 101206 | 17.3 | 916 | 0.019 | 52.948 | 103 | 295.3 | 0.0065 | |
| 101207 | 14.8 | 787 | 0.019 | 53.176 | 102 | 296.5 | 0.0088 | |
| 101208 | 15.7 | 820 | 0.019 | 52.229 | 102 | 297.1 | 0.0079 | |
| 101209 | 17.6 | 917 | 0.019 | 52.102 | 103 | 296.7 | 0.0064 | |
| 101210 | 16.6 | 891 | 0.019 | 53.675 | 103 | 300 | 0.0070 | |
| Average | 16.39 | 868.70 | 0.019 | 53.00 | 102.60 | 296.74 | 0.0072 | |
| SPL Cal | 90 | Session 1 | | | | Post-Training | | |
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE | |
| 101301 | 15.3 | 724 | 0.021 | 47.320 | 101 | 299.6 | 0.0091 | |
| 101302 | 13.9 | 569 | 0.024 | 40.935 | 99.1 | 296.4 | 0.0125 | |
| 101303 | 14.2 | 664 | 0.021 | 46.761 | 100 | 295.2 | 0.0106 | |
| 101304 | 15.7 | 705 | 0.022 | 44.904 | 101 | 297.3 | 0.0091 | |
| 101305 | 14.8 | 690 | 0.021 | 46.622 | 101 | 297.7 | 0.0099 | |
| 101306 | 15.6 | 684 | 0.023 | 43.846 | 101 | 297.7 | 0.0095 | |
| 101307 | 15.2 | 764 | 0.020 | 50.263 | 101 | 297.8 | 0.0087 | |
| 101308 | 14.9 | 810 | 0.018 | 54.362 | 102 | 297.7 | 0.0085 | |
| 101309 | 17.4 | 926 | 0.019 | 53.218 | 103 | 296.8 | 0.0064 | |
| 101310 | 15.2 | 701 | 0.022 | 46.118 | 101 | 299.3 | 0.0095 | |
| Average | 15.22 | 723.70 | 0.021 | 47.435 | 101.01 | 297.6 | 0.0092 | |

EXERCISE BALL SUBJECT 10 AERODYNAMIC DATA

Subglottal Pressure (Psub), Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency (VE) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | | SPL Cal | 72 | |
|-----------|---------------|----------------|-----------|-------------------|---------------|-----------------|-----------|
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 102101 | 17.4 | 508 | 0.034 | 29.195 | 92.3 | 298.5 | 0.0104 |
| 102102 | 7.69 | 554 | 0.014 | 72.042 | 93.2 | 297.5 | 0.0219 |
| 102103 | 16.5 | 609 | 0.027 | 36.909 | 93.7 | 300.1 | 0.0093 |
| 102104 | 17.2 | 484 | 0.036 | 28.140 | 92.1 | 296.6 | 0.0111 |
| 102105 | 15.5 | 286 | 0.054 | 18.452 | 88.4 | 297.6 | 0.0199 |
| 102106 | 14.8 | 478 | 0.031 | 32.297 | 91.7 | 297.5 | 0.0130 |
| 102107 | 15.1 | 381 | 0.040 | 25.232 | 89.8 | 297.3 | 0.0156 |
| 102108 | 16.3 | 472 | 0.035 | 28.957 | 91.8 | 301.8 | 0.0119 |
| 102109 | 16 | 104 | 0.154 | 6.500 | 84.8 | 297.6 | 0.0510 |
| 102110 | 15.9 | 325 | 0.049 | 20.440 | 89.1 | 297.7 | 0.0172 |
| Average | 15.239 | 420.1 | 0.036 | 29.816 | 90.69 | 298.22 | 0.0142 |
| Session 2 | Training | | | | SPL Cal | 96 | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 102201 | 16.9 | 687 | 0.025 | 40.651 | 94.4 | 294.9 | 0.0081 |
| 102202 | 14.5 | 487 | 0.030 | 33.586 | 92 | 293.9 | 0.0130 |
| 102203 | 17.4 | 652 | 0.027 | 37.471 | 94.1 | 293.8 | 0.0083 |
| 102204 | 16.6 | 661 | 0.025 | 39.819 | 94.4 | 296.6 | 0.0086 |
| 102205 | 18.7 | 794 | 0.024 | 42.460 | 96 | 296.1 | 0.0065 |
| 102206 | 16.7 | 709 | 0.024 | 42.455 | 94.7 | 296.4 | 0.0080 |
| 102207 | 17.6 | 567 | 0.031 | 32.216 | 93 | 297.9 | 0.0093 |
| 102208 | 16.2 | 570 | 0.028 | 35.185 | 92.6 | 297.4 | 0.0100 |
| 102209 | 16.6 | 602 | 0.028 | 36.265 | 93.7 | 296.3 | 0.0094 |
| 102210 | 14.6 | 603 | 0.024 | 41.301 | 93.6 | 295.3 | 0.0106 |
| Average | 16.58 | 633.20 | 0.026 | 38.14 | 93.85 | 295.86 | 0.0089 |
| Session 2 | Post-Training | | | | SPL Cal | 90 | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 102301 | 17.3 | 199 | 0.087 | 11.503 | 86.3 | 299.7 | 0.0251 |
| 102302 | 18.3 | 651 | 0.028 | 35.574 | 94 | 299.3 | 0.0079 |
| 102303 | 17.4 | 652 | 0.027 | 37.471 | 94.3 | 296.3 | 0.0083 |
| 102304 | 16.3 | 449 | 0.036 | 27.546 | 91.3 | 294.7 | 0.0125 |
| 102305 | 16.3 | 411 | 0.040 | 25.215 | 90.8 | 295.7 | 0.0136 |
| 102306 | 18.4 | 498 | 0.037 | 27.065 | 92.1 | 297 | 0.0101 |
| 102307 | 17.6 | 690 | 0.026 | 39.205 | 94.7 | 298.8 | 0.0078 |
| 102308 | 17.1 | 129 | 0.133 | 7.544 | 84.5 | 298.1 | 0.0383 |
| 102309 | 16.4 | 75.2 | 0.218 | 4.585 | 82.8 | 294.6 | 0.0671 |
| 102310 | 17.3 | 432 | 0.040 | 24.971 | 91.1 | 297.5 | 0.0122 |
| Average | 14.84 | 682.10 | 0.022 | 47.12 | 93.81 | 297.17 | 0.0093 |

EXERCISE BALL SUBJECT 10 AERODYNAMIC DATA

Subglottal Pressure (Psub), Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency (VE) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | | SPL Cal 82 | | |
|-----------|---------------|----------------|-----------|-------------------|------------|-----------------|-----------|
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 103101 | 14.4 | 650 | 0.022 | 45.139 | 92.9 | 295.5 | 0.0099 |
| 103102 | 14.6 | 973 | 0.015 | 66.644 | 96 | 302.8 | 0.0068 |
| 103103 | 13.3 | 810 | 0.016 | 60.902 | 94.3 | 297.3 | 0.0088 |
| 103104 | 12.6 | 729 | 0.017 | 57.857 | 93.7 | 295.1 | 0.0102 |
| 103105 | 12.7 | 418 | 0.030 | 32.913 | 90 | 298.7 | 0.0170 |
| 103106 | 13 | 676 | 0.019 | 52.000 | 93.1 | 298.8 | 0.0106 |
| 103107 | 12.7 | 641 | 0.020 | 50.472 | 92.7 | 298.9 | 0.0114 |
| 103108 | 12.2 | 209 | 0.058 | 17.131 | 86.2 | 297.4 | 0.0338 |
| 103109 | 11.9 | 149 | 0.080 | 12.521 | 85.3 | 297.2 | 0.0481 |
| 103110 | 11.3 | 196 | 0.058 | 17.345 | 85.9 | 297 | 0.0388 |
| Average | 12.87 | 545.10 | 0.024 | 41.29 | 91.01 | 297.87 | 0.0130 |
| Session 3 | Training | | | | SPL Cal 96 | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 103201 | 15.1 | 1100 | 0.014 | 72.848 | 96.5 | 297.4 | 0.0058 |
| 103202 | 13.8 | 800 | 0.017 | 57.971 | 95.3 | 298.9 | 0.0086 |
| 103203 | 12.9 | 551 | 0.023 | 42.713 | 91.8 | 296.1 | 0.0129 |
| 103204 | 12.7 | 650 | 0.020 | 51.181 | 93.1 | 297.5 | 0.0113 |
| 103205 | 13.4 | 412 | 0.033 | 30.746 | 90.2 | 297.6 | 0.0163 |
| 103206 | 12.8 | 682 | 0.019 | 53.281 | 93.1 | 297.9 | 0.0107 |
| 103207 | 13.4 | 899 | 0.015 | 67.090 | 95.4 | 297.2 | 0.0079 |
| 103208 | 12.5 | 669 | 0.019 | 53.520 | 93.3 | 297.3 | 0.0112 |
| 103209 | 11.3 | 812 | 0.014 | 71.858 | 94.6 | 298.5 | 0.0103 |
| 103210 | 11.4 | 784 | 0.015 | 68.772 | 94.3 | 294.3 | 0.0106 |
| Average | 12.93 | 735.9 | 0.018 | 56.998 | 93.76 | 297.27 | 0.0099 |
| Session 3 | Post-Training | | | | SPL Cal 90 | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 103301 | 13.2 | 521 | 0.025 | 39.470 | 91.5 | 300.5 | 0.0133 |
| 103302 | 12.6 | 622 | 0.020 | 49.365 | 92.5 | 294.4 | 0.0118 |
| 103303 | 13 | 619 | 0.021 | 47.615 | 92.7 | 297.3 | 0.0115 |
| 103304 | 11.8 | 560 | 0.021 | 47.458 | 91.8 | 294.9 | 0.0139 |
| 103305 | 11.7 | 222 | 0.053 | 18.974 | 87 | 298.2 | 0.0335 |
| 103306 | 12 | 247 | 0.049 | 20.583 | 87 | 298.3 | 0.0294 |
| 103307 | 11.8 | 577 | 0.020 | 48.898 | 91.8 | 297.9 | 0.0135 |
| 103308 | 11.7 | 461 | 0.025 | 39.402 | 90.9 | 298.4 | 0.0169 |
| 103309 | 11.9 | 549 | 0.022 | 46.134 | 92 | 298.3 | 0.0141 |
| 103310 | 11 | 448 | 0.025 | 40.727 | 90.5 | 293.9 | 0.0184 |
| Average | 12.07 | 482.6 | 0.025 | 39.863 | 90.77 | 297.21 | 0.0156 |

BALANCE BALL SUBJECT 11 AERODYNAMIC DATA

Subglottal Pressure, Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency Test Results for All Phases in All Test Sessions

| Session 1 | Baseline | | | | SPL Cal 93 | | |
|-----------|---------------|----------------|-----------|-------------------|---------------|-----------------|-----------|
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 11101 | 13 | 277 | 0.047 | 21.308 | 102 | 583.3 | 0.0283 |
| 11102 | 14.4 | 240 | 0.060 | 16.667 | 104 | 587.2 | 0.0301 |
| 11103 | 13.1 | 252 | 0.052 | 19.237 | 103 | 570 | 0.0312 |
| 11104 | 14.2 | 312 | 0.046 | 21.972 | 103 | 584.4 | 0.0232 |
| 11105 | 15.1 | 314 | 0.048 | 20.795 | 104 | 577.6 | 0.0219 |
| 11106 | 12.2 | 275 | 0.044 | 22.541 | 103 | 582.2 | 0.0307 |
| 11107 | 15.3 | 318 | 0.048 | 20.784 | 105 | 582.1 | 0.0216 |
| 11108 | 16.6 | 309 | 0.054 | 18.614 | 105 | 582.6 | 0.0205 |
| 11109 | 15.6 | 291 | 0.054 | 18.654 | 104 | 582.8 | 0.0229 |
| 11110 | 13.3 | 320 | 0.042 | 24.060 | 105 | 581.5 | 0.0247 |
| Average | 14.28 | 290.8 | 0.049 | 20.463 | 103.8 | 581.37 | 0.0250 |
| Session 1 | Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 111201 | 12.7 | 290 | 0.044 | 22.835 | 105 | 588.4 | 0.0285 |
| 111202 | 13.1 | 291 | 0.045 | 22.214 | 106 | 584.9 | 0.0278 |
| 111203 | 15.3 | 261 | 0.059 | 17.059 | 103 | 587.6 | 0.0258 |
| 111204 | 15 | 283 | 0.053 | 18.867 | 104 | 593.5 | 0.0245 |
| 111205 | 13.2 | 333 | 0.040 | 25.227 | 103 | 587.5 | 0.0234 |
| 111206 | 14 | 290 | 0.048 | 20.714 | 104 | 587.6 | 0.0256 |
| 111207 | 14 | 404 | 0.035 | 28.857 | 106 | 582 | 0.0187 |
| 111208 | 15.2 | 302 | 0.050 | 19.868 | 106 | 583.4 | 0.0231 |
| 111209 | 14 | 243 | 0.058 | 17.357 | 103 | 591.8 | 0.0303 |
| 111210 | 10.6 | 153 | 0.069 | 14.434 | 101 | 578.3 | 0.0623 |
| Average | 13.71 | 285 | 0.050 | 20.743 | 104.1 | 586.5 | 0.0290 |
| Session 1 | Post-Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 111301 | 13.6 | 111 | 0.123 | 8.162 | 103 | 581.7 | 0.0682 |
| 111302 | 12 | 215 | 0.056 | 17.917 | 104 | 581.2 | 0.0403 |
| 111303 | 13.6 | 259 | 0.053 | 19.044 | 104 | 581.3 | 0.0295 |
| 111304 | 14.3 | 299 | 0.048 | 20.909 | 105 | 581.6 | 0.0246 |
| 111305 | 13.8 | 162 | 0.085 | 11.739 | 102 | 578.3 | 0.0456 |
| 111306 | 13.4 | 235 | 0.057 | 17.537 | 102 | 580.2 | 0.0324 |
| 111307 | 15.4 | 244 | 0.063 | 15.844 | 104 | 585.4 | 0.0277 |
| 111308 | 13.8 | 246 | 0.056 | 17.826 | 103 | 578.7 | 0.0303 |
| 111309 | 14.1 | 325 | 0.043 | 23.050 | 105 | 583 | 0.0229 |
| 111310 | 13.7 | 321 | 0.043 | 23.431 | 106 | 580.8 | 0.0241 |
| Average | 13.8 | 241.7 | 0.057 | 17.546 | 103.8 | 581.2 | 0.0312 |

BALANCE BALL SUBJECT 11 AERODYNAMIC DATA

Subglottal Pressure (Psub), Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency (VE) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | | SPL Cal | 76 | |
|-----------|---------------|----------------|-----------|-------------------|---------------|-----------------|-----------|
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 112101 | 14.7 | 227 | 0.065 | 15.442 | 80.8 | 573.1 | 0.0242 |
| 112102 | 16 | 254 | 0.063 | 15.875 | 81 | 582.5 | 0.0199 |
| 112103 | 14.6 | 195 | 0.075 | 13.356 | 79.4 | 585.4 | 0.0279 |
| 112104 | 17.1 | 201 | 0.085 | 11.754 | 80.1 | 581 | 0.0233 |
| 112105 | 15.7 | 110 | 0.143 | 7.006 | 78.2 | 571.3 | 0.0453 |
| 112106 | 14.7 | 140 | 0.105 | 9.524 | 78.1 | 571.5 | 0.0379 |
| 112107 | 14.4 | 135 | 0.107 | 9.375 | 78.6 | 574.2 | 0.0404 |
| 112108 | 15.8 | 127 | 0.124 | 8.038 | 79.1 | 582.8 | 0.0394 |
| 112109 | 16.6 | 108 | 0.154 | 6.506 | 79.3 | 575.4 | 0.0442 |
| 112110 | 15.6 | 143 | 0.109 | 9.167 | 80.1 | 572.7 | 0.0359 |
| Average | 15.52 | 164 | 0.095 | 10.604 | 79.5 | 576.99 | 0.0312 |
| Session 2 | Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 112201 | 16.2 | 306 | 0.053 | 18.889 | 82.3 | 581.4 | 0.0166 |
| 112202 | 16.8 | 231 | 0.073 | 13.750 | 81.8 | 575.1 | 0.0211 |
| 112203 | 14.6 | 193 | 0.076 | 13.219 | 79.3 | 577 | 0.0281 |
| 112204 | 14.9 | 247 | 0.060 | 16.577 | 81.7 | 582.1 | 0.0222 |
| 112205 | 15.9 | 241 | 0.066 | 15.157 | 81.9 | 584.2 | 0.0214 |
| 112206 | 17.1 | 284 | 0.060 | 16.608 | 82.2 | 586.5 | 0.0169 |
| 112207 | 17.3 | 209 | 0.083 | 12.081 | 81.5 | 577.7 | 0.0225 |
| 112208 | 15.6 | 252 | 0.062 | 16.154 | 81.3 | 577.6 | 0.0207 |
| 112209 | 16.5 | 274 | 0.060 | 16.606 | 82.1 | 575.1 | 0.0182 |
| 112210 | 16.6 | 354 | 0.047 | 21.325 | 83.6 | 572.0 | 0.0142 |
| Average | 16.15 | 259 | 0.062 | 16.037 | 81.8 | 578.9 | 0.0195 |
| Session 2 | Post-Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 112301 | 16.7 | 283 | 0.059 | 16.946 | 83.1 | 575.9 | 0.0176 |
| 112302 | 17.3 | 312 | 0.055 | 18.035 | 83.5 | 574.3 | 0.0155 |
| 112303 | 17.9 | 353 | 0.051 | 19.721 | 84.7 | 576.8 | 0.0134 |
| 112304 | 17 | 225 | 0.076 | 13.235 | 82.1 | 573.4 | 0.0215 |
| 112305 | 17.3 | 252 | 0.069 | 14.566 | 82.3 | 574.7 | 0.0189 |
| 112306 | 17.3 | 148 | 0.117 | 8.555 | 81 | 580.4 | 0.0316 |
| 112307 | 17.9 | 244 | 0.073 | 13.631 | 82.6 | 575.2 | 0.0189 |
| 112308 | 18.3 | 222 | 0.082 | 12.131 | 82 | 576.4 | 0.0202 |
| 112309 | 16.1 | 212 | 0.076 | 13.168 | 81.1 | 578.7 | 0.0238 |
| 112310 | 18.4 | 132 | 0.139 | 7.174 | 79.9 | 571.5 | 0.0329 |
| Average | 17.4 | 238 | 0.073 | 13.716 | 82.2 | 575.7 | 0.0198 |

BALANCE BALL SUBJECT 11 AERODYNAMIC DATA

Subglottal Pressure (Psub), Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency (VE) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | | SPL Cal | 79 | | |
|-----------|---------------|----------------|-----------|-------------------|------------|-----------------|-----------|--|
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE | |
| 113101 | 15.4 | 249 | 0.062 | 16.169 | 87.4 | 581.5 | 0.0228 | |
| 113102 | 15.2 | 271 | 0.056 | 17.829 | 86.8 | 587.2 | 0.0211 | |
| 113103 | 17 | 346 | 0.049 | 20.353 | 89.8 | 575.8 | 0.0153 | |
| 113104 | 16.1 | 239 | 0.067 | 14.845 | 86.9 | 573.7 | 0.0226 | |
| 113105 | 17.9 | 289 | 0.062 | 16.145 | 88.8 | 582.1 | 0.0172 | |
| 113106 | 17 | 298 | 0.057 | 17.529 | 89 | 579.3 | 0.0176 | |
| 113107 | 16.6 | 301 | 0.055 | 18.133 | 87.9 | 572.4 | 0.0176 | |
| 113108 | 8.08 | 228 | 0.035 | 28.218 | 86.5 | 577.9 | 0.0470 | |
| 113109 | 14.1 | 204 | 0.069 | 14.468 | 86.2 | 571.2 | 0.0300 | |
| 113110 | 14.3 | 198 | 0.072 | 13.846 | 85.7 | 579.4 | 0.0303 | |
| Average | 15.17 | 262.30 | 0.058 | 17.75 | 87.50 | 578.05 | 0.0220 | |
| Session 3 | Training | | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE | |
| 113201 | 16 | 507 | 0.032 | 31.688 | 90.2 | 570.1 | 0.0111 | |
| 113202 | 17.2 | 350 | 0.049 | 20.349 | 89.5 | 576.9 | 0.0149 | |
| 113203 | 17.1 | 428 | 0.040 | 25.029 | 88.5 | 575.2 | 0.0121 | |
| 113204 | 14.3 | 336 | 0.043 | 23.497 | 87.5 | 571.3 | 0.0182 | |
| 113205 | 13.1 | 336 | 0.039 | 25.649 | 87.3 | 569.5 | 0.0198 | |
| 113206 | 14.9 | 382 | 0.039 | 25.638 | 88 | 574.4 | 0.0155 | |
| 113207 | 15.5 | 396 | 0.039 | 25.548 | 88.6 | 575.5 | 0.0144 | |
| 113208 | 16.7 | 373 | 0.045 | 22.335 | 89 | 570.6 | 0.0143 | |
| 113209 | 17.4 | 380 | 0.046 | 21.839 | 88.6 | 573.1 | 0.0134 | |
| 113210 | 17 | 329 | 0.052 | 19.353 | 87.7 | 568.8 | 0.0157 | |
| Average | 15.92 | 381.7 | 0.042 | 24.092 | 88.49 | 572.54 | 0.0149 | |
| Session 3 | Post-Training | | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE | |
| 113301 | 17 | 423 | 0.040 | 24.882 | 88.8 | 570.9 | 0.0123 | |
| 113302 | 17.1 | 309 | 0.055 | 18.070 | 87.2 | 573.4 | 0.0165 | |
| 113303 | 16.9 | 324 | 0.052 | 19.172 | 87.7 | 580.7 | 0.0160 | |
| 113304 | 17.7 | 330 | 0.054 | 18.644 | 88.4 | 581.8 | 0.0151 | |
| 113305 | 17.6 | 279 | 0.063 | 15.852 | 87.6 | 581.5 | 0.0178 | |
| 113306 | 15.7 | 271 | 0.058 | 17.261 | 86 | 575.8 | 0.0202 | |
| 113307 | 16.6 | 373 | 0.045 | 22.470 | 87.4 | 581 | 0.0141 | |
| 113308 | 16.6 | 194 | 0.086 | 11.687 | 86.1 | 581.5 | 0.0267 | |
| 113309 | 18.4 | 298 | 0.062 | 16.196 | 87.5 | 575.8 | 0.0160 | |
| 113310 | 17.1 | 309 | 0.055 | 18.070 | 87.2 | 570.9 | 0.0165 | |
| Average | 17.07 | 311 | 0.055 | 18.2304 | 87.39 | 577.33 | 0.0165 | |

| BALANCE BALL SUBJECT 12 AERODYNAMIC DATA | | | | | | | |
|---|---------------|----------------|-----------|-------------------|---------------|-----------------|-----------|
| Subglottal Pressure, Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency Test Results for All Phases in All Test Sessions | | | | | | | |
| Session 1 | Baseline | | | | SPL Cal | 93 | |
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 121101 | 8.65 | 457 | 0.019 | 52.832 | 99.8 | 588.2 | 0.0252 |
| 121102 | 8.04 | 389 | 0.021 | 48.383 | 97.4 | 591.6 | 0.0311 |
| 121103 | 7.65 | 654 | 0.012 | 85.490 | 98.4 | 589.2 | 0.0197 |
| 121104 | 8.83 | 932 | 0.009 | 105.549 | 101 | 586.2 | 0.0123 |
| 121105 | 8.83 | 1140 | 0.008 | 129.105 | 99.7 | 585.0 | 0.0099 |
| 121106 | 8.65 | 775 | 0.011 | 89.595 | 100 | 583.2 | 0.0149 |
| 121107 | 8.56 | 778 | 0.011 | 90.888 | 102 | 586.4 | 0.0153 |
| 121108 | 7.29 | 725 | 0.010 | 99.451 | 101 | 580.8 | 0.0191 |
| 121109 | 8.83 | 755 | 0.012 | 85.504 | 101 | 583.4 | 0.0152 |
| 121110 | 8.12 | 619 | 0.013 | 76.232 | 101 | 581.8 | 0.0201 |
| Average | 8.345 | 722.4 | 0.012 | 86.303 | 100.13 | 585.58 | 0.0166 |
| Session 1 | Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 121201 | 8.8 | 295 | 0.030 | 35.600 | 94.6 | 577.4 | 0.0364 |
| 121202 | 9.45 | 292 | 0.032 | 30.899 | 94.6 | 587.4 | 0.0343 |
| 121203 | 8.89 | 659 | 0.013 | 74.128 | 98.6 | 584.4 | 0.0168 |
| 121204 | 8.66 | 410 | 0.021 | 47.344 | 98.8 | 591.4 | 0.0278 |
| 121205 | 9.47 | 604 | 0.016 | 64.200 | 96.4 | 590.2 | 0.0169 |
| 121206 | 9.49 | 321 | 0.030 | 33.825 | 93 | 582.8 | 0.0305 |
| 121207 | 8.83 | 212 | 0.042 | 24.009 | 92.6 | 581.0 | 0.0495 |
| 121208 | 9.9 | 520 | 0.019 | 52.525 | 98.1 | 588.0 | 0.0191 |
| 121209 | 9.01 | 559 | 0.016 | 62.042 | 99.6 | 588.0 | 0.0198 |
| 121210 | 8.73 | 528 | 0.017 | 60.481 | 99.6 | 584.8 | 0.0216 |
| Average | 9.12 | 440.00 | 0.021 | 48.51 | 96.59 | 585.54 | 0.0241 |
| Session 1 | Post-Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 121301 | 9.21 | 876 | 0.011 | 95.114 | 95.1 | 580.6 | 0.0118 |
| 121302 | 8.49 | 842 | 0.010 | 99.176 | 105 | 579.0 | 0.0147 |
| 121303 | 9.26 | 983 | 0.009 | 106.156 | 106 | 584.6 | 0.0116 |
| 121304 | 8.33 | 1220 | 0.007 | 146.459 | 103 | 587.6 | 0.0101 |
| 121305 | 8.29 | 573 | 0.014 | 69.119 | 100 | 591.0 | 0.0211 |
| 121306 | 8.29 | 580 | 0.014 | 69.964 | 100 | 582.8 | 0.0208 |
| 121307 | 8.73 | 685 | 0.013 | 78.465 | 103 | 584.4 | 0.0172 |
| 121308 | 9.9 | 481 | 0.021 | 48.586 | 97.5 | 583.0 | 0.0205 |
| 121309 | 8.4 | 804 | 0.010 | 95.714 | 103 | 584.0 | 0.0153 |
| 121310 | 8.51 | 862 | 0.010 | 101.293 | 102 | 584.2 | 0.0139 |
| Average | 8.74 | 790.60 | 0.011 | 91.00 | 101.46 | 584.12 | 0.0147 |

BALANCE BALL SUBJECT 1 AERODYNAMIC DATA

Subglottal Pressure (Psub), Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency (VE) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | | SPL Cal | 88 | |
|-----------|---------------|----------------|-----------|-------------------|---------------|-----------------|-----------|
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 122101 | 7.62 | 783 | 0.010 | 102.756 | 95.8 | 591.0 | 0.0161 |
| 122102 | 7.37 | 936 | 0.008 | 127.001 | 96.1 | 602.7 | 0.0139 |
| 122103 | 7.3 | 915 | 0.008 | 127.000 | 99 | 589.6 | 0.0148 |
| 122104 | 7.7 | 1360 | 0.006 | 176.623 | 97.4 | 599.8 | 0.0093 |
| 122105 | 7.87 | 698 | 0.011 | 88.691 | 92.9 | 607.6 | 0.0169 |
| 122106 | 5.67 | 1100 | 0.005 | 194.004 | 91.7 | 581.2 | 0.0147 |
| 122107 | 7.36 | 1220 | 0.006 | 165.761 | 97.7 | 597.4 | 0.0109 |
| 122108 | 8.28 | 964 | 0.009 | 116.425 | 97.6 | 588.0 | 0.0122 |
| 122109 | 8.42 | 901 | 0.009 | 107.007 | 100 | 587.2 | 0.0132 |
| 122110 | 7.6 | 782 | 0.010 | 102.895 | 99 | 587.8 | 0.0167 |
| Average | 7.519 | 965.9 | 0.008 | 130.8163 | 96.72 | 593.23 | 0.0133 |
| Session 2 | Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 122201 | 8.07 | 605 | 0.013 | 74.969 | 95.6 | 591.4 | 0.0196 |
| 122202 | 7.31 | 290 | 0.025 | 39.672 | 87.9 | 592.0 | 0.0415 |
| 122203 | 8.53 | 212 | 0.040 | 24.853 | 88.6 | 599.8 | 0.0490 |
| 122204 | 8.57 | 731 | 0.012 | 85.298 | 91.7 | 607.6 | 0.0146 |
| 122205 | 7.93 | 338 | 0.023 | 42.623 | 90.2 | 597.4 | 0.0337 |
| 122206 | 8.23 | 633 | 0.013 | 76.914 | 94.8 | 597.1 | 0.0182 |
| 122207 | 8.03 | 483 | 0.017 | 60.149 | 95.4 | 594.0 | 0.0246 |
| 122208 | 7.93 | 1340 | 0.006 | 168.979 | 98.1 | 599.5 | 0.0092 |
| 122209 | 8.2 | 670 | 0.012 | 81.707 | 95.7 | 590.0 | 0.0174 |
| 122210 | 7.87 | 602 | 0.013 | 76.493 | 96.6 | 599.8 | 0.0204 |
| Average | 8.067 | 590.40 | 0.014 | 73.16567 | 93.46 | 596.866 | 0.0196 |
| Session 2 | Post-Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 122301 | 7.37 | 776 | 0.009 | 105.292 | 97 | 595.4 | 0.0170 |
| 122302 | 6.83 | 609 | 0.011 | 89.165 | 92.3 | 606.3 | 0.0222 |
| 122303 | 6.64 | 850 | 0.008 | 128.012 | 91.1 | 599.4 | 0.0161 |
| 122304 | 6.68 | 536 | 0.012 | 80.240 | 97.3 | 596.2 | 0.0272 |
| 122305 | 6.73 | 681 | 0.010 | 101.189 | 94.2 | 602.0 | 0.0206 |
| 122306 | 7.02 | 1220 | 0.006 | 173.789 | 97.6 | 594.6 | 0.0114 |
| 122307 | 6.53 | 631 | 0.010 | 96.631 | 98 | 599.4 | 0.0238 |
| 122308 | 7.55 | 701 | 0.011 | 92.848 | 99.8 | 597.4 | 0.0189 |
| 122309 | 7.46 | 841 | 0.009 | 112.735 | 96.1 | 601.3 | 0.0153 |
| 122310 | 6.87 | 909 | 0.008 | 132.314 | 99.7 | 595.2 | 0.0160 |
| Average | 6.968 | 775.400 | 0.009 | 111.221 | 96.310 | 598.722 | 0.0178 |

BALANCE BALL SUBJECT 12 AERODYNAMIC DATA

Subglottal Pressure (Psub), Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency (VE) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | | SPL Cal | 87 | |
|-----------|---------------|----------------|-----------|-------------------|------------|-----------------|-----------|
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 123101 | 8.35 | 657 | 0.013 | 78.683 | 94 | 595.4 | 0.0171 |
| 123102 | 7.82 | 653 | 0.012 | 83.504 | 95.9 | 596.2 | 0.0188 |
| 123103 | 7.35 | 774 | 0.009 | 105.306 | 96.5 | 593.8 | 0.0170 |
| 123104 | 8.4 | 925 | 0.009 | 110.119 | 99.8 | 592.0 | 0.0128 |
| 123105 | 8.1 | 906 | 0.009 | 111.852 | 100 | 576.6 | 0.0136 |
| 123106 | 7.35 | 879 | 0.008 | 119.592 | 99.1 | 594.0 | 0.0153 |
| 123107 | 7.39 | 912 | 0.008 | 123.410 | 100 | 596.0 | 0.0148 |
| 123108 | 8.76 | 987 | 0.009 | 112.671 | 93.7 | 595.4 | 0.0108 |
| 123109 | 7.07 | 541 | 0.013 | 76.521 | 96.9 | 594.8 | 0.0253 |
| 123110 | 6.95 | 580 | 0.012 | 83.453 | 97.4 | 593.0 | 0.0242 |
| Average | 7.75 | 781.40 | 0.010 | 100.51 | 97.33 | 592.72 | 0.0161 |
| Session 3 | Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 123201 | 8.57 | 544 | 0.016 | 63.477 | 97.8 | 590.2 | 0.0210 |
| 123202 | 8.13 | 553 | 0.015 | 68.020 | 98 | 590.2 | 0.0218 |
| 123203 | 8.59 | 581 | 0.015 | 67.637 | 93.5 | 598.0 | 0.0187 |
| 123204 | 8.88 | 505 | 0.018 | 56.869 | 57.6 | 593.0 | 0.0128 |
| 123205 | 8.49 | 571 | 0.015 | 67.256 | 95.4 | 597.6 | 0.0197 |
| 123206 | 8.68 | 659 | 0.013 | 75.922 | 96.3 | 589.4 | 0.0168 |
| 123207 | 8.58 | 535 | 0.016 | 62.354 | 96.3 | 591.4 | 0.0210 |
| 123208 | 7.65 | 600 | 0.013 | 78.431 | 97.8 | 596.6 | 0.0213 |
| 123209 | 6.08 | 493 | 0.012 | 81.086 | 99.4 | 589.2 | 0.0332 |
| 123210 | 5.14 | 430 | 0.012 | 83.658 | 97.1 | 591.0 | 0.0439 |
| Average | 7.879 | 547.1 | 0.014 | 70.47091 | 92.92 | 592.66 | 0.0216 |
| Session 3 | Post-Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 123301 | 8.36 | 544 | 0.015 | 65.072 | 98.2 | 586.8 | 0.0216 |
| 123302 | 8.57 | 624 | 0.014 | 72.812 | 98.3 | 593.4 | 0.0184 |
| 123303 | 5.6 | 566 | 0.010 | 101.071 | 97.6 | 595.4 | 0.0308 |
| 123304 | 7.72 | 626 | 0.012 | 81.088 | 98.9 | 593.4 | 0.0205 |
| 123305 | 5.81 | 602 | 0.010 | 103.614 | 95.8 | 587.0 | 0.0274 |
| 123306 | 5.23 | 490 | 0.011 | 93.690 | 99 | 591.0 | 0.0386 |
| 123307 | 5.57 | 586 | 0.010 | 105.206 | 97.4 | 588.4 | 0.0298 |
| 123308 | 7.65 | 626 | 0.012 | 81.830 | 98.1 | 595.6 | 0.0205 |
| 123309 | 6.08 | 493 | 0.012 | 81.086 | 99.4 | 595.0 | 0.0332 |
| 123310 | 5.14 | 430 | 0.012 | 83.658 | 97.1 | 590.4 | 0.0439 |
| Average | 6.573 | 558.7 | 0.012 | 86.913 | 97.98 | 591.64 | 0.0267 |

CASE STUDY SUBJECT 1 AERODYNAMIC DATA

Subglottal Pressure, Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency Test Results for All Phases in All Test Sessions

| Session1 | Baseline | | | | SPL Cal | 90 | |
|-----------|---------------|----------------|-----------|-------------------|---------------|-----------------|-----------|
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 11101 | 11 | 246 | 0.045 | 22.36 | 95 | 542.4 | 0.035 |
| 11102 | 9.47 | 213 | 0.044 | 22.49 | 93.8 | 512.4 | 0.047 |
| 11103 | 14.3 | 186 | 0.077 | 13.01 | 94.2 | 518.6 | 0.035 |
| 11104 | 14.5 | 142 | 0.102 | 9.79 | 92.1 | 555.7 | 0.045 |
| 11105 | 14.8 | 240 | 0.062 | 16.22 | 95.5 | 579.9 | 0.027 |
| 11106 | 15.1 | 202 | 0.075 | 13.38 | 93.8 | 578.5 | 0.031 |
| 11107 | 15.2 | 298 | 0.051 | 19.61 | 96.6 | 574 | 0.021 |
| 11108 | 14.9 | 266 | 0.056 | 17.85 | 95.8 | 559.8 | 0.024 |
| 11109 | 14.6 | 224 | 0.065 | 15.34 | 94.6 | 572.8 | 0.029 |
| 11110 | 10.7 | 312 | 0.034 | 29.16 | 96.9 | 567.7 | 0.029 |
| Average | 13.46 | 232.9 | 0.058 | 17.921 | 94.83 | 556.2 | 0.0323 |
| Session 1 | Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 11201 | 14.8 | 260 | 0.057 | 17.57 | 95.3 | 587.1 | 0.025 |
| 11202 | 15.2 | 294 | 0.052 | 19.34 | 96.5 | 557.6 | 0.022 |
| 11203 | 15.6 | 298 | 0.052 | 19.10 | 96.6 | 563.6 | 0.021 |
| 11204 | 15.6 | 267 | 0.058 | 17.12 | 95.8 | 561.7 | 0.023 |
| 11205 | 15.7 | 318 | 0.049 | 20.25 | 97 | 557.8 | 0.019 |
| 11206 | 15.3 | 280 | 0.055 | 18.30 | 86.2 | 563.2 | 0.020 |
| 11207 | 15.6 | 254 | 0.061 | 16.28 | 95.5 | 570.3 | 0.024 |
| 11208 | 15 | 229 | 0.066 | 15.27 | 95.1 | 575.5 | 0.028 |
| 11209 | 15.3 | 296 | 0.052 | 19.35 | 96.7 | 567.1 | 0.021 |
| 11210 | 14.6 | 281 | 0.052 | 19.25 | 96.3 | 569.9 | 0.023 |
| Average | 15.27 | 277.7 | 0.055 | 18.182 | 95.1 | 567.4 | 0.0226 |
| Session 1 | Post-Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 11301 | 15.5 | 185 | 0.084 | 11.94 | 93.7 | 580.5 | 0.033 |
| 11302 | 15 | 191 | 0.079 | 12.73 | 94.3 | 581.1 | 0.033 |
| 11303 | 14.6 | 167 | 0.087 | 11.44 | 92.3 | 578.6 | 0.038 |
| 11304 | 15 | 190 | 0.079 | 12.67 | 93.7 | 574.3 | 0.033 |
| 11305 | 14.6 | 205 | 0.071 | 14.04 | 94.6 | 575.4 | 0.032 |
| 11306 | 14.7 | 225 | 0.065 | 15.31 | 95.2 | 576.8 | 0.029 |
| 11307 | 14.6 | 204 | 0.072 | 13.97 | 94.2 | 582.1 | 0.032 |
| 11308 | 14.6 | 146 | 0.100 | 10.00 | 93.2 | 585.2 | 0.044 |
| 11309 | 14.6 | 94.3 | 0.155 | 6.46 | 91.9 | 578 | 0.067 |
| 11310 | 14.6 | 170 | 0.086 | 11.64 | 93.4 | 582.5 | 0.038 |
| Average | 14.78 | 177.73 | 0.083 | 12.020 | 93.65 | 579.5 | 0.0376 |

CASE STUDY SUBJECT 1 AERODYNAMIC DATA

Subglottal Pressure (Psub), Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency (VE) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | | SPL Cal | 93 | |
|-----------|---------------|----------------|-----------|-------------------|---------------|-----------------|-----------|
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 12101 | 18.2 | 452 | 0.040 | 24.84 | 106 | 594.7 | 0.0129 |
| 12102 | 17.8 | 454 | 0.039 | 25.51 | 105 | 592.5 | 0.0130 |
| 12103 | 17.9 | 388 | 0.046 | 21.68 | 104 | 584.7 | 0.0150 |
| 12104 | 17.6 | 344 | 0.051 | 19.55 | 103 | 583.4 | 0.0004 |
| 12105 | 18.2 | 427 | 0.043 | 23.46 | 105 | 587.5 | 0.0004 |
| 12106 | 18.6 | 381 | 0.049 | 20.48 | 105 | 588.9 | 0.0004 |
| 12107 | 17.6 | 427 | 0.041 | 24.26 | 105 | 586 | 0.0140 |
| 12108 | 18.2 | 387 | 0.047 | 21.26 | 104 | 585.8 | 0.0148 |
| 12109 | 17.4 | 482 | 0.036 | 27.70 | 105 | 587.8 | 0.0125 |
| 12110 | 17 | 306 | 0.056 | 18.00 | 103 | 586.3 | 0.0198 |
| Average | 17.85 | 404.8 | 0.044 | 22.67 | 104.5 | 587.8 | 0.0145 |
| Session 2 | Training | | | | SPL | Pitch Hz | VE |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 12201 | 20 | 406 | 0.0493 | 20.30 | 105 | 586 | 0.0129 |
| 12202 | 18.1 | 278 | 0.0651 | 15.36 | 102 | 586.2 | 0.0203 |
| 12203 | 19.1 | 372 | 0.0513 | 19.48 | 104 | 589.5 | 0.0146 |
| 12204 | 19.6 | 487 | 0.0402 | 24.85 | 106 | 586 | 0.0111 |
| 12205 | 18.8 | 494 | 0.0381 | 26.28 | 106 | 589.8 | 0.0114 |
| 12206 | 18.5 | 443 | 0.0418 | 23.95 | 105 | 588.5 | 0.0128 |
| 12207 | 18.2 | 351 | 0.0519 | 19.29 | 104 | 584.5 | 0.0163 |
| 12208 | 19 | 329 | 0.0578 | 17.32 | 104 | 589.5 | 0.0166 |
| 12209 | 18.5 | 356 | 0.0520 | 19.24 | 104 | 583.6 | 0.0158 |
| 12210 | 18.8 | 332 | 0.0566 | 17.66 | 104 | 586 | 0.0167 |
| Average | 18.86 | 384.8 | 0.0490 | 20.371 | 104.4 | 587.0 | 0.0144 |
| Session 2 | Post-Training | | | | SPL | Pitch Hz | VE |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 12301 | 16.6 | 451 | 0.0368 | 27.17 | 105 | 585.6 | 0.0140 |
| 12302 | 16.8 | 471 | 0.0357 | 28.04 | 106 | 587.4 | 0.0134 |
| 12303 | 17.6 | 349 | 0.0504 | 19.83 | 104 | 584.2 | 0.0169 |
| 12304 | 17.6 | 350 | 0.0503 | 19.89 | 104 | 586.1 | 0.0169 |
| 12305 | 18.1 | 393 | 0.0461 | 21.71 | 105 | 590.9 | 0.0148 |
| 12306 | 17.6 | 338 | 0.0521 | 19.20 | 104 | 588.1 | 0.0175 |
| 12307 | 16.6 | 369 | 0.0450 | 22.23 | 104 | 584.7 | 0.0170 |
| 12308 | 18.3 | 315 | 0.0581 | 17.21 | 104 | 584 | 0.0180 |
| 12309 | 18.3 | 314 | 0.0583 | 17.16 | 103 | 586.9 | 0.0179 |
| 12310 | 18.1 | 199 | 0.0910 | 10.99 | 102 | 587.3 | 0.0283 |
| Average | 17.56 | 354.9 | 0.0495 | 20.343 | 104.1 | 586.5 | 0.0167 |

CASE STUDY SUBJECT 1 AERODYNAMIC DATA

Subglottal Pressure (Psub), Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency (VE) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | | SPL Cal | 88 | |
|-----------|---------------|----------------|-----------|-------------------|------------|-----------------|-----------|
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 13101 | 20.9 | 404 | 0.052 | 19.33 | 97 | 589.6 | 0.0115 |
| 13102 | 22.5 | 402 | 0.056 | 17.87 | 96.6 | 583.2 | 0.0107 |
| 13103 | 18.6 | 407 | 0.046 | 21.88 | 96.3 | 574.3 | 0.0127 |
| 13104 | 21.8 | 407 | 0.054 | 18.67 | 96.9 | 591 | 0.0109 |
| 13105 | 21.4 | 407 | 0.053 | 19.02 | 96.5 | 586.3 | 0.0111 |
| 13106 | 20.3 | 402 | 0.050 | 19.80 | 96.4 | 579 | 0.0118 |
| 13107 | 19.8 | 408 | 0.049 | 20.61 | 96.5 | 584 | 0.0119 |
| 13108 | 19.9 | 404 | 0.049 | 20.30 | 96.5 | 587.2 | 0.0120 |
| 13109 | 17.7 | 407 | 0.043 | 22.99 | 96.1 | 580.1 | 0.0133 |
| 13110 | 18 | 272 | 0.066 | 15.11 | 97.1 | 588.7 | 0.0198 |
| Average | 20.09 | 392 | 0.052 | 19.558 | 96.59 | 584.3 | 0.0123 |
| Session 3 | Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 13201 | 21.2 | 406 | 0.052 | 19.15 | 102 | 582.7 | 0.0119 |
| 13202 | 21.2 | 401 | 0.053 | 18.92 | 101 | 569.7 | 0.0119 |
| 13203 | 20.8 | 401 | 0.052 | 19.28 | 101 | 580.6 | 0.0121 |
| 13204 | 17 | 406 | 0.042 | 23.88 | 96.3 | 572.5 | 0.0140 |
| 13205 | 21.6 | 403 | 0.054 | 18.66 | 101 | 569.2 | 0.0116 |
| 13206 | 17.6 | 406 | 0.043 | 23.07 | 101 | 565.3 | 0.0141 |
| 13207 | 21 | 403 | 0.052 | 19.19 | 101 | 571.6 | 0.0119 |
| 13208 | 20.9 | 401 | 0.052 | 19.19 | 101 | 581.6 | 0.0121 |
| 13209 | 21.4 | 400 | 0.054 | 18.69 | 101 | 578 | 0.0118 |
| 13210 | 18.4 | 404 | 0.046 | 21.96 | 96 | 571.1 | 0.0129 |
| Average | 20.11 | 403.1 | 0.050 | 20.198 | 100.13 | 574.2 | 0.0124 |
| Session 3 | Post-Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 13301 | 16.1 | 318 | 0.051 | 19.75 | 102 | 552 | 0.0199 |
| 13302 | 17.1 | 320 | 0.053 | 18.71 | 99.4 | 568.8 | 0.0182 |
| 13303 | 20.8 | 401 | 0.052 | 19.28 | 101 | 580.6 | 0.0121 |
| 13304 | 17.1 | 325 | 0.053 | 19.01 | 99.4 | 567.9 | 0.0179 |
| 13305 | 17.8 | 322 | 0.055 | 18.09 | 99.4 | 559.1 | 0.0173 |
| 13306 | 17 | 324 | 0.052 | 19.06 | 99.5 | 569.6 | 0.0181 |
| 13307 | 18.6 | 320 | 0.058 | 17.20 | 99.5 | 577 | 0.0167 |
| 13308 | 17.6 | 319 | 0.055 | 18.13 | 99.4 | 569.6 | 0.0177 |
| 13309 | 18.3 | 320 | 0.057 | 17.49 | 99.5 | 573.7 | 0.0170 |
| 13310 | 18.1 | 320 | 0.057 | 17.68 | 99.5 | 576.1 | 0.0172 |
| Average | 17.85 | 328.9 | 0.054 | 18.439 | 99.86 | 569.4 | 0.0170 |

CASE STUDY SUBJECT 2 AERODYNAMIC DATA

Subglottal Pressure, Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency Test Results for All Phases in All Test Sessions

| Session1 | Baseline | | | | SPL Cal | 78 | |
|-----------|---------------|----------------|-----------|-------------------|---------------|-----------------|-----------|
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 21101 | 10.6 | 326 | 0.033 | 30.75 | 83.3 | 294.8 | 0.024 |
| 21102 | 11.4 | 305 | 0.037 | 26.75 | 84.3 | 295.9 | 0.024 |
| 21103 | 10.8 | 398 | 0.027 | 36.85 | 85.2 | 290.4 | 0.020 |
| 21104 | 11.5 | 377 | 0.031 | 32.78 | 84.9 | 293.2 | 0.020 |
| 21105 | 9.98 | 296 | 0.034 | 29.66 | 83.9 | 295 | 0.028 |
| 21106 | 11.7 | 404 | 0.029 | 34.53 | 85.6 | 284.7 | 0.018 |
| 21107 | 8.81 | 389 | 0.023 | 44.15 | 85.3 | 287.2 | 0.025 |
| 21108 | 10.6 | 391 | 0.027 | 36.89 | 85.9 | 292.1 | 0.021 |
| 21109 | 11 | 433 | 0.025 | 39.36 | 86 | 274 | 0.018 |
| 21110 | 9.46 | 370 | 0.026 | 39.11 | 85.1 | 297 | 0.024 |
| Average | 10.59 | 369 | 0.029 | 35.085 | 84.95 | 290.4 | 0.0218 |
| Session 1 | Training | | | | SPL | Pitch Hz | VE |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 21201 | 10.7 | 399 | 0.027 | 37.29 | 85.1 | 293.5 | 0.020 |
| 21202 | 10.2 | 334 | 0.031 | 32.75 | 85.7 | 283.7 | 0.025 |
| 21203 | 12.1 | 477 | 0.025 | 39.42 | 86.7 | 288.7 | 0.015 |
| 21204 | 16.3 | 421 | 0.039 | 25.83 | 85.8 | 291 | 0.013 |
| 21205 | 13.4 | 480 | 0.028 | 35.82 | 86.9 | 280.5 | 0.014 |
| 21206 | 16.4 | 481 | 0.034 | 29.33 | 87.3 | 258 | 0.011 |
| 21207 | 16.3 | 477 | 0.034 | 29.26 | 87 | 261.9 | 0.011 |
| 21208 | 16.1 | 466 | 0.035 | 28.94 | 87.2 | 256.9 | 0.012 |
| 21209 | 16.3 | 471 | 0.035 | 28.90 | 86.9 | 261.3 | 0.011 |
| 21210 | 13.4 | 501 | 0.027 | 37.39 | 87.1 | 266.7 | 0.013 |
| Average | 8.75 | 256 | 0.034 | 29.65 | 96.52 | 296.1 | 0.0432 |
| Session 1 | Post-Training | | | | SPL dB | Pitch Hz | VE |
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 21301 | 15.6 | 438 | 0.036 | 28.08 | 86.3 | 274.4 | 0.013 |
| 21302 | 13.5 | 406 | 0.033 | 30.07 | 86.1 | 277.4 | 0.016 |
| 21303 | 14 | 523 | 0.027 | 37.36 | 87.5 | 262.3 | 0.012 |
| 21304 | 14.2 | 495 | 0.029 | 34.86 | 87.1 | 262.3 | 0.012 |
| 21305 | 11.4 | 565 | 0.020 | 49.56 | 87.7 | 259.2 | 0.014 |
| 21306 | 13.7 | 553 | 0.025 | 40.36 | 87.4 | 251.4 | 0.012 |
| 21307 | 13 | 492 | 0.026 | 37.85 | 87.2 | 269.4 | 0.014 |
| 21308 | 15.9 | 606 | 0.026 | 38.11 | 87.6 | 264.8 | 0.009 |
| 21309 | 15.3 | 478 | 0.032 | 31.24 | 86.9 | 263.8 | 0.012 |
| 21310 | 12.7 | 529 | 0.024 | 41.65 | 87.4 | 260.8 | 0.013 |
| Average | 13.93 | 509 | 0.027 | 36.915 | 87.12 | 264.6 | 0.0123 |

CASE STUDY SUBJECT 2 AERODYNAMIC DATA

Subglottal Pressure (Psub), Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency (VE) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | | SPL Cal | 86 | |
|-----------|---------------|----------------|-----------|-------------------|---------------|-----------------|-----------|
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 22101 | 7.33 | 418 | 0.018 | 57.03 | 75.2 | 295.1 | 0.025 |
| 22102 | 6.94 | 510 | 0.014 | 73.49 | 68.9 | 298.1 | 0.019 |
| 22103 | 7.90 | 553 | 0.014 | 70.00 | 69.3 | 294.2 | 0.016 |
| 22104 | 5.35 | 467 | 0.011 | 87.29 | 68.9 | 293.8 | 0.028 |
| 22105 | 6.15 | 567 | 0.011 | 92.20 | 69.4 | 295.6 | 0.020 |
| 22106 | 6.45 | 569 | 0.011 | 88.22 | 69.4 | 295.1 | 0.019 |
| 22107 | 6.44 | 523 | 0.012 | 81.21 | 69.7 | 299.1 | 0.021 |
| 22108 | 5.98 | 584 | 0.010 | 97.66 | 70.5 | 293.1 | 0.020 |
| 22109 | 6.06 | 546 | 0.011 | 90.10 | 70.4 | 297.1 | 0.021 |
| 22110 | 7.16 | 553 | 0.013 | 77.23 | 69.8 | 297.2 | 0.018 |
| Average | 6.6 | 529 | 0.012 | 81.442 | 70.15 | 295.8 | 0.0202 |
| Session 2 | Training | | | | SPL | Pitch Hz | VE |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 22201 | 10.3 | 485 | 0.021 | 47.09 | 69.9 | 296.4 | 0.014 |
| 22202 | 9.81 | 487 | 0.020 | 49.64 | 70.3 | 293.6 | 0.015 |
| 22203 | 8.91 | 437 | 0.020 | 49.05 | 70.1 | 296.4 | 0.018 |
| 22204 | 12.9 | 516 | 0.025 | 40.00 | 70.9 | 297.2 | 0.011 |
| 22205 | 8.51 | 534 | 0.016 | 62.75 | 70.7 | 296.6 | 0.016 |
| 22206 | 9.26 | 446 | 0.021 | 48.16 | 70.3 | 296 | 0.017 |
| 22207 | 8.81 | 523 | 0.017 | 59.36 | 70.2 | 295.1 | 0.015 |
| 22208 | 7.85 | 487 | 0.016 | 62.04 | 70.3 | 295.2 | 0.018 |
| 22209 | 7.62 | 487 | 0.016 | 63.91 | 71.2 | 298 | 0.019 |
| 22210 | 6.87 | 508 | 0.014 | 73.94 | 70.5 | 295.7 | 0.020 |
| Average | 9.1 | 491 | 0.019 | 55.595 | 70.44 | 296.0 | 0.0158 |
| Session 2 | Post-Training | | | | SPL | Pitch Hz | VE |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 22301 | 7.46 | 483 | 0.015 | 64.75 | 69.9 | 294.8 | 0.019 |
| 22302 | 9.37 | 607 | 0.015 | 64.78 | 70.4 | 292.6 | 0.012 |
| 22303 | 10.40 | 514 | 0.020 | 49.42 | 70.3 | 295.8 | 0.013 |
| 22304 | 8.13 | 515 | 0.016 | 63.35 | 69.2 | 295.9 | 0.017 |
| 22305 | 7.73 | 457 | 0.017 | 59.12 | 69.8 | 299 | 0.020 |
| 22306 | 9.26 | 446 | 0.021 | 48.16 | 70.3 | 297.2 | 0.017 |
| 22307 | 9.95 | 631 | 0.016 | 63.42 | 70.7 | 294.3 | 0.011 |
| 22308 | 7.89 | 525 | 0.015 | 66.54 | 70.4 | 299.3 | 0.017 |
| 22309 | 9.80 | 547 | 0.018 | 55.82 | 70.4 | 296.4 | 0.013 |
| 22310 | 8.61 | 468 | 0.018 | 54.36 | 69.7 | 298.2 | 0.017 |
| Average | 8.9 | 519 | 0.017 | 58.971 | 70.11 | 296.4 | 0.0152 |

CASE STUDY SUBJECT 2 AERODYNAMIC DATA

Subglottal Pressure (Psub), Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency (VE) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | | SPL Cal | 86 | |
|-----------|---------------|----------------|-----------|-------------------|------------|-----------------|-----------|
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 23101 | 7.46 | 601 | 0.012 | 80.56 | 103 | 292.8 | 0.023 |
| 23102 | 9.39 | 534 | 0.018 | 56.87 | 102 | 293.2 | 0.020 |
| 23103 | 8.57 | 594 | 0.014 | 69.31 | 103 | 296.5 | 0.020 |
| 23104 | 10.9 | 272 | 0.040 | 24.95 | 100 | 294.9 | 0.034 |
| 23105 | 8.98 | 679 | 0.013 | 75.61 | 104 | 295.8 | 0.017 |
| 23106 | 8.48 | 249 | 0.034 | 29.36 | 100 | 292.9 | 0.047 |
| 23107 | 9.93 | 260 | 0.038 | 26.18 | 101 | 293.1 | 0.039 |
| 23108 | 9.66 | 244 | 0.040 | 25.26 | 101 | 294 | 0.043 |
| 23109 | 8.39 | 191 | 0.044 | 22.77 | 100 | 297.2 | 0.062 |
| 23110 | 8.25 | 204 | 0.040 | 24.73 | 99.3 | 297.9 | 0.059 |
| Average | 9.0 | 383 | 0.024 | 43.561 | 101.33 | 294.8 | 0.0294 |
| Session 3 | Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 23201 | 10.7 | 254 | 0.042 | 23.74 | 100 | 294.4 | 0.037 |
| 23202 | 9.7 | 255 | 0.038 | 26.37 | 101 | 296.1 | 0.041 |
| 23203 | 8.2 | 257 | 0.032 | 31.46 | 100 | 298.4 | 0.048 |
| 23204 | 11.5 | 266 | 0.043 | 23.13 | 101 | 297.7 | 0.033 |
| 23205 | 10.6 | 256 | 0.041 | 24.15 | 96.5 | 296.5 | 0.036 |
| 23206 | 9.5 | 257 | 0.037 | 27.08 | 96.3 | 295.7 | 0.039 |
| 23207 | 7.2 | 244 | 0.030 | 33.89 | 96.5 | 294.8 | 0.055 |
| 23208 | 8.2 | 256 | 0.032 | 31.14 | 95.8 | 297.1 | 0.046 |
| 23209 | 6.6 | 255 | 0.026 | 38.40 | 96.3 | 297.8 | 0.057 |
| 23210 | 10.9 | 252 | 0.043 | 23.12 | 96.4 | 297 | 0.035 |
| Average | 9.3 | 255 | 0.036 | 28.248 | 97.98 | 296.6 | 0.0412 |
| Session 3 | Post-Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 23301 | 8.82 | 248 | 0.036 | 28.12 | 95.4 | 294.7 | 0.044 |
| 23302 | 6.56 | 258 | 0.025 | 39.33 | 96.2 | 294.7 | 0.057 |
| 23303 | 8.08 | 245 | 0.033 | 30.32 | 96.2 | 292.7 | 0.049 |
| 23304 | 8.73 | 254 | 0.034 | 29.10 | 96.5 | 297.8 | 0.044 |
| 23305 | 9.95 | 248 | 0.040 | 24.92 | 96.3 | 293.9 | 0.039 |
| 23306 | 8.29 | 260 | 0.032 | 31.36 | 96.5 | 298.4 | 0.045 |
| 23307 | 8.99 | 266 | 0.034 | 29.59 | 97 | 299.1 | 0.041 |
| 23308 | 8.57 | 254 | 0.034 | 29.64 | 96.8 | 297.6 | 0.044 |
| 23309 | 9.76 | 253 | 0.039 | 25.92 | 96.5 | 296.1 | 0.039 |
| 23310 | 9.83 | 262 | 0.038 | 26.65 | 96.7 | 294.9 | 0.038 |
| Average | 8.8 | 255 | 0.034 | 29.495 | 96.41 | 296.0 | 0.0432 |

CASE STUDY SUBJECT 3 AERODYNAMIC DATA

Subglottal Pressure, Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency Test Results for All Phases in All Test Sessions

| Session1 | Baseline | | | | SPL Cal | 89 | |
|----------------|---------------|----------------|-----------|-------------------|---------------|-----------------|-----------|
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 31101 | 6.24 | 292 | 0.021 | 46.79 | 99.4 | 593 | 0.055 |
| 31102 | 8.6 | 289 | 0.030 | 33.60 | 100 | 593.5 | 0.040 |
| 31103 | 5.05 | 354 | 0.014 | 70.10 | 100 | 595.9 | 0.056 |
| 31104 | 14.1 | 415 | 0.034 | 29.43 | 102 | 587.2 | 0.017 |
| 31105 | 9.92 | 254 | 0.039 | 25.60 | 100 | 592.8 | 0.040 |
| 31106 | 10.7 | 299 | 0.036 | 27.94 | 101 | 592.9 | 0.032 |
| 31107 | 11.7 | 301 | 0.039 | 25.73 | 98.9 | 594.2 | 0.028 |
| 31108 | 12.6 | 364 | 0.035 | 28.89 | 100 | 592.1 | 0.022 |
| 31109 | 11.4 | 349 | 0.033 | 30.61 | 100 | 590.2 | 0.025 |
| 31110 | 9.94 | 272 | 0.037 | 27.36 | 102 | 591.2 | 0.038 |
| Average | 10.03 | 318.9 | 0.031 | 34.607 | 100.33 | 592.3 | 0.0314 |
| Session 1 | Training | | | | SPL | Pitch Hz | VE |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 31201 | 8.95 | 417 | 0.021 | 46.59 | 103 | 582.3 | 0.028 |
| 31202 | 6.28 | 393 | 0.016 | 62.58 | 102 | 576.2 | 0.041 |
| 31203 | 8.5 | 367 | 0.023 | 43.18 | 102 | 570.6 | 0.033 |
| 31204 | 7.15 | 377 | 0.019 | 52.73 | 102 | 581 | 0.038 |
| 31205 | 7.4 | 348 | 0.021 | 47.03 | 102 | 589.1 | 0.040 |
| 31206 | 8.5 | 398 | 0.021 | 46.82 | 103 | 573 | 0.030 |
| 31207 | 8.67 | 371 | 0.023 | 42.79 | 102 | 572.1 | 0.032 |
| 31208 | 8.48 | 360 | 0.024 | 42.45 | 102 | 582.4 | 0.033 |
| 31209 | 9.22 | 401 | 0.023 | 43.49 | 103 | 587 | 0.028 |
| 31210 | 6.95 | 426 | 0.016 | 61.29 | 103 | 585.8 | 0.035 |
| Average | 8.01 | 385.8 | 0.021 | 48.896 | 102.4 | 580.0 | 0.0331 |
| Session 1 | Post-Training | | | | SPL dB | Pitch Hz | VE |
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 31301 | 13.4 | 361 | 0.037 | 26.94 | 103 | 596.7 | 0.021 |
| 31302 | 10.4 | 446 | 0.023 | 42.88 | 103 | 583.9 | 0.022 |
| 31303 | 12.7 | 417 | 0.030 | 32.83 | 102 | 568.4 | 0.019 |
| 31304 | 14.2 | 416 | 0.034 | 29.30 | 102 | 584.5 | 0.017 |
| 31305 | 11.9 | 380 | 0.031 | 31.93 | 103 | 594.6 | 0.023 |
| 31306 | 13.5 | 373 | 0.036 | 27.63 | 102 | 579 | 0.020 |
| 31307 | 16 | 386 | 0.041 | 24.13 | 102 | 571 | 0.017 |
| 31308 | 12.6 | 389 | 0.032 | 30.87 | 102 | 583.6 | 0.021 |
| 31309 | 10.5 | 388 | 0.027 | 36.95 | 103 | 576.7 | 0.025 |
| 31310 | 13.4 | 345 | 0.039 | 25.75 | 102 | 590 | 0.022 |
| Average | 12.860 | 390.10 | 0.033 | 30.921 | 102.4 | 582.8 | 0.0204 |

CASE STUDY SUBJECT 3 AERODYNAMIC DATA

Subglottal Pressure (Psub), Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency (VE) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | | SPL Cal | 93 | |
|-----------|---------------|---------|-------|------------|---------|----------|--------|
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 32101 | 11.6 | 393 | 0.030 | 33.88 | 102 | 590 | 0.022 |
| 32102 | 11.5 | 409 | 0.028 | 35.57 | 104 | 591.3 | 0.022 |
| 32103 | 11.1 | 409 | 0.027 | 36.85 | 107 | 591.4 | 0.024 |
| 32104 | 12.2 | 387 | 0.032 | 31.72 | 106 | 596.8 | 0.022 |
| 32105 | 14.2 | 226 | 0.063 | 15.92 | 103 | 594.7 | 0.032 |
| 32106 | 12.4 | 207 | 0.060 | 16.69 | 104 | 589.4 | 0.041 |
| 32107 | 10.8 | 200 | 0.054 | 18.52 | 103 | 592.7 | 0.048 |
| 32108 | 9.93 | 197 | 0.050 | 19.84 | 105 | 594.9 | 0.054 |
| 32109 | 9.96 | 198 | 0.050 | 19.88 | 104 | 590.2 | 0.053 |
| 32110 | 6.6 | 209 | 0.032 | 31.67 | 105 | 592.7 | 0.076 |
| Average | 11.03 | 283.5 | 0.039 | 26.053 | 104.3 | 592.4 | 0.0334 |
| Session 2 | Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 32201 | 8.96 | 228 | 0.039 | 25.45 | 107 | 579.9 | 0.052 |
| 32202 | 7.22 | 247 | 0.029 | 34.21 | 107 | 582.2 | 0.060 |
| 32203 | 7.82 | 238 | 0.033 | 30.43 | 107 | 580.4 | 0.057 |
| 32204 | 9.42 | 243 | 0.039 | 25.80 | 107 | 579.8 | 0.047 |
| 32205 | 8.13 | 236 | 0.034 | 29.03 | 108 | 587.2 | 0.056 |
| 32206 | 10.5 | 232 | 0.045 | 22.10 | 106 | 585.4 | 0.044 |
| 32207 | 10.2 | 234 | 0.044 | 22.94 | 107 | 587.3 | 0.045 |
| 32208 | 9.59 | 231 | 0.042 | 24.09 | 107 | 587.3 | 0.048 |
| 32209 | 8.35 | 233 | 0.036 | 27.90 | 107 | 586.4 | 0.055 |
| 32210 | 12.5 | 228 | 0.055 | 18.24 | 106 | 589 | 0.037 |
| Average | 9.269 | 235.00 | 0.039 | 26.018 | 106.9 | 584.5 | 0.0491 |
| Session 2 | Post-Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 32301 | 11 | 232 | 0.047 | 21.09 | 107 | 581.7 | 0.042 |
| 32302 | 10 | 243 | 0.041 | 24.30 | 107 | 583.9 | 0.044 |
| 32303 | 9.39 | 235 | 0.040 | 25.03 | 107 | 584.9 | 0.048 |
| 32304 | 13.3 | 229 | 0.058 | 17.22 | 108 | 589.1 | 0.035 |
| 32305 | 10.6 | 226 | 0.047 | 21.32 | 108 | 588.8 | 0.045 |
| 32306 | 9.56 | 234 | 0.041 | 24.48 | 107 | 589.1 | 0.048 |
| 32307 | 12.8 | 243 | 0.053 | 18.98 | 107 | 583.7 | 0.034 |
| 32308 | 11.2 | 258 | 0.043 | 23.04 | 105 | 587.9 | 0.036 |
| 32309 | 12.7 | 239 | 0.053 | 18.82 | 107 | 587.6 | 0.035 |
| 32310 | 11.1 | 227 | 0.049 | 20.45 | 107 | 592.8 | 0.042 |
| Average | 11.2 | 236.60 | 0.047 | 21.4723 | 107.0 | 586.95 | 0.0405 |

CASE STUDY SUBJECT 3 AERODYNAMIC DATA

Subglottal Pressure (Psub), Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency (VE) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | | SPL Cal | 97 | |
|-----------|---------------|----------------|-----------|-------------------|------------|-----------------|-----------|
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 33101 | 11.1 | 599 | 0.019 | 54.0 | 100 | 597.2 | 0.015 |
| 33102 | 12.5 | 380 | 0.033 | 30.4 | 98 | 602.8 | 0.021 |
| 33103 | 9.51 | 319 | 0.030 | 33.5 | 97.9 | 605.3 | 0.032 |
| 33104 | 12.1 | 250 | 0.048 | 20.7 | 96.9 | 604.2 | 0.032 |
| 33105 | 13.2 | 365 | 0.036 | 27.7 | 98.3 | 600.4 | 0.020 |
| 33106 | 12.1 | 389 | 0.031 | 32.1 | 98.1 | 600.3 | 0.021 |
| 33107 | 11.6 | 346 | 0.034 | 29.8 | 97.4 | 602.1 | 0.024 |
| 33108 | 12.6 | 316 | 0.040 | 25.1 | 97.3 | 599.5 | 0.024 |
| 33109 | 11.2 | 328 | 0.034 | 29.3 | 97.2 | 597.2 | 0.026 |
| 33110 | 11.1 | 624 | 0.018 | 56.2 | 100 | 596.9 | 0.014 |
| Average | 11.70 | 391.60 | 0.030 | 33.9 | 98.11 | 600.59 | 0.0214 |
| Session 3 | Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 33201 | 11.5 | 324 | 0.035 | 28.2 | 97.9 | 598.6 | 0.026 |
| 33202 | 11.2 | 240 | 0.047 | 21.4 | 95.8 | 592.9 | 0.036 |
| 33203 | 13.2 | 322 | 0.041 | 24.4 | 96.1 | 596.9 | 0.023 |
| 33204 | 11.6 | 330 | 0.035 | 28.4 | 97 | 605.2 | 0.025 |
| 33205 | 11 | 472 | 0.023 | 42.9 | 98.1 | 605.2 | 0.019 |
| 33206 | 14.2 | 560 | 0.025 | 39.4 | 98.4 | 604.6 | 0.012 |
| 33207 | 10.6 | 484 | 0.022 | 45.7 | 97.6 | 601.6 | 0.019 |
| 33208 | 11.7 | 488 | 0.024 | 41.7 | 98 | 603.1 | 0.017 |
| 33209 | 11.3 | 483 | 0.023 | 42.7 | 98.2 | 608.9 | 0.018 |
| 33210 | 11.2 | 480 | 0.023 | 42.9 | 98.7 | 608.6 | 0.018 |
| Average | 11.75 | 418.30 | 0.028 | 35.8 | 97.58 | 602.56 | 0.0199 |
| Session 3 | Post-Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 33301 | 12.2 | 328 | 0.037 | 26.9 | 98.5 | 590.8 | 0.025 |
| 33302 | 13.1 | 323 | 0.041 | 24.7 | 96.9 | 591.1 | 0.023 |
| 33303 | 12.3 | 321 | 0.038 | 26.1 | 97.3 | 596.3 | 0.025 |
| 33304 | 12.3 | 310 | 0.040 | 25.2 | 97.2 | 597.8 | 0.025 |
| 33305 | 11 | 325 | 0.034 | 29.5 | 97.8 | 604.9 | 0.027 |
| 33306 | 9.61 | 323 | 0.030 | 33.6 | 97.2 | 598.2 | 0.031 |
| 33307 | 11.3 | 322 | 0.035 | 28.5 | 96.7 | 600.4 | 0.027 |
| 33308 | 10 | 324 | 0.031 | 32.4 | 97.2 | 602.4 | 0.030 |
| 33309 | 10.8 | 325 | 0.033 | 30.1 | 97.8 | 602.7 | 0.028 |
| 33310 | 11.6 | 324 | 0.036 | 27.9 | 97 | 603.3 | 0.026 |
| Average | 11.42 | 322.50 | 0.035 | 28.5 | 97.36 | 598.79 | 0.0264 |

CASE STUDY SUBJECT 4 AERODYNAMIC DATA

Subglottal Pressure, Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency Test Results for All Phases in All Test Sessions

| Session1 | Baseline | | | | SPL Cal | 86 | |
|-----------|---------------|----------------|-----------|-------------------|---------------|-----------------|-----------|
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 41101 | 8.36 | 360.00 | 0.023 | 43.1 | 89.40 | 300.10 | 0.030 |
| 41102 | 10.30 | 426.00 | 0.024 | 41.4 | 90.1 | 302.70 | 0.021 |
| 41103 | 10.60 | 457.00 | 0.023 | 43.1 | 91.2 | 298.30 | 0.019 |
| 41104 | 12.90 | 470.00 | 0.027 | 36.4 | 91 | 304.80 | 0.015 |
| 41105 | 13.90 | 433.00 | 0.032 | 31.2 | 90.5 | 300.90 | 0.015 |
| 41106 | 14.20 | 415.00 | 0.034 | 29.2 | 90.2 | 300.20 | 0.015 |
| 41107 | 11.80 | 436.00 | 0.027 | 36.9 | 90.6 | 304.20 | 0.018 |
| 41108 | 12.20 | 386.00 | 0.032 | 31.6 | 90.3 | 301.10 | 0.019 |
| 41109 | 14.40 | 363.00 | 0.040 | 25.2 | 89.4 | 302.40 | 0.017 |
| 41110 | 12.60 | 399.00 | 0.032 | 31.7 | 90.1 | 299.50 | 0.018 |
| Average | 12.13 | 414.50 | 0.029 | 35.0 | 90.28 | 301.42 | 0.019 |
| Session 1 | Training | | | | SPL | Pitch Hz | VE |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 41201 | 12.40 | 435.00 | 0.029 | 35.1 | 90.9 | 299.30 | 0.017 |
| 41202 | 13.00 | 488.00 | 0.027 | 37.5 | 91.5 | 303.30 | 0.014 |
| 41203 | 11.20 | 486.00 | 0.023 | 43.4 | 91.2 | 299.60 | 0.017 |
| 41204 | 11.20 | 367.00 | 0.031 | 32.8 | 90 | 299.70 | 0.022 |
| 41205 | 10.60 | 409.00 | 0.026 | 38.6 | 90.5 | 299.60 | 0.021 |
| 41206 | 12.60 | 402.00 | 0.031 | 31.9 | 90.1 | 298.80 | 0.018 |
| 41207 | 14.00 | 337.00 | 0.042 | 24.1 | 89.4 | 300.70 | 0.019 |
| 41208 | 12.20 | 386.00 | 0.032 | 31.6 | 90 | 294.60 | 0.019 |
| 41209 | 11.80 | 370.00 | 0.032 | 31.4 | 89.7 | 302.00 | 0.021 |
| 41210 | 12.10 | 299.00 | 0.040 | 24.7 | 88.6 | 300.60 | 0.024 |
| Average | 12.11 | 397.90 | 0.031 | 33.1 | 90.19 | 299.82 | 0.019 |
| Session 1 | Post-Training | | | | SPL dB | Pitch Hz | VE |
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 41301 | 11.90 | 351.00 | 0.034 | 29.5 | 89.3 | 300.20 | 0.021 |
| 41302 | 9.53 | 333.00 | 0.029 | 34.9 | 89.2 | 303.00 | 0.028 |
| 41303 | 10.40 | 385.00 | 0.027 | 37.0 | 90 | 301.10 | 0.022 |
| 41304 | 10.30 | 290.00 | 0.036 | 28.2 | 88.5 | 299.20 | 0.030 |
| 41305 | 9.39 | 279.00 | 0.034 | 29.7 | 88.3 | 301.20 | 0.034 |
| 41306 | 11.50 | 353.00 | 0.033 | 30.7 | 89.4 | 303.10 | 0.022 |
| 41307 | 11.70 | 221.00 | 0.053 | 18.9 | 87.1 | 303.20 | 0.034 |
| 41308 | 9.94 | 230.00 | 0.043 | 23.1 | 87.2 | 301.10 | 0.038 |
| 41309 | 12.70 | 400.00 | 0.032 | 31.5 | 90.1 | 301.00 | 0.018 |
| 41310 | 11.30 | 287.00 | 0.039 | 25.4 | 88.5 | 302.90 | 0.027 |
| Average | 10.87 | 312.90 | 0.036 | 28.9 | 88.76 | 301.60 | 0.027 |

CASE STUDY SUBJECT 4 AERODYNAMIC DATA

Subglottal Pressure (Psub), Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency (VE) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | | SPL Cal | 91 | |
|-----------|---------------|----------------|-----------|-------------------|---------------|-----------------|-----------|
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 42101 | 9.47 | 246 | 0.038 | 26.0 | 97.3 | 297 | 0.042 |
| 42102 | 7.08 | 311 | 0.023 | 43.9 | 98.7 | 298 | 0.045 |
| 42103 | 8.46 | 293 | 0.029 | 34.6 | 98.2 | 297.4 | 0.040 |
| 42104 | 8.43 | 263 | 0.032 | 31.2 | 98.1 | 296.7 | 0.044 |
| 42105 | 8.50 | 261 | 0.033 | 30.7 | 97.9 | 298.3 | 0.044 |
| 42106 | 7.45 | 306 | 0.024 | 41.1 | 99.2 | 296.9 | 0.044 |
| 42107 | 7.44 | 241 | 0.031 | 32.4 | 97.3 | 298 | 0.054 |
| 42108 | 9.22 | 279 | 0.033 | 30.3 | 90.4 | 295.2 | 0.035 |
| 42109 | 6.11 | 227 | 0.027 | 37.2 | 97.1 | 298.6 | 0.070 |
| 42110 | 6.51 | 248 | 0.026 | 38.1 | 97.6 | 298.5 | 0.060 |
| Average | 7.87 | 268 | 0.030 | 34.5 | 97.18 | 297.46 | 0.048 |
| Session 2 | Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 42201 | 7.78 | 225 | 0.035 | 28.9 | 96.9 | 294.5 | 0.055 |
| 42202 | 7.29 | 213 | 0.034 | 29.2 | 96.1 | 295.9 | 0.062 |
| 42203 | 7.59 | 225 | 0.034 | 29.6 | 97 | 294.5 | 0.057 |
| 42204 | 9.27 | 171 | 0.054 | 18.4 | 95.4 | 299.6 | 0.060 |
| 42205 | 9.52 | 215 | 0.044 | 22.6 | 96.9 | 298.3 | 0.047 |
| 42206 | 8.50 | 216 | 0.039 | 25.4 | 96.9 | 298.8 | 0.053 |
| 42207 | 8.73 | 209 | 0.042 | 23.9 | 96.4 | 299 | 0.053 |
| 42208 | 9.52 | 211 | 0.045 | 22.2 | 96.3 | 302.5 | 0.048 |
| 42209 | 8.36 | 211 | 0.040 | 25.2 | 96.6 | 298.9 | 0.055 |
| 42210 | 10.10 | 211 | 0.048 | 20.9 | 96.6 | 301 | 0.045 |
| Average | 8.67 | 210.70 | 0.041 | 24.6 | 96.51 | 298.30 | 0.054 |
| Session 2 | Post-Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 42301 | 8.69 | 251 | 0.035 | 28.9 | 97.4 | 299.3 | 0.045 |
| 42302 | 7.17 | 270 | 0.027 | 37.7 | 98 | 299.7 | 0.051 |
| 42303 | 7.76 | 257 | 0.030 | 33.1 | 98.1 | 297.4 | 0.049 |
| 42304 | 7.74 | 212 | 0.037 | 27.4 | 96.8 | 295.2 | 0.059 |
| 42305 | 7.58 | 268 | 0.028 | 35.4 | 98.4 | 297.9 | 0.048 |
| 42306 | 8.68 | 261 | 0.033 | 30.1 | 98.5 | 300.4 | 0.043 |
| 42307 | 6.94 | 242 | 0.029 | 34.9 | 97.9 | 297.3 | 0.058 |
| 42308 | 8.27 | 238 | 0.035 | 28.8 | 98.2 | 298.9 | 0.050 |
| 42309 | 9.07 | 270 | 0.034 | 29.8 | 98.7 | 298.7 | 0.040 |
| 42310 | 9.36 | 240 | 0.039 | 25.6 | 97.8 | 300.7 | 0.044 |
| Average | 8.13 | 250.90 | 0.033 | 31.2 | 97.98 | 298.55 | 0.049 |

CASE STUDY SUBJECT 4 AERODYNAMIC DATA

Subglottal Pressure (Psub), Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency (VE) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | | SPL Cal 90 | | |
|-----------|---------------|---------|-------|------------|------------|----------|-------|
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 43101 | 12.6 | 560 | 0.023 | 44.4 | 99.2 | 297.6 | 0.014 |
| 43102 | 9.8 | 323 | 0.030 | 33.0 | 96.3 | 298.7 | 0.030 |
| 43103 | 9.55 | 324 | 0.029 | 33.9 | 96.4 | 297.2 | 0.031 |
| 43104 | 8.93 | 335 | 0.027 | 37.5 | 96.7 | 295.5 | 0.032 |
| 43105 | 9.72 | 326 | 0.030 | 33.5 | 96.4 | 296.7 | 0.030 |
| 43106 | 9.91 | 328 | 0.030 | 33.1 | 96.6 | 300.2 | 0.030 |
| 43107 | 10 | 321 | 0.031 | 32.1 | 96.6 | 298.4 | 0.030 |
| 43108 | 9.74 | 345 | 0.028 | 35.4 | 96.7 | 295.9 | 0.029 |
| 43109 | 8.82 | 330 | 0.027 | 37.4 | 97.2 | 297.1 | 0.033 |
| 43110 | 8.42 | 331 | 0.025 | 39.3 | 97.1 | 298.7 | 0.035 |
| Average | 9.75 | 352.30 | 0.028 | 36.0 | 96.92 | 297.60 | 0.030 |
| Session 3 | Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 43201 | 9.14 | 344 | 0.027 | 37.6 | 97.1 | 301.3 | 0.031 |
| 43202 | 9.01 | 338 | 0.027 | 37.5 | 96.9 | 298.2 | 0.032 |
| 43203 | 8.78 | 344 | 0.026 | 39.2 | 97.3 | 299.3 | 0.032 |
| 43204 | 9.77 | 338 | 0.029 | 34.6 | 97.3 | 299.2 | 0.029 |
| 43205 | 11.8 | 322 | 0.037 | 27.3 | 97.4 | 300.8 | 0.026 |
| 43206 | 9.28 | 324 | 0.029 | 34.9 | 97 | 300.7 | 0.032 |
| 43207 | 10.1 | 324 | 0.031 | 32.1 | 97.5 | 297.6 | 0.030 |
| 43208 | 10.3 | 338 | 0.030 | 32.8 | 97.2 | 297.9 | 0.028 |
| 43209 | 9.77 | 328 | 0.030 | 33.6 | 97.2 | 298.1 | 0.030 |
| 43210 | 10.4 | 341 | 0.030 | 32.8 | 97.3 | 298.9 | 0.027 |
| Average | 9.84 | 334.10 | 0.029 | 34.2 | 97.22 | 299.20 | 0.030 |
| Session 3 | Post-Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 43301 | 8.8 | 332 | 0.027 | 37.7 | 97 | 296.3 | 0.033 |
| 43302 | 8.95 | 343 | 0.026 | 38.3 | 97.3 | 297.8 | 0.032 |
| 43303 | 6.85 | 318 | 0.022 | 46.4 | 97.6 | 299.8 | 0.045 |
| 43304 | 7.64 | 333 | 0.023 | 43.6 | 97.3 | 297.7 | 0.038 |
| 43305 | 8.2 | 334 | 0.025 | 40.7 | 97.5 | 296 | 0.036 |
| 43306 | 8.51 | 330 | 0.026 | 38.8 | 97.2 | 297.6 | 0.035 |
| 43307 | 7.94 | 327 | 0.024 | 41.2 | 97.8 | 301.3 | 0.038 |
| 43308 | 8.66 | 321 | 0.027 | 37.1 | 97.6 | 295.6 | 0.035 |
| 43309 | 7.94 | 331 | 0.024 | 41.7 | 97.4 | 295.8 | 0.037 |
| 43310 | 8.53 | 329 | 0.026 | 38.6 | 97.3 | 297.7 | 0.035 |
| Average | 8.20 | 329.80 | 0.025 | 40.4 | 97.4 | 297.56 | 0.036 |

CASE STUDY SUBJECT 5 AERODYNAMIC DATA

Subglottal Pressure, Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency Test Results for All Phases in All Test Sessions

| Session 1 | Baseline | | | | SPL Cal | 86 | |
|-----------|---------------|----------------|-----------|-------------------|---------------|-----------------|-----------|
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 51101 | 11.00 | 381 | 0.029 | 34.6 | 102 | 577.30 | 0.024 |
| 51102 | 11.40 | 381 | 0.030 | 33.4 | 102 | 573.60 | 0.023 |
| 51103 | 10.20 | 305 | 0.033 | 29.9 | 102 | 582.40 | 0.033 |
| 51104 | 9.04 | 289 | 0.031 | 32.0 | 102 | 576.50 | 0.039 |
| 51105 | 10.40 | 302 | 0.034 | 29.0 | 102 | 587.80 | 0.032 |
| 51106 | 11.10 | 296 | 0.038 | 26.7 | 102 | 584.10 | 0.031 |
| 51107 | 10.00 | 303 | 0.033 | 30.3 | 102 | 563.10 | 0.034 |
| 51108 | 11.40 | 301 | 0.038 | 26.4 | 100 | 572.70 | 0.029 |
| 51109 | 10.00 | 311 | 0.032 | 31.1 | 98 | 581.70 | 0.032 |
| 51110 | 11.20 | 269 | 0.042 | 24.0 | 99.5 | 573.70 | 0.033 |
| Average | 10.57 | 313.80 | 0.034 | 29.7 | 101.15 | 577.29 | 0.030 |
| Session 1 | Training | | | | SPL | Pitch Hz | VE |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 51201 | 11.40 | 313 | 0.036 | 27.5 | 102.00 | 570.60 | 0.029 |
| 51202 | 11.40 | 283 | 0.047 | 21.5 | 102 | 576.40 | 0.031 |
| 51203 | 12.40 | 266 | 0.048 | 21.0 | 101 | 584.30 | 0.031 |
| 51204 | 12.40 | 260 | 0.048 | 21.0 | 101 | 577.80 | 0.038 |
| 51205 | 10.50 | 251 | 0.042 | 23.9 | 101 | 573.20 | 0.038 |
| 51206 | 9.69 | 262 | 0.037 | 27.0 | 101 | 578.40 | 0.040 |
| 51207 | 10.10 | 237 | 0.043 | 23.5 | 101 | 577.70 | 0.042 |
| 51208 | 11.00 | 217 | 0.051 | 19.7 | 99 | 581.60 | 0.041 |
| 51209 | 12.40 | 270 | 0.046 | 21.8 | 101 | 576.80 | 0.030 |
| 51210 | 9.47 | 273 | 0.035 | 28.8 | 101 | 571.30 | 0.039 |
| Average | 11.08 | 263 | 0.042 | 23.6 | 101 | 576.81 | 0.035 |
| Session 1 | Post-Training | | | | SPL dB | Pitch Hz | VE |
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 51301 | 12.90 | 267 | 0.048 | 20.7 | 101 | 561.60 | 0.029 |
| 51302 | 14.80 | 192 | 0.077 | 13.0 | 99.2 | 580.20 | 0.035 |
| 51303 | 9.98 | 194 | 0.051 | 19.4 | 98.9 | 578.60 | 0.051 |
| 51304 | 10.60 | 191 | 0.064 | 15.7 | 98.9 | 575.40 | 0.048 |
| 51305 | 11.50 | 181 | 0.046 | 21.7 | 99.1 | 585.20 | 0.041 |
| 51306 | 10.60 | 230 | 0.041 | 24.6 | 99.9 | 572.20 | 0.041 |
| 51307 | 10.10 | 248 | 0.041 | 24.6 | 100 | 554.90 | 0.040 |
| 51308 | 10.60 | 258 | 0.041 | 24.3 | 101 | 571.80 | 0.037 |
| 51309 | 11.30 | 168 | 0.067 | 14.9 | 98.1 | 576.80 | 0.052 |
| 51310 | 13.20 | 180 | 0.073 | 13.6 | 98.5 | 577.50 | 0.041 |
| Average | 11.56 | 211 | 0.055 | 19.2 | 99.46 | 573.42 | 0.041 |

CASE STUDY SUBJECT 5 AERODYNAMIC DATA

Subglottal Pressure (Psub), Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency (VE) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | | SPL Cal | 90 | |
|-----------|---------------|----------------|-----------|-------------------|---------------|-----------------|-----------|
| | Psub | Airflow | GR | Flow/Press | SPL dB | Pitch Hz | VE |
| 52101 | 8.17 | 134 | 0.061 | 16.4 | 95.4 | 591 | 0.087 |
| 52102 | 7.23 | 366 | 0.020 | 50.6 | 97.9 | 603.4 | 0.037 |
| 52103 | 7.14 | 279 | 0.026 | 39.1 | 97.1 | 604 | 0.049 |
| 52104 | 8.29 | 435 | 0.019 | 52.5 | 98.4 | 605.3 | 0.027 |
| 52105 | 8.31 | 442 | 0.019 | 53.2 | 99.2 | 605.6 | 0.027 |
| 52106 | 8.02 | 443 | 0.018 | 55.2 | 97.7 | 599.4 | 0.027 |
| 52107 | 7.50 | 294 | 0.026 | 39.2 | 98.1 | 607 | 0.044 |
| 52108 | 7.38 | 329 | 0.022 | 44.6 | 97.1 | 596.8 | 0.040 |
| 52109 | 8.16 | 630 | 0.013 | 77.2 | 100 | 597 | 0.019 |
| 52110 | 6.93 | 314 | 0.022 | 45.3 | 97.8 | 598.6 | 0.045 |
| Average | 7.71 | 366.60 | 0.021 | 47.3 | 97.87 | 600.81 | 0.035 |
| Session 2 | Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 52201 | 8.42 | 498 | 0.017 | 59.1 | 98.8 | 587.9 | 0.024 |
| 52202 | 8.35 | 477 | 0.018 | 57.1 | 98.2 | 589.9 | 0.025 |
| 52203 | 8.13 | 477 | 0.017 | 58.7 | 98.6 | 591.2 | 0.025 |
| 52204 | 8.11 | 463 | 0.018 | 57.1 | 98.3 | 592.8 | 0.026 |
| 52205 | 8.22 | 463 | 0.018 | 56.3 | 98.4 | 596.8 | 0.026 |
| 52206 | 7.35 | 461 | 0.016 | 62.7 | 98.1 | 596.4 | 0.029 |
| 52207 | 6.93 | 481 | 0.014 | 69.4 | 98.1 | 593.2 | 0.029 |
| 52208 | 7.63 | 478 | 0.016 | 62.6 | 99.6 | 590.3 | 0.027 |
| 52209 | 8.47 | 478 | 0.018 | 56.4 | 99.8 | 594.3 | 0.025 |
| 52210 | 7.41 | 497 | 0.015 | 67.1 | 99.9 | 595.7 | 0.027 |
| Average | 7.90 | 477.30 | 0.017 | 60.7 | 98.78 | 592.85 | 0.026 |
| Session 2 | Post-Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 52301 | 7.92 | 480 | 0.017 | 60.6 | 99.6 | 590.4 | 0.026 |
| 52302 | 7.94 | 488 | 0.016 | 61.5 | 98.8 | 589.9 | 0.025 |
| 52303 | 7.70 | 484 | 0.016 | 62.9 | 99.2 | 592.8 | 0.027 |
| 52304 | 7.50 | 486 | 0.015 | 64.8 | 99.1 | 586.6 | 0.027 |
| 52305 | 7.81 | 475 | 0.016 | 60.8 | 99.5 | 597.3 | 0.027 |
| 52306 | 7.39 | 488 | 0.015 | 66.0 | 98.8 | 586.7 | 0.027 |
| 52307 | 7.66 | 487 | 0.016 | 63.6 | 99 | 589.6 | 0.027 |
| 52308 | 7.37 | 486 | 0.015 | 65.9 | 98.6 | 583.2 | 0.028 |
| 52309 | 8.14 | 489 | 0.017 | 60.1 | 98.8 | 586.8 | 0.025 |
| 52310 | 8.04 | 495 | 0.016 | 61.6 | 98.8 | 587.8 | 0.025 |
| Average | 7.75 | 485.80 | 0.016 | 62.8 | 99.02 | 589.11 | 0.026 |

CASE STUDY SUBJECT 5 AERODYNAMIC DATA

Subglottal Pressure (Psub), Airflow, Glottal Resistance (GR), Airflow/Pressure, Sound Pressure Level (SPL), Frequency (Pitch), and Vocal Efficiency (VE) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | | SPL Cal | 88 | |
|-----------|---------------|----------------|-----------|-------------------|------------|-----------------|-----------|
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 53101 | 10.1 | 667 | 0.015 | 66.04 | 98.6 | 585.4 | 0.015 |
| 53102 | 10.4 | 516 | 0.020 | 49.62 | 96.8 | 582.5 | 0.018 |
| 53103 | 12 | 518 | 0.023 | 43.17 | 96.8 | 589.1 | 0.016 |
| 53104 | 9.8 | 549 | 0.018 | 56.02 | 96.5 | 575 | 0.018 |
| 53105 | 11.7 | 296 | 0.040 | 25.30 | 93.4 | 577.3 | 0.027 |
| 53106 | 13 | 373 | 0.035 | 28.69 | 94.5 | 581.2 | 0.019 |
| 53107 | 13.4 | 269 | 0.050 | 20.07 | 93.2 | 587.4 | 0.026 |
| 53108 | 14.7 | 356 | 0.041 | 24.22 | 94.2 | 576.2 | 0.018 |
| 53109 | 12.9 | 251 | 0.051 | 19.46 | 92.7 | 578.9 | 0.029 |
| 53110 | 9.66 | 178 | 0.054 | 18.43 | 91.4 | 572.4 | 0.053 |
| Average | 11.77 | 397.30 | 0.030 | 35.101 | 94.81 | 580.5 | 0.020 |
| Session 3 | Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 53201 | 11.6 | 485 | 0.024 | 41.81 | 96.3 | 584 | 0.017 |
| 53202 | 8.75 | 284 | 0.031 | 32.46 | 93.5 | 585.8 | 0.038 |
| 53203 | 9.99 | 421 | 0.024 | 42.14 | 95.1 | 578.3 | 0.023 |
| 53204 | 11 | 535 | 0.021 | 48.64 | 96.7 | 568.3 | 0.016 |
| 53205 | 13.3 | 519 | 0.026 | 39.02 | 96.7 | 579.6 | 0.014 |
| 53206 | 17.8 | 493 | 0.036 | 27.70 | 96.2 | 577.3 | 0.011 |
| 53207 | 13.8 | 407 | 0.034 | 29.49 | 95 | 582 | 0.017 |
| 53208 | 13.5 | 415 | 0.033 | 30.74 | 95.4 | 579.3 | 0.017 |
| 53209 | 13.7 | 592 | 0.023 | 43.21 | 97.5 | 583.8 | 0.012 |
| 53210 | 10.6 | 473 | 0.022 | 44.62 | 95.9 | 576.5 | 0.019 |
| Average | 12.40 | 462.40 | 0.027 | 37.983 | 95.83 | 579.5 | 0.017 |
| Session 3 | Post-Training | | | | | | |
| | Psub | Airflow | GR | Flow/Press | SPL | Pitch Hz | VE |
| 53301 | 16.8 | 765 | 0.022 | 45.54 | 99.1 | 567.8 | 0.008 |
| 53302 | 17 | 544 | 0.031 | 32.00 | 97.1 | 583.2 | 0.010 |
| 53303 | 14.7 | 661 | 0.022 | 44.97 | 98 | 572.3 | 0.010 |
| 53304 | 10.2 | 383 | 0.027 | 37.55 | 94.5 | 570.5 | 0.024 |
| 53305 | 11.3 | 538 | 0.021 | 47.61 | 96.8 | 565.4 | 0.016 |
| 53306 | 17.8 | 361 | 0.049 | 20.28 | 94.9 | 581.3 | 0.015 |
| 53307 | 11.2 | 374 | 0.030 | 33.39 | 95 | 577.1 | 0.023 |
| 53308 | 10.1 | 555 | 0.018 | 54.95 | 96.9 | 563.9 | 0.017 |
| 53309 | 15.9 | 360 | 0.044 | 22.64 | 94 | 566 | 0.016 |
| 53310 | 11.1 | 560.9 | 0.020 | 50.53 | 96.7 | 561.1 | 0.016 |
| Average | 13.61 | 510.19 | 0.027 | 38.946 | 96.3 | 570.9 | 0.016 |

APPENDIX C

Acoustic Test Results for All Studies

EXERCISE BALL SUBJECT 1 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases All Test Sessions

| Session 1 | Baseline | | | Mic Cal | 98 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 11101 | 37.301 | 49.568 | 12.267 | 598.490 | 2507.33 |
| 11102 | 38.804 | 51.734 | 12.93 | 590.625 | 2537.77 |
| 11103 | 43.463 | 53.451 | 9.988 | 598.930 | 2212.49 |
| 11104 | 37.291 | 48.516 | 11.225 | 602.847 | 2477.61 |
| 11105 | 40.132 | 48.745 | 8.613 | 590.286 | 2588.69 |
| 11106 | 39.217 | 48.146 | 8.929 | 276.416 | 2831.68 |
| 11107 | 39.383 | 48.997 | 9.614 | 583.616 | 2840.80 |
| 11108 | 39.710 | 49.480 | 9.77 | 588.983 | 2488.13 |
| 11109 | 39.565 | 49.529 | 9.964 | 584.815 | 2593.94 |
| 11110 | 41.090 | 49.950 | 8.86 | 277.999 | 2613.29 |
| Average | 39.596 | 49.812 | 10.216 | 529.301 | 2569.172 |
| Session 1 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 11201 | 42.330 | 53.553 | 11.223 | 580.380 | 2858.137 |
| 11202 | 40.319 | 52.695 | 12.376 | 280.682 | 2611.740 |
| 11203 | 39.257 | 50.917 | 11.66 | 576.365 | 2652.732 |
| 11204 | 40.452 | 51.196 | 10.744 | 587.569 | 2584.189 |
| 11205 | 41.936 | 50.778 | 8.842 | 283.996 | 2634.586 |
| 11206 | 38.402 | 51.387 | 12.985 | 286.391 | 2625.379 |
| 11207 | 40.505 | 53.007 | 12.502 | 291.145 | 2627.883 |
| 11208 | 41.658 | 52.231 | 10.573 | 582.348 | 2690.223 |
| 11209 | 42.927 | 54.072 | 11.145 | 288.480 | 2119.346 |
| 11210 | 42.253 | 53.548 | 11.295 | 281.301 | 2682.324 |
| Average | 41.004 | 52.338 | 11.335 | 403.866 | 2608.654 |
| Session 1 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 11301 | 41.531 | 51.040 | 9.509 | 578.815 | 2712.976 |
| 11302 | 37.482 | 52.213 | 14.731 | 577.972 | 2851.635 |
| 11303 | 39.436 | 50.898 | 11.462 | 582.269 | 2640.326 |
| 11304 | 39.986 | 52.071 | 12.085 | 589.050 | 2829.379 |
| 11305 | 39.719 | 50.036 | 10.317 | 595.344 | 2664.411 |
| 11306 | 38.465 | 51.847 | 13.382 | 583.821 | 2762.268 |
| 11307 | 37.482 | 52.213 | 14.731 | 577.972 | 2851.630 |
| 11308 | 40.754 | 52.844 | 12.09 | 575.286 | 2863.536 |
| 11309 | 39.695 | 51.365 | 11.67 | 579.602 | 2731.231 |
| 11310 | 37.481 | 52.213 | 14.732 | 577.972 | 2851.625 |
| Average | 39.203 | 51.674 | 12.471 | 581.810 | 2775.902 |

EXERCISE BALL SUBJECT 1 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases All Test Sessions

| Session 1 | Baseline | | | Mic Cal | 98 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 11101 | 26.890 | 31.820 | 4.930 | 37.080 | 30.810 |
| 11102 | 26.380 | 32.690 | 6.310 | 41.460 | 31.260 |
| 11103 | 20.570 | 23.580 | 3.010 | 39.830 | 19.420 |
| 11104 | 26.760 | 32.210 | 5.450 | 36.350 | 30.930 |
| 11105 | 26.110 | 29.870 | 3.760 | 36.180 | 28.280 |
| 11106 | 26.050 | 30.750 | 4.700 | 34.870 | 29.670 |
| 11107 | 26.410 | 31.530 | 5.120 | 32.860 | 32.190 |
| 11108 | 28.080 | 32.330 | 4.250 | 35.450 | 33.310 |
| 11109 | 26.960 | 32.290 | 5.330 | 36.460 | 30.620 |
| 11110 | 26.950 | 31.640 | 4.690 | 34.810 | 31.110 |
| Average | 26.116 | 30.871 | 4.755 | 36.535 | 29.760 |
| Session 1 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 11201 | 24.520 | 30.000 | 5.480 | 40.110 | 27.420 |
| 11202 | 26.650 | 32.190 | 5.540 | 41.060 | 30.930 |
| 11203 | 25.230 | 30.400 | 5.170 | 38.620 | 27.180 |
| 11204 | 26.680 | 31.020 | 4.340 | 36.390 | 28.420 |
| 11205 | 26.070 | 30.280 | 4.210 | 35.480 | 27.460 |
| 11206 | 25.460 | 30.890 | 5.430 | 38.650 | 28.140 |
| 11207 | 25.010 | 31.590 | 6.580 | 37.460 | 27.440 |
| 11208 | 25.750 | 31.380 | 5.630 | 39.460 | 27.520 |
| 11209 | 25.340 | 30.770 | 5.430 | 37.760 | 26.520 |
| 11210 | 24.950 | 30.090 | 5.140 | 36.970 | 26.790 |
| Average | 20.315 | 25.094 | 5.295 | 38.196 | 27.782 |
| Session 1 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 11301 | 26.650 | 31.060 | 4.410 | 38.380 | 30.640 |
| 11302 | 25.730 | 31.320 | 5.590 | 33.980 | 32.470 |
| 11303 | 27.150 | 32.620 | 5.470 | 39.680 | 32.380 |
| 11304 | 26.830 | 32.44 | 5.610 | 34.830 | 31.530 |
| 11305 | 25.290 | 30.120 | 4.830 | 32.410 | 28.750 |
| 11306 | 26.660 | 32.370 | 5.710 | 36.680 | 31.930 |
| 11307 | 25.730 | 31.320 | 5.590 | 33.980 | 32.470 |
| 11308 | 25.680 | 31.450 | 5.770 | 38.370 | 31.470 |
| 11309 | 27.310 | 32.760 | 5.450 | 39.000 | 34.120 |
| 11310 | 25.730 | 31.320 | 5.590 | 33.980 | 32.470 |
| Average | 26.276 | 31.678 | 5.402 | 36.129 | 31.823 |

EXERCISE BALL SUBJECT 1 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | Mic Cal | 94 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 12101 | 37.677 | 47.022 | 9.345 | 588.151 | 2877.053 |
| 12102 | 40.374 | 48.169 | 7.795 | 570.953 | 2848.042 |
| 12103 | 38.825 | 47.319 | 8.494 | 586.904 | 2539.744 |
| 12104 | 39.405 | 47.88 | 8.475 | 574.664 | 2598.727 |
| 12105 | 40.280 | 49.403 | 9.123 | 584.253 | 2585.467 |
| 12106 | 40.658 | 48.428 | 7.770 | 578.888 | 2643.825 |
| 12107 | 39.858 | 48.923 | 9.065 | 588.915 | 2629.296 |
| 12108 | 39.518 | 49.488 | 9.970 | 585.269 | 2587.983 |
| 12109 | 38.931 | 48.502 | 9.571 | 587.017 | 2865.069 |
| 12110 | 38.931 | 48.502 | 9.571 | 579.151 | 2841.454 |
| Average | 39.446 | 48.364 | 8.918 | 582.417 | 2701.666 |
| Session 2 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 12201 | 36.441 | 45.437 | 8.996 | 585.864 | 2704.414 |
| 12202 | 40.709 | 45.283 | 4.574 | 584.068 | 2830.656 |
| 12203 | 35.673 | 44.439 | 8.766 | 592.721 | 2652.071 |
| 12204 | 39.983 | 45.714 | 5.731 | 590.006 | 2656.947 |
| 12205 | 38.825 | 45.820 | 6.995 | 586.469 | 2656.827 |
| 12206 | 40.327 | 45.200 | 4.873 | 579.471 | 2849.606 |
| 12207 | 42.341 | 47.942 | 5.601 | 588.747 | 2860.512 |
| 12208 | 42.241 | 46.277 | 4.036 | 584.329 | 2845.94 |
| 12209 | 41.303 | 45.797 | 4.494 | 589.972 | 2867.669 |
| 12210 | 43.341 | 47.245 | 3.904 | 585.415 | 2870.132 |
| Average | 40.118 | 45.915 | 5.797 | 586.706 | 2779.477 |
| Session 2 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 12301 | 42.683 | 46.875 | 4.192 | 583.298 | 2875.49 |
| 12302 | 38.670 | 42.721 | 4.051 | 582.342 | 3194.358 |
| 12303 | 43.710 | 47.345 | 3.635 | 575.047 | 2817.31 |
| 12304 | 41.362 | 44.952 | 3.59 | 580.913 | 2855.248 |
| 12305 | 41.877 | 45.996 | 4.119 | 582.699 | 2839.267 |
| 12306 | 40.756 | 45.969 | 5.213 | 583.294 | 2819.296 |
| 12307 | 37.663 | 43.910 | 6.247 | 589.555 | 2868.225 |
| 12308 | 39.161 | 43.662 | 4.501 | 582.039 | 2660.861 |
| 12309 | 38.245 | 42.621 | 4.376 | 585.714 | 3164.574 |
| 12310 | 39.108 | 43.724 | 4.616 | 579.687 | 2545.869 |
| Average | 40.324 | 44.778 | 4.454 | 582.459 | 2864.050 |

EXERCISE BALL SUBJECT 1 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | Mic Cal | 94 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 12101 | 26.170 | 29.41 | 3.24 | 33.9 | 30.48 |
| 12102 | 24.640 | 28.25 | 3.61 | 30.57 | 28.22 |
| 12103 | 25.710 | 29.34 | 3.63 | 35.55 | 32.59 |
| 12104 | 24.380 | 28.27 | 3.89 | 33.01 | 27.82 |
| 12105 | 24.030 | 27.26 | 3.23 | 31.03 | 28.15 |
| 12106 | 24.440 | 28.64 | 4.2 | 33.25 | 29.21 |
| 12107 | 25.330 | 29.9 | 4.57 | 28.56 | 30.77 |
| 12108 | 26.180 | 30.64 | 4.46 | 30.69 | 31.5 |
| 12109 | 24.960 | 28.52 | 3.56 | 29.45 | 30.35 |
| 12110 | 24.960 | 28.52 | 3.56 | 29.45 | 30.35 |
| Average | 25.080 | 28.875 | 3.795 | 31.546 | 29.944 |
| Session 2 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 12201 | 19.070 | 26.270 | 7.200 | 30.830 | 26.400 |
| 12202 | 18.910 | 22.810 | 3.900 | 26.260 | 19.340 |
| 12203 | 25.840 | 27.410 | 1.570 | 27.290 | 29.770 |
| 12204 | 18.700 | 24.200 | 5.500 | 27.530 | 23.430 |
| 12205 | 24.080 | 25.620 | 1.540 | 29.380 | 25.300 |
| 12206 | 19.070 | 23.870 | 4.800 | 28.540 | 22.560 |
| 12207 | 20.980 | 26.720 | 5.740 | 33.550 | 26.640 |
| 12208 | 22.110 | 24.820 | 2.710 | 32.360 | 23.150 |
| 12209 | 23.130 | 24.860 | 1.730 | 30.240 | 23.240 |
| 12210 | 21.220 | 24.550 | 3.330 | 32.230 | 22.300 |
| Average | 21.311 | 25.113 | 3.802 | 29.821 | 24.213 |
| Session 2 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 12301 | 22.670 | 24.670 | 2.000 | 31.930 | 23.980 |
| 12302 | 17.280 | 23.930 | 6.650 | 27.560 | 26.050 |
| 12303 | 21.450 | 23.470 | 2.020 | 28.350 | 22.330 |
| 12304 | 19.600 | 22.82 | 3.220 | 26.950 | 23.430 |
| 12305 | 15.340 | 23.380 | 8.040 | 24.730 | 22.610 |
| 12306 | 23.520 | 24.530 | 1.010 | 29.630 | 24.950 |
| 12307 | 16.120 | 24.240 | 8.120 | 26.110 | 26.000 |
| 12308 | 18.910 | 24.500 | 5.590 | 24.970 | 26.210 |
| 12309 | 15.360 | 24.260 | 8.900 | 27.400 | 28.260 |
| 12310 | 20.300 | 23.930 | 3.630 | 24.720 | 25.110 |
| Average | 19.055 | 23.973 | 4.918 | 27.235 | 24.893 |

EXERCISE BALL SUBJECT 1 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | Mic Cal | 84 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 13101 | 43.097 | 54.983 | 11.886 | 50.000 | 2515.761 |
| 13102 | 32.459 | 48.944 | 16.485 | 581.891 | 2533.345 |
| 13103 | 34.596 | 48.466 | 13.87 | 587.300 | 2539.866 |
| 13104 | 31.316 | 49.115 | 17.799 | 585.919 | 2544.419 |
| 13105 | 35.171 | 47.442 | 12.271 | 586.880 | 2508.278 |
| 13106 | 32.332 | 49.164 | 16.832 | 586.887 | 2539.045 |
| 13107 | 33.953 | 47.643 | 13.69 | 588.303 | 2503.276 |
| 13108 | 34.491 | 47.809 | 13.318 | 585.417 | 2569.579 |
| 13109 | 31.348 | 48.111 | 16.763 | 580.977 | 2524.427 |
| 13110 | 36.285 | 49.108 | 12.823 | 586.419 | 2888.037 |
| Average | 34.505 | 49.079 | 14.574 | 531.999 | 2566.603 |
| Session 3 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 13201 | 31.486 | 49.606 | 18.12 | 590.644 | 2523.891 |
| 13202 | 30.375 | 49.457 | 19.082 | 577.880 | 2550.733 |
| 13203 | 36.694 | 49.870 | 13.176 | 580.840 | 2508.718 |
| 13204 | 34.660 | 50.925 | 16.265 | 879.686 | 2541.980 |
| 13205 | 32.442 | 50.803 | 18.361 | 868.529 | 2529.196 |
| 13206 | 34.504 | 51.612 | 17.108 | 873.282 | 2552.476 |
| 13207 | 35.316 | 49.362 | 14.046 | 875.059 | 2541.604 |
| 13208 | 33.223 | 50.529 | 17.306 | 868.882 | 2543.147 |
| 13209 | 32.995 | 49.349 | 16.354 | 585.498 | 2528.841 |
| 13210 | 35.086 | 49.944 | 14.858 | 581.919 | 2553.847 |
| Average | 33.678 | 50.146 | 16.468 | 728.222 | 2537.443 |
| Session 3 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 13301 | 30.515 | 45.153 | 14.638 | 585.971 | 2504.371 |
| 13302 | 32.243 | 47.451 | 15.208 | 583.613 | 2544.736 |
| 13303 | 28.822 | 47.633 | 18.811 | 578.624 | 2566.037 |
| 13304 | 34.834 | 48.262 | 13.428 | 586.875 | 2519.008 |
| 13305 | 31.576 | 48.373 | 16.797 | 583.866 | 2526.005 |
| 13306 | 31.317 | 56.249 | 24.932 | 594.157 | 2740.418 |
| 13307 | 32.467 | 47.738 | 15.271 | 587.104 | 2563.174 |
| 13308 | 29.930 | 47.710 | 17.78 | 587.652 | 2532.785 |
| 13309 | 32.839 | 47.867 | 15.028 | 579.719 | 3214.570 |
| 13310 | 32.466 | 47.458 | 14.992 | 583.512 | 2540.874 |
| Average | 31.701 | 48.389 | 16.689 | 585.109 | 2625.198 |

EXERCISE BALL SUBJECT 1 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | Mic Cal | 84 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 13101 | 22.690 | 27.300 | 4.610 | 32.540 | 27.440 |
| 13102 | 18.560 | 25.080 | 6.520 | 33.190 | 34.550 |
| 13103 | 17.410 | 24.580 | 7.170 | 31.510 | 33.550 |
| 13104 | 15.200 | 24.930 | 9.730 | 30.000 | 32.800 |
| 13105 | 17.810 | 25.440 | 7.630 | 29.950 | 35.450 |
| 13106 | 14.470 | 24.990 | 10.520 | 32.330 | 33.830 |
| 13107 | 16.010 | 24.490 | 8.480 | 28.940 | 33.950 |
| 13108 | 16.500 | 23.360 | 6.860 | 34.820 | 31.370 |
| 13109 | 17.480 | 24.280 | 6.800 | 34.680 | 32.890 |
| 13110 | 17.360 | 24.140 | 6.780 | 33.860 | 33.040 |
| Average | 17.349 | 24.859 | 7.510 | 32.182 | 32.887 |
| Session 3 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 13201 | 20.550 | 28.070 | 7.520 | 36.230 | 36.530 |
| 13202 | 19.930 | 26.410 | 6.480 | 33.770 | 34.330 |
| 13203 | 25.410 | 26.920 | 1.510 | 34.190 | 35.600 |
| 13204 | 22.500 | 27.020 | 4.520 | 34.050 | 34.530 |
| 13205 | 19.470 | 26.350 | 6.880 | 33.470 | 35.030 |
| 13206 | 22.880 | 26.760 | 3.880 | 35.300 | 35.310 |
| 13207 | 22.410 | 26.360 | 3.950 | 33.370 | 35.100 |
| 13208 | 20.470 | 27.570 | 7.100 | 37.380 | 35.950 |
| 13209 | 22.140 | 27.050 | 4.910 | 37.460 | 35.320 |
| 13210 | 21.180 | 27.430 | 6.250 | 36.550 | 35.970 |
| Average | 21.694 | 26.994 | 5.300 | 35.177 | 35.367 |
| Session 3 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 13301 | 15.110 | 24.290 | 9.180 | 31.250 | 32.660 |
| 13302 | 14.640 | 25.900 | 11.260 | 33.410 | 34.220 |
| 13303 | 14.600 | 25.700 | 11.100 | 34.190 | 31.210 |
| 13304 | 14.690 | 24.380 | 9.690 | 31.710 | 31.050 |
| 13305 | 16.000 | 25.210 | 9.210 | 30.980 | 31.340 |
| 13306 | 12.390 | 22.440 | 10.050 | 28.020 | 34.250 |
| 13307 | 15.380 | 26.310 | 10.930 | 32.010 | 32.710 |
| 13308 | 15.030 | 26.970 | 11.940 | 33.070 | 34.500 |
| 13309 | 15.480 | 26.590 | 11.110 | 33.780 | 33.960 |
| 13310 | 15.530 | 26.330 | 10.800 | 33.430 | 34.240 |
| Average | 14.885 | 25.412 | 10.527 | 32.185 | 33.014 |

EXERCISE BALL SUBJECT 2 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases All Test Sessions

| Session 1 | Baseline | | | Mic Cal | 81 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 21101 | 35.897 | 46.846 | 10.949 | 267.266 | 3304.36 |
| 21102 | 36.327 | 46.617 | 10.29 | 259.975 | 3191.25 |
| 21103 | 37.294 | 46.808 | 9.514 | 263.176 | 3062.54 |
| 21104 | 38.096 | 46.805 | 8.709 | 267.999 | 2741.44 |
| 21105 | 37.207 | 47.06 | 9.853 | 265.419 | 3222.91 |
| 21106 | 37.417 | 47.111 | 9.694 | 265.886 | 3266.86 |
| 21107 | 36.081 | 46.658 | 10.577 | 269.445 | 3310.92 |
| 21108 | 37.589 | 47.386 | 9.797 | 267.593 | 3250.21 |
| 21109 | 35.974 | 46.842 | 10.868 | 276.286 | 3365.88 |
| 21110 | 34.940 | 45.681 | 10.741 | 263.464 | 3294.44 |
| Average | 36.682 | 46.781 | 10.099 | 266.651 | 3201.082 |
| Session 1 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 21201 | 37.365 | 46.708 | 9.343 | 274.344 | 2969.724 |
| 21202 | 35.967 | 46.264 | 10.297 | 263.295 | 2991.692 |
| 21203 | 36.277 | 46.574 | 10.297 | 265.862 | 3250.997 |
| 21204 | 34.511 | 45.023 | 10.512 | 266.106 | 3228.934 |
| 21205 | 34.668 | 45.252 | 10.584 | 257.200 | 3276.976 |
| 21206 | 35.018 | 45.567 | 10.549 | 266.404 | 3204.474 |
| 21207 | 36.865 | 46.691 | 9.826 | 270.039 | 2891.800 |
| 21208 | 37.860 | 46.99 | 9.13 | 268.708 | 3364.891 |
| 21209 | 34.940 | 45.956 | 11.016 | 257.654 | 3211.187 |
| 21210 | 35.991 | 45.707 | 9.716 | 259.648 | 3232.173 |
| Average | 35.946 | 46.073 | 10.127 | 264.926 | 3162.285 |
| Session 1 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 21301 | 36.664 | 44.313 | 7.649 | 256.651 | 2238.629 |
| 21302 | 35.776 | 46.166 | 10.39 | 256.846 | 3203.678 |
| 21303 | 37.711 | 47.285 | 9.574 | 256.819 | 3360.488 |
| 21304 | 35.850 | 47.451 | 11.601 | 259.053 | 2846.665 |
| 21305 | 39.047 | 48.271 | 9.224 | 254.394 | 2754.210 |
| 21306 | 38.539 | 47.56 | 9.021 | 255.402 | 3379.648 |
| 21307 | 36.102 | 47.626 | 11.524 | 260.539 | 3095.821 |
| 21308 | 36.295 | 47.435 | 11.14 | 256.966 | 3291.486 |
| 21309 | 35.581 | 46.488 | 10.907 | 263.521 | 3090.786 |
| 21310 | 36.049 | 45.932 | 9.883 | 266.614 | 3304.258 |
| Average | 36.761 | 46.853 | 10.091 | 258.681 | 3056.567 |

EXERCISE BALL SUBJECT 2 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases All Test Sessions

| Session 1 | Baseline | | | Mic Cal | 81 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 21101 | 20.410 | 22.75 | 2.34 | 24.24 | 17.46 |
| 21102 | 18.280 | 20.96 | 2.68 | 20.97 | 15.86 |
| 21103 | 19.920 | 21.9 | 1.98 | 23.24 | 16.91 |
| 21104 | 17.700 | 20.86 | 3.16 | 22.36 | 15.4 |
| 21105 | 17.340 | 21.95 | 4.61 | 22.7 | 14.18 |
| 21106 | 18.560 | 21.28 | 2.72 | 22.34 | 15.87 |
| 21107 | 22.370 | 24.58 | 2.21 | 26.92 | 19.05 |
| 21108 | 19.670 | 22.62 | 2.95 | 24.42 | 17.37 |
| 21109 | 19.750 | 22.9 | 3.15 | 25.57 | 17.75 |
| 21110 | 20.730 | 23.45 | 2.72 | 24.78 | 17.87 |
| Average | 19.473 | 22.325 | 2.852 | 23.754 | 16.772 |
| Session 1 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 21201 | 18.420 | 21.95 | 3.53 | 24.18 | 14.64 |
| 21202 | 20.330 | 22.68 | 2.35 | 23.52 | 17.22 |
| 21203 | 17.640 | 21.13 | 3.49 | 22.31 | 15.94 |
| 21204 | 20.970 | 23.36 | 2.39 | 25.2 | 17.99 |
| 21205 | 19.570 | 22.26 | 2.69 | 22.08 | 16.92 |
| 21206 | 21.240 | 23.09 | 1.85 | 24.34 | 17.26 |
| 21207 | 20.560 | 22.81 | 2.25 | 25.23 | 17.37 |
| 21208 | 17.720 | 21.91 | 4.19 | 22.71 | 14.37 |
| 21209 | 20.060 | 22.66 | 2.6 | 21.99 | 16.89 |
| 21210 | 19.000 | 21.42 | 2.42 | 21.12 | 16.38 |
| Average | 19.551 | 22.327 | 2.776 | 23.268 | 16.498 |
| Session 1 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 21301 | 20.100 | 20.88 | 0.78 | 21.66 | 15.11 |
| 21302 | 18.070 | 20.57 | 2.5 | 20.14 | 15.53 |
| 21303 | 17.880 | 20.59 | 2.71 | 18.86 | 15.74 |
| 21304 | 19.760 | 22.53 | 2.77 | 21.4 | 17.05 |
| 21305 | 16.790 | 21.03 | 4.24 | 19.05 | 13.27 |
| 21306 | 16.550 | 19.96 | 3.41 | 17.19 | 12.41 |
| 21307 | 20.990 | 23.42 | 2.43 | 26.06 | 17.11 |
| 21308 | 19.190 | 21.79 | 2.6 | 20.42 | 16.29 |
| 21309 | 18.770 | 21.8 | 3.03 | 22.94 | 16.56 |
| 21310 | 18.300 | 21.4 | 3.1 | 23.02 | 16.47 |
| Average | 18.640 | 21.397 | 2.757 | 21.074 | 15.554 |

EXERCISE BALL SUBJECT 2 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | Mic Cal | 94 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 22101 | 33.225 | 44.050 | 10.825 | 257.355 | 3424.81 |
| 22102 | 36.981 | 42.159 | 5.178 | 258.922 | 3174.65 |
| 22103 | 38.041 | 40.527 | 2.486 | 256.605 | 3145.78 |
| 22104 | 36.050 | 42.450 | 6.4 | 258.973 | 3182.01 |
| 22105 | 35.590 | 40.918 | 5.328 | 258.416 | 3182.32 |
| 22106 | 38.285 | 42.018 | 3.733 | 262.923 | 2212.95 |
| 22107 | 39.225 | 42.760 | 3.535 | 264.164 | 2228.08 |
| 22108 | 38.604 | 44.917 | 6.313 | 264.939 | 3139.29 |
| 22109 | 38.074 | 42.968 | 4.894 | 262.036 | 3172.72 |
| 22110 | 39.153 | 46.184 | 7.031 | 266.477 | 2635.89 |
| Average | 37.323 | 42.895 | 5.572 | 261.081 | 2949.852 |
| Session 2 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 22201 | 37.559 | 43.418 | 5.859 | 278.828 | 2237.350 |
| 22202 | 38.079 | 41.833 | 3.754 | 260.752 | 2232.985 |
| 22203 | 38.567 | 42.661 | 4.094 | 263.471 | 2229.782 |
| 22204 | 34.532 | 41.110 | 6.578 | 262.829 | 3451.156 |
| 22205 | 34.195 | 40.227 | 6.032 | 252.123 | 3415.683 |
| 22206 | 38.373 | 42.487 | 4.114 | 265.689 | 2204.477 |
| 22207 | 38.919 | 44.707 | 5.788 | 266.127 | 2050.000 |
| 22208 | 39.349 | 48.337 | 8.988 | 267.905 | 2610.437 |
| 22209 | 37.136 | 46.991 | 9.855 | 271.961 | 3255.182 |
| 22210 | 37.519 | 41.235 | 3.716 | 265.549 | 2270.084 |
| Average | 37.423 | 43.301 | 5.878 | 265.523 | 2595.713 |
| Session 2 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 22301 | 33.739 | 41.145 | 7.406 | 265.267 | 3412.708 |
| 22302 | 35.912 | 43.897 | 7.985 | 264.350 | 3156.793 |
| 22303 | 37.232 | 40.580 | 3.348 | 266.165 | 2239.265 |
| 22304 | 37.033 | 46.619 | 9.586 | 253.261 | 3145.662 |
| 22305 | 32.389 | 42.138 | 9.749 | 256.371 | 2260.972 |
| 22306 | 37.638 | 41.826 | 4.188 | 255.502 | 3170.067 |
| 22307 | 37.637 | 41.153 | 3.516 | 269.403 | 3034.135 |
| 22308 | 38.000 | 47.545 | 9.545 | 265.204 | 2223.701 |
| 22309 | 38.080 | 40.739 | 2.659 | 285.122 | 2208.279 |
| 22310 | 36.266 | 42.117 | 5.851 | 257.594 | 3389.013 |
| Average | 36.393 | 42.776 | 6.383 | 263.824 | 2824.059 |

EXERCISE BALL SUBJECT 2 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | Mic Cal | 94 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 22101 | 19.710 | 22.000 | 2.290 | 22.070 | 17.710 |
| 22102 | 16.170 | 16.380 | 0.210 | 15.630 | 11.570 |
| 22103 | 12.010 | 14.000 | 1.990 | 13.350 | 9.900 |
| 22104 | 18.660 | 19.160 | 0.500 | 19.390 | 14.220 |
| 22105 | 15.850 | 16.980 | 1.130 | 16.990 | 12.370 |
| 22106 | 15.990 | 17.300 | 1.310 | 18.160 | 12.050 |
| 22107 | 16.330 | 16.360 | 0.030 | 17.410 | 8.730 |
| 22108 | 17.120 | 18.490 | 1.370 | 20.110 | 14.010 |
| 22109 | 16.190 | 17.090 | 0.900 | 18.080 | 11.380 |
| 22110 | 17.270 | 20.140 | 2.870 | 21.030 | 12.540 |
| Average | 16.530 | 17.790 | 1.260 | 18.222 | 12.448 |
| Session 2 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 22201 | 16.710 | 18.700 | 1.990 | 20.400 | 11.890 |
| 22202 | 15.920 | 16.140 | 0.220 | 15.200 | 9.200 |
| 22203 | 16.160 | 16.560 | 0.400 | 17.780 | 8.530 |
| 22204 | 17.960 | 19.630 | 1.670 | 19.830 | 14.280 |
| 22205 | 16.470 | 17.700 | 1.230 | 16.080 | 13.250 |
| 22206 | 16.440 | 16.610 | 0.170 | 16.760 | 9.820 |
| 22207 | 16.730 | 18.640 | 1.910 | 18.560 | 11.750 |
| 22208 | 18.140 | 22.180 | 4.040 | 22.190 | 14.930 |
| 22209 | 20.460 | 22.810 | 2.350 | 25.060 | 17.960 |
| 22210 | 15.650 | 15.960 | 0.310 | 15.780 | 8.810 |
| Average | 17.064 | 18.493 | 1.429 | 18.764 | 12.042 |
| Session 2 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 22301 | 18.690 | 19.200 | 0.510 | 19.070 | 14.290 |
| 22302 | 17.930 | 20.020 | 2.090 | 21.430 | 15.580 |
| 22303 | 15.440 | 15.850 | 0.410 | 15.910 | 8.960 |
| 22304 | 18.310 | 20.9 | 2.590 | 20.250 | 16.480 |
| 22305 | 14.220 | 17.300 | 3.080 | 17.630 | 9.960 |
| 22306 | 15.310 | 15.740 | 0.430 | 14.870 | 11.140 |
| 22307 | 16.220 | 16.310 | 0.090 | 17.490 | 10.420 |
| 22308 | 17.770 | 21.650 | 3.880 | 21.980 | 14.530 |
| 22309 | 15.210 | 16.530 | 1.320 | 17.770 | 11.210 |
| 22310 | 17.160 | 17.740 | 0.580 | 17.130 | 12.530 |
| Average | 16.626 | 18.124 | 1.498 | 18.353 | 12.510 |

EXERCISE BALL SUBJECT 2 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | Mic Cal | 101 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 22101 | 44.384 | 54.948 | 10.564 | 278.651 | 2018.200 |
| 22102 | 38.353 | 47.433 | 9.08 | 291.792 | 2211.592 |
| 22103 | 35.018 | 46.881 | 11.863 | 267.589 | 3172.204 |
| 22104 | 37.051 | 47.214 | 10.163 | 276.605 | 3867.451 |
| 22105 | 37.504 | 47.388 | 9.884 | 279.970 | 3161.836 |
| 22106 | 38.266 | 47.459 | 9.193 | 305.646 | 3152.765 |
| 22107 | 35.098 | 45.863 | 10.765 | 298.349 | 3848.641 |
| 22108 | 34.504 | 45.797 | 11.293 | 300.321 | 3158.822 |
| 22109 | 38.906 | 47.598 | 8.692 | 299.001 | 2236.585 |
| 22110 | 38.013 | 47.684 | 9.671 | 287.304 | 3163.149 |
| Average | 37.710 | 47.827 | 10.117 | 288.523 | 2999.124 |
| Session 2 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 22201 | 40.297 | 48.483 | 8.186 | 294.332 | 2250.548 |
| 22202 | 38.673 | 48.457 | 9.784 | 265.557 | 2207.740 |
| 22203 | 39.497 | 48.860 | 9.363 | 297.205 | 2224.700 |
| 22204 | 36.124 | 47.236 | 11.112 | 293.313 | 3168.210 |
| 22205 | 38.415 | 48.738 | 10.323 | 291.986 | 3156.912 |
| 22206 | 38.573 | 48.743 | 10.17 | 287.275 | 2638.614 |
| 22207 | 38.740 | 49.099 | 10.359 | 313.253 | 2721.135 |
| 22208 | 38.400 | 47.922 | 9.522 | 295.228 | 3161.699 |
| 22209 | 36.468 | 47.724 | 11.256 | 283.068 | 3837.770 |
| 22210 | 41.708 | 49.605 | 7.897 | 288.502 | 2240.687 |
| Average | 38.690 | 48.487 | 9.797 | 290.972 | 2760.801 |
| Session 2 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 22301 | 38.443 | 48.57 | 10.127 | 270.835 | 2645.096 |
| 22302 | 38.158 | 48.121 | 9.963 | 291.817 | 2630.194 |
| 22303 | 38.339 | 48.358 | 10.019 | 285.757 | 2210.662 |
| 22304 | 41.216 | 48.835 | 7.619 | 277.653 | 2236.213 |
| 22305 | 38.033 | 48.192 | 10.159 | 283.914 | 2623.396 |
| 22306 | 38.411 | 48.565 | 10.154 | 274.748 | 2205.326 |
| 22307 | 41.067 | 49.008 | 7.941 | 281.817 | 2238.309 |
| 22308 | 40.585 | 48.718 | 8.133 | 274.122 | 2221.789 |
| 22309 | 38.892 | 48.106 | 9.214 | 280.726 | 3173.730 |
| 22310 | 38.158 | 48.12 | 9.962 | 291.817 | 2630.230 |
| Average | 39.130 | 48.459 | 9.329 | 281.321 | 2481.494 |

EXERCISE BALL SUBJECT 2 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | Mic Cal | 101 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 22101 | 26.26 | 27.630 | 1.370 | 31.770 | 23.560 |
| 22102 | 22.44 | 24.170 | 1.730 | 29.770 | 21.150 |
| 22103 | 24.17 | 25.870 | 1.700 | 27.260 | 21.790 |
| 22104 | 23.98 | 25.500 | 1.520 | 28.990 | 22.000 |
| 22105 | 23.45 | 25.280 | 1.830 | 28.810 | 22.210 |
| 22106 | 23.51 | 25.380 | 1.870 | 31.900 | 22.780 |
| 22107 | 24.37 | 26.090 | 1.720 | 32.080 | 22.540 |
| 22108 | 24.19 | 25.920 | 1.730 | 31.730 | 22.970 |
| 22109 | 21.75 | 24.870 | 3.120 | 30.020 | 20.430 |
| 22110 | 23.02 | 24.620 | 1.600 | 29.880 | 21.640 |
| Average | 23.714 | 25.533 | 1.819 | 30.221 | 22.107 |
| Session 2 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 22201 | 22.83 | 25.900 | 3.070 | 30.500 | 21.620 |
| 22202 | 22.75 | 24.600 | 1.850 | 26.300 | 21.310 |
| 22203 | 23.38 | 26.090 | 2.710 | 31.050 | 22.050 |
| 22204 | 24.4 | 26.03 | 1.630 | 31.210 | 22.760 |
| 22205 | 23.48 | 25.460 | 1.980 | 31.020 | 21.960 |
| 22206 | 23.23 | 25.140 | 1.910 | 30.320 | 22.010 |
| 22207 | 24.14 | 26.120 | 1.980 | 32.470 | 23.860 |
| 22208 | 23.2 | 25.130 | 1.930 | 31.490 | 21.890 |
| 22209 | 24.04 | 25.860 | 1.820 | 29.810 | 22.070 |
| 22210 | 22.43 | 25.400 | 2.970 | 29.660 | 20.460 |
| Average | 23.388 | 25.573 | 2.185 | 30.383 | 21.999 |
| Session 2 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 22301 | 22.76 | 24.94 | 2.18 | 28.05 | 21.04 |
| 22302 | 22.83 | 24.77 | 1.94 | 30.21 | 21.2 |
| 22303 | 22.84 | 25.01 | 2.17 | 29.77 | 21.86 |
| 22304 | 21.55 | 24.53 | 2.98 | 27.24 | 18.95 |
| 22305 | 22.85 | 24.41 | 1.56 | 29.21 | 21.33 |
| 22306 | 22.37 | 24.85 | 2.48 | 27.96 | 21.8 |
| 22307 | 22.02 | 25.01 | 2.99 | 27.77 | 19.88 |
| 22308 | 21.1 | 23.93 | 2.83 | 26.2 | 18.36 |
| 22309 | 22.28 | 23.96 | 1.68 | 28.29 | 20.57 |
| 22310 | 22.83 | 24.77 | 1.94 | 30.21 | 21.2 |
| Average | 22.343 | 24.618 | 2.275 | 28.491 | 20.619 |

EXERCISE BALL SUBJECT 3 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases All Test Sessions

| Session 1 | Baseline | | | Mic Cal | 89 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 31101 | 44.662 | 53.389 | 8.727 | 264.800 | 3256.659 |
| 31102 | 42.522 | 53.245 | 10.723 | 272.312 | 3431.592 |
| 31103 | 43.652 | 53.735 | 10.083 | 265.094 | 3287.312 |
| 31104 | 42.793 | 53.076 | 10.283 | 260.913 | 3371.831 |
| 31105 | 42.777 | 52.933 | 10.156 | 259.252 | 3292.050 |
| 31106 | 42.647 | 52.262 | 9.615 | 266.085 | 3286.933 |
| 31107 | 43.500 | 53.284 | 9.784 | 260.836 | 2627.707 |
| 31108 | 44.048 | 52.942 | 8.894 | 262.109 | 3283.097 |
| 31109 | 43.474 | 53.231 | 9.757 | 259.562 | 3278.969 |
| 31110 | 45.278 | 54.020 | 8.742 | 256.825 | 2611.746 |
| Average | 43.535 | 53.212 | 9.676 | 262.779 | 3172.79 |
| Session 1 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 31201 | 43.710 | 53.123 | 9.413 | 266.354 | 2628.634 |
| 31202 | 43.245 | 53.331 | 10.086 | 269.609 | 2611.842 |
| 31203 | 44.606 | 54.397 | 9.791 | 263.716 | 2557.434 |
| 31204 | 44.609 | 54.386 | 9.777 | 260.887 | 2573.723 |
| 31205 | 44.369 | 54.307 | 9.938 | 262.013 | 2623.106 |
| 31206 | 43.621 | 52.896 | 9.275 | 267.263 | 2645.339 |
| 31207 | 43.883 | 53.930 | 10.047 | 263.036 | 2622.140 |
| 31208 | 44.210 | 55.096 | 10.886 | 262.966 | 3285.892 |
| 31209 | 44.370 | 54.575 | 10.205 | 268.289 | 2614.082 |
| 31210 | 44.980 | 53.971 | 8.991 | 260.643 | 2628.590 |
| Average | 44.160 | 54.001 | 9.841 | 264.478 | 2679.078 |
| Session 1 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 31301 | 43.088 | 52.972 | 9.884 | 269.498 | 2610.237 |
| 31302 | 44.332 | 53.880 | 9.548 | 260.119 | 2551.966 |
| 31303 | 43.214 | 53.244 | 10.030 | 262.324 | 3296.821 |
| 31304 | 44.087 | 53.978 | 9.891 | 260.697 | 2519.798 |
| 31305 | 43.301 | 53.925 | 10.624 | 263.243 | 3378.792 |
| 31306 | 43.750 | 53.443 | 9.693 | 260.510 | 2623.928 |
| 31307 | 44.056 | 53.389 | 9.333 | 266.047 | 2631.579 |
| 31308 | 44.022 | 52.933 | 8.911 | 263.950 | 2529.017 |
| 31309 | 43.565 | 53.396 | 9.831 | 259.474 | 3285.161 |
| 31310 | 42.830 | 53.542 | 10.712 | 264.894 | 2514.869 |
| Average | 43.625 | 53.470 | 9.846 | 263.076 | 2794.217 |

EXERCISE BALL SUBJECT 3 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases All Test Sessions

| Session 1 | Baseline | | | Mic Cal | 89 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 31101 | 16.72 | 22.010 | 4.050 | 15.730 | 12.590 |
| 31102 | 22.94 | 21.610 | 2.160 | 25.380 | 21.590 |
| 31103 | 20.54 | 21.990 | 2.670 | 21.620 | 19.010 |
| 31104 | 20.47 | 21.530 | 2.160 | 20.630 | 18.920 |
| 31105 | 19.65 | 22.240 | 2.380 | 20.090 | 18.380 |
| 31106 | 21.14 | 23.020 | 1.820 | 22.260 | 19.540 |
| 31107 | 20.7 | 21.840 | 2.410 | 20.430 | 18.710 |
| 31108 | 20.45 | 23.530 | 1.710 | 20.700 | 18.650 |
| 31109 | 20.02 | 22.690 | 2.620 | 20.520 | 18.690 |
| 31110 | 18.93 | 21.340 | 3.620 | 19.170 | 16.200 |
| Average | 20.156 | 22.180 | 2.560 | 20.653 | 18.228 |
| Session 1 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 31201 | 20.57 | 21.550 | 2.370 | 21.260 | 18.400 |
| 31202 | 22.1 | 23.810 | 1.920 | 24.280 | 20.490 |
| 31203 | 20.69 | 24.890 | 2.590 | 20.580 | 19.190 |
| 31204 | 20.81 | 21.860 | 2.350 | 20.580 | 19.520 |
| 31205 | 20.23 | 21.680 | 2.750 | 20.780 | 19.290 |
| 31206 | 22.2 | 22.650 | 1.840 | 23.280 | 20.510 |
| 31207 | 20.93 | 22.390 | 2.200 | 21.040 | 19.130 |
| 31208 | 20.82 | 23.120 | 3.170 | 21.490 | 19.730 |
| 31209 | 20.95 | 22.510 | 2.990 | 21.560 | 18.640 |
| 31210 | 20.53 | 21.670 | 2.000 | 19.900 | 18.770 |
| Average | 20.983 | 22.613 | 2.418 | 21.475 | 19.367 |
| Session 1 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 31301 | 20.78 | 21.760 | 2.010 | 22.130 | 18.690 |
| 31302 | 20.36 | 22.990 | 2.360 | 20.360 | 18.840 |
| 31303 | 20.64 | 22.320 | 2.220 | 20.220 | 19.530 |
| 31304 | 20.46 | 21.59 | 2.010 | 19.780 | 18.760 |
| 31305 | 20.98 | 21.790 | 2.380 | 21.060 | 19.710 |
| 31306 | 21.25 | 21.640 | 2.070 | 20.510 | 19.340 |
| 31307 | 21.13 | 21.750 | 1.900 | 21.670 | 19.110 |
| 31308 | 20.72 | 22.230 | 1.730 | 21.180 | 18.640 |
| 31309 | 20.27 | 24.140 | 2.240 | 19.880 | 19.070 |
| 31310 | 20.68 | 21.810 | 2.660 | 21.750 | 19.540 |
| Average | 20.727 | 22.202 | 2.158 | 20.854 | 19.123 |

EXERCISE BALL SUBJECT 3 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | Mic Cal | 93 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 32101 | 50.384 | 57.658 | 7.274 | 255.162 | 3210.98 |
| 32102 | 49.325 | 56.603 | 7.278 | 256.648 | 3267.06 |
| 32103 | 48.916 | 57.128 | 8.212 | 254.411 | 2874.54 |
| 32104 | 48.679 | 55.292 | 6.613 | 252.430 | 3251.74 |
| 32105 | 48.212 | 56.783 | 8.571 | 248.376 | 3215.37 |
| 32106 | 47.769 | 57.560 | 9.791 | 258.271 | 2609.57 |
| 32107 | 50.923 | 57.905 | 6.982 | 250.243 | 2518.32 |
| 32108 | 47.912 | 57.020 | 9.108 | 265.037 | 2570.54 |
| 32109 | 50.611 | 57.748 | 7.137 | 257.577 | 2514.79 |
| 32110 | 49.533 | 57.192 | 7.659 | 259.417 | 2544.45 |
| Average | 49.226 | 57.089 | 7.863 | 255.757 | 2857.7 |
| Session 2 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 32201 | 51.297 | 57.969 | 6.672 | 257.640 | 2539.138 |
| 32202 | 48.953 | 58.779 | 9.826 | 270.697 | 2654.849 |
| 32203 | 50.730 | 58.409 | 7.679 | 257.745 | 3251.516 |
| 32204 | 50.518 | 58.053 | 7.535 | 257.414 | 3273.027 |
| 32205 | 50.780 | 58.225 | 7.445 | 257.781 | 3261.900 |
| 32206 | 50.009 | 58.405 | 8.396 | 252.548 | 3234.819 |
| 32207 | 51.240 | 59.046 | 7.806 | 268.208 | 2626.295 |
| 32208 | 49.751 | 57.721 | 7.97 | 263.056 | 2638.131 |
| 32209 | 51.237 | 58.061 | 6.824 | 257.083 | 3237.298 |
| 32210 | 50.742 | 58.060 | 7.318 | 253.042 | 3194.137 |
| Average | 50.526 | 58.273 | 7.747 | 259.521 | 2991.111 |
| Session 2 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 32301 | 50.607 | 57.552 | 6.945 | 258.984 | 2629.017 |
| 32302 | 48.862 | 57.414 | 8.552 | 259.807 | 2610.702 |
| 32303 | 50.237 | 57.686 | 7.449 | 259.838 | 3270.438 |
| 32304 | 49.283 | 57.238 | 7.955 | 260.068 | 3240.926 |
| 32305 | 51.082 | 58.268 | 7.186 | 259.930 | 2611.866 |
| 32306 | 49.880 | 57.075 | 7.195 | 259.440 | 3261.309 |
| 32307 | 50.544 | 58.174 | 7.63 | 257.824 | 2514.821 |
| 32308 | 49.421 | 57.711 | 8.29 | 261.010 | 2631.272 |
| 32309 | 49.515 | 58.112 | 8.597 | 256.248 | 3250.898 |
| 32310 | 50.568 | 57.926 | 7.358 | 254.199 | 2509.980 |
| Average | 50.000 | 57.716 | 7.716 | 258.735 | 2853.123 |

EXERCISE BALL SUBJECT 3 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | Mic Cal | 93 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 302101 | 18.550 | 20.770 | 4.050 | 15.730 | 12.590 |
| 302102 | 19.070 | 25.100 | 2.160 | 25.380 | 21.590 |
| 302103 | 19.230 | 23.210 | 2.670 | 21.620 | 19.010 |
| 302104 | 20.120 | 22.630 | 2.160 | 20.630 | 18.920 |
| 302105 | 18.500 | 22.030 | 2.380 | 20.090 | 18.380 |
| 302106 | 17.830 | 22.960 | 1.820 | 22.260 | 19.540 |
| 302107 | 19.740 | 23.110 | 2.410 | 20.430 | 18.710 |
| 302108 | 18.460 | 22.160 | 1.710 | 20.700 | 18.650 |
| 302109 | 20.130 | 22.640 | 2.620 | 20.520 | 18.690 |
| 302110 | 18.950 | 22.550 | 3.620 | 19.170 | 16.200 |
| Average | 19.058 | 22.716 | 2.560 | 20.653 | 18.228 |
| Session 2 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 302201 | 19.560 | 22.940 | 2.370 | 21.260 | 18.400 |
| 302202 | 17.880 | 24.020 | 1.920 | 24.280 | 20.490 |
| 302203 | 21.580 | 23.280 | 2.590 | 20.580 | 19.190 |
| 302204 | 19.200 | 23.160 | 2.350 | 20.580 | 19.520 |
| 302205 | 19.700 | 22.980 | 2.750 | 20.780 | 19.290 |
| 302206 | 19.620 | 24.040 | 1.840 | 23.280 | 20.510 |
| 302207 | 19.090 | 23.130 | 2.200 | 21.040 | 19.130 |
| 302208 | 20.780 | 23.990 | 3.170 | 21.490 | 19.730 |
| 302209 | 20.240 | 23.940 | 2.990 | 21.560 | 18.640 |
| 302210 | 18.710 | 22.530 | 2.000 | 19.900 | 18.770 |
| Average | 19.636 | 23.401 | 2.418 | 21.475 | 19.367 |
| Session 2 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 302301 | 19.830 | 22.790 | 2.010 | 22.130 | 18.690 |
| 302302 | 18.670 | 22.720 | 2.360 | 20.360 | 18.840 |
| 302303 | 20.130 | 22.860 | 2.220 | 20.220 | 19.530 |
| 302304 | 18.930 | 22.47 | 2.010 | 19.780 | 18.760 |
| 302305 | 18.980 | 23.360 | 2.380 | 21.060 | 19.710 |
| 302306 | 19.080 | 23.320 | 2.070 | 20.510 | 19.340 |
| 302307 | 19.240 | 23.030 | 1.900 | 21.670 | 19.110 |
| 302308 | 19.070 | 22.450 | 1.730 | 21.180 | 18.640 |
| 302309 | 19.660 | 22.510 | 2.240 | 19.880 | 19.070 |
| 302310 | 19.060 | 23.340 | 2.660 | 21.750 | 19.540 |
| Average | 19.265 | 22.885 | 2.158 | 20.854 | 19.123 |

EXERCISE BALL SUBJECT 3 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | Mic Cal | 94 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 303101 | 35.897 | 46.846 | 10.949 | 267.266 | 3419.341 |
| 303102 | 36.327 | 46.617 | 10.29 | 259.975 | 3323.404 |
| 303103 | 37.294 | 46.808 | 9.514 | 263.176 | 3276.429 |
| 303104 | 38.096 | 46.805 | 8.709 | 267.999 | 3066.227 |
| 303105 | 37.207 | 47.060 | 9.853 | 265.419 | 3228.173 |
| 303106 | 37.417 | 47.111 | 9.694 | 265.886 | 3266.862 |
| 303107 | 36.081 | 46.658 | 10.577 | 269.445 | 3310.916 |
| 303108 | 37.589 | 47.386 | 9.797 | 267.593 | 3250.214 |
| 303109 | 35.974 | 46.842 | 10.868 | 276.286 | 3365.877 |
| 303110 | 34.940 | 45.681 | 10.741 | 263.464 | 3294.437 |
| Average | 36.682 | 46.781 | 10.0992 | 266.651 | 3280.188 |
| Session 3 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 303201 | 37.365 | 46.708 | 9.343 | 274.344 | 2620.363 |
| 303202 | 35.967 | 46.264 | 10.297 | 263.295 | 3313.473 |
| 303203 | 36.277 | 46.574 | 10.297 | 265.862 | 3259.812 |
| 303204 | 34.511 | 45.023 | 10.512 | 266.106 | 3296.829 |
| 303205 | 34.668 | 45.252 | 10.584 | 257.2 | 3339.67 |
| 303206 | 35.018 | 45.567 | 10.549 | 266.404 | 3275.601 |
| 303207 | 36.865 | 46.691 | 9.826 | 270.039 | 2614.727 |
| 303208 | 37.860 | 46.990 | 9.13 | 268.708 | 2646.041 |
| 303209 | 34.940 | 45.956 | 11.016 | 257.654 | 3405.99 |
| 303210 | 35.991 | 45.707 | 9.716 | 259.648 | 3271.233 |
| Average | 35.946 | 46.073 | 10.127 | 264.926 | 3104.374 |
| Session 3 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 303301 | 36.664 | 44.313 | 7.649 | 256.651 | 3310.296 |
| 303302 | 35.776 | 46.166 | 10.39 | 256.846 | 3370.356 |
| 303303 | 37.711 | 47.285 | 9.574 | 256.819 | 3251.682 |
| 303304 | 35.850 | 47.451 | 11.601 | 259.053 | 3434.961 |
| 303305 | 39.047 | 48.271 | 9.224 | 254.394 | 2622.294 |
| 303306 | 38.539 | 47.560 | 9.021 | 255.402 | 3199.342 |
| 303307 | 36.102 | 47.626 | 11.524 | 260.539 | 3450.885 |
| 303308 | 36.295 | 47.435 | 11.14 | 256.966 | 3406.087 |
| 303309 | 35.581 | 46.488 | 10.907 | 263.521 | 3368.156 |
| 303310 | 36.049 | 45.932 | 9.883 | 266.614 | 3254.568 |
| Average | 36.761 | 46.853 | 10.0913 | 585.109 | 2625.198 |

EXERCISE BALL SUBJECT 3 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | Mic Cal | 94 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 303101 | 20.410 | 22.750 | 2.340 | 24.240 | 17.460 |
| 303102 | 18.280 | 20.960 | 2.680 | 20.970 | 15.860 |
| 303103 | 19.920 | 21.900 | 1.980 | 23.240 | 16.910 |
| 303104 | 17.700 | 20.860 | 3.160 | 22.360 | 15.400 |
| 303105 | 17.340 | 21.950 | 4.610 | 22.700 | 14.180 |
| 303106 | 18.560 | 21.280 | 2.720 | 22.340 | 15.870 |
| 303107 | 22.370 | 24.580 | 2.210 | 26.920 | 19.050 |
| 303108 | 19.670 | 22.620 | 2.950 | 24.420 | 17.370 |
| 303109 | 19.750 | 22.900 | 3.150 | 25.570 | 17.750 |
| 303110 | 20.730 | 23.450 | 2.720 | 24.780 | 17.870 |
| Average | 19.473 | 22.325 | 2.852 | 23.754 | 16.772 |
| Session 3 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 303201 | 18.420 | 21.950 | 3.530 | 24.180 | 14.640 |
| 303202 | 20.330 | 22.680 | 2.350 | 23.520 | 17.220 |
| 303203 | 17.640 | 21.130 | 3.490 | 22.310 | 15.940 |
| 303204 | 20.970 | 23.360 | 2.390 | 25.200 | 17.990 |
| 303205 | 19.570 | 22.260 | 2.690 | 22.080 | 16.920 |
| 303206 | 21.240 | 23.090 | 1.850 | 24.340 | 17.260 |
| 303207 | 20.560 | 22.810 | 2.250 | 25.230 | 17.370 |
| 303208 | 17.720 | 21.910 | 4.190 | 22.710 | 14.370 |
| 303209 | 20.060 | 22.660 | 2.600 | 21.990 | 16.890 |
| 303210 | 19.000 | 21.420 | 2.420 | 21.120 | 16.380 |
| Average | 19.551 | 22.327 | 2.776 | 23.268 | 16.498 |
| Session 3 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 303301 | 20.100 | 20.570 | 0.780 | 21.660 | 15.110 |
| 303302 | 18.070 | 20.590 | 2.500 | 20.140 | 15.530 |
| 303303 | 17.880 | 22.530 | 2.710 | 18.860 | 15.740 |
| 303304 | 19.760 | 21.030 | 2.770 | 21.400 | 17.050 |
| 303305 | 16.790 | 19.960 | 4.240 | 19.050 | 13.270 |
| 303306 | 16.550 | 23.420 | 3.410 | 17.190 | 12.410 |
| 303307 | 20.990 | 21.790 | 2.430 | 26.060 | 17.110 |
| 303308 | 19.190 | 21.800 | 2.600 | 20.420 | 16.290 |
| 303309 | 18.770 | 21.400 | 3.030 | 22.940 | 16.560 |
| 303310 | 18.300 | 21.397 | 3.100 | 23.020 | 16.470 |
| Average | 18.640 | 0.000 | 2.757 | 21.074 | 15.554 |

| EXERCISE BALL SUBJECT 4 ACOUSTIC DATA | | | | | |
|---|---------------|-------------------|----------------------|--------------------|--------------------|
| Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions | | | | | |
| Session 1 | Baseline | | | Mic Cal | 83 |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 41101 | 37.062 | 44.901 | 7.839 | 592.140 | 2767.999 |
| 41102 | 32.192 | 42.291 | 10.099 | 598.707 | 3080.448 |
| 41103 | 33.717 | 42.231 | 8.514 | 596.488 | 2760.200 |
| 41104 | 33.351 | 42.479 | 9.128 | 599.416 | 2785.132 |
| 41105 | 33.853 | 42.392 | 8.539 | 600.396 | 2771.410 |
| 41106 | 33.807 | 43.516 | 9.709 | 590.629 | 2745.318 |
| 41107 | 36.314 | 43.875 | 7.561 | 595.186 | 2765.572 |
| 41108 | 34.457 | 43.147 | 8.690 | 597.677 | 2820.440 |
| 41109 | 35.157 | 42.790 | 7.633 | 599.373 | 2783.182 |
| 41110 | 32.999 | 41.947 | 8.948 | 597.148 | 3057.525 |
| Average | 34.291 | 42.957 | 8.666 | 596.716 | 2833.723 |
| Session 1 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 41201 | 35.267 | 44.713 | 9.446 | 592.140 | 2729.911 |
| 41202 | 35.266 | 44.638 | 9.372 | 599.774 | 2763.943 |
| 41203 | 35.554 | 44.253 | 8.699 | 589.749 | 2768.138 |
| 41204 | 36.566 | 44.369 | 7.803 | 587.952 | 2748.060 |
| 41205 | 33.464 | 42.592 | 9.128 | 590.228 | 2767.694 |
| 41206 | 32.827 | 43.220 | 10.393 | 598.485 | 2780.867 |
| 41207 | 33.693 | 44.250 | 10.557 | 599.678 | 2764.624 |
| 41208 | 34.103 | 42.903 | 8.800 | 598.858 | 2792.842 |
| 41209 | 36.120 | 45.654 | 9.534 | 598.226 | 2768.076 |
| 41210 | 35.408 | 44.512 | 9.104 | 598.426 | 2763.913 |
| Average | 34.827 | 44.110 | 9.284 | 595.352 | 2764.807 |
| Session 1 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 41301 | 33.955 | 43.576 | 9.621 | 598.832 | 2785.060 |
| 41302 | 37.080 | 44.535 | 7.455 | 600.090 | 2805.653 |
| 41303 | 34.295 | 43.365 | 9.070 | 599.338 | 2832.509 |
| 41304 | 33.376 | 43.417 | 10.041 | 598.286 | 2822.127 |
| 41305 | 32.504 | 41.461 | 8.957 | 599.548 | 2759.920 |
| 41306 | 33.644 | 44.269 | 10.625 | 597.550 | 2759.217 |
| 41307 | 37.475 | 45.631 | 8.156 | 595.764 | 2804.055 |
| 41308 | 35.761 | 45.104 | 9.343 | 596.600 | 2828.172 |
| 41309 | 35.301 | 43.985 | 8.684 | 596.140 | 2756.397 |
| 41310 | 34.571 | 43.589 | 9.018 | 599.201 | 2772.863 |
| Average | 34.796 | 43.893 | 9.097 | 598.135 | 2792.597 |

| EXERCISE BALL SUBJECT 4 ACOUSTIC DATA | | | | | |
|---|---------------|------------------|--------------------|-------------------|--------------------|
| Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases All Test Sessions | | | | | |
| Session 1 | Baseline | | | Mic Cal | 83 |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 41101 | 4.670 | 12.300 | 7.630 | 20.460 | 13.150 |
| 41102 | -0.740 | 6.340 | 7.080 | 15.960 | 9.450 |
| 41103 | 5.810 | 12.880 | 7.070 | 20.890 | 14.540 |
| 41104 | 6.800 | 12.750 | 5.950 | 22.010 | 14.820 |
| 41105 | 5.440 | 12.530 | 7.090 | 21.070 | 14.710 |
| 41106 | 6.290 | 13.050 | 6.760 | 21.450 | 14.870 |
| 41107 | 6.600 | 12.950 | 6.350 | 19.880 | 13.730 |
| 41108 | 6.410 | 12.560 | 6.150 | 20.510 | 14.000 |
| 41109 | 6.910 | 12.730 | 5.820 | 21.170 | 14.110 |
| 41110 | 6.400 | 12.990 | 6.590 | 20.780 | 15.120 |
| Average | 5.459 | 12.108 | 6.649 | 20.418 | 13.850 |
| Session 1 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 41201 | 7.170 | 13.280 | 6.110 | 19.740 | 13.690 |
| 41202 | 7.450 | 13.060 | 5.610 | 19.400 | 12.290 |
| 41203 | 6.660 | 12.690 | 6.030 | 18.740 | 12.750 |
| 41204 | 8.610 | 14.060 | 5.450 | 19.350 | 14.260 |
| 41205 | 6.970 | 12.990 | 6.020 | 19.430 | 13.500 |
| 41206 | 9.240 | 14.440 | 5.200 | 22.290 | 15.670 |
| 41207 | 7.910 | 13.610 | 5.700 | 21.950 | 15.090 |
| 41208 | 6.790 | 13.090 | 6.300 | 21.930 | 14.830 |
| 41209 | 8.430 | 13.830 | 5.400 | 21.310 | 15.300 |
| 41210 | 10.900 | 15.830 | 4.930 | 23.360 | 17.000 |
| Average | 8.013 | 13.688 | 5.675 | 20.750 | 14.438 |
| Session 1 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 41301 | 6.600 | 12.650 | 6.050 | 21.150 | 13.470 |
| 41302 | 6.300 | 12.620 | 6.320 | 20.660 | 13.310 |
| 41303 | 7.580 | 13.010 | 5.430 | 21.470 | 13.640 |
| 41304 | 7.930 | 13.120 | 5.190 | 21.020 | 14.120 |
| 41305 | 6.690 | 12.870 | 6.180 | 21.670 | 14.220 |
| 41306 | 8.890 | 14.790 | 5.900 | 20.340 | 18.430 |
| 41307 | 6.930 | 13.020 | 6.090 | 20.300 | 13.830 |
| 41308 | 7.600 | 13.160 | 5.560 | 20.340 | 14.090 |
| 41309 | 7.360 | 13.040 | 5.680 | 20.010 | 13.820 |
| 41310 | 6.350 | 12.900 | 6.550 | 19.010 | 13.790 |
| Average | 7.223 | 13.118 | 5.895 | 20.597 | 14.272 |

| EXERCISE BALL SUBJECT 4 ACOUSTIC DATA | | | | | |
|---|---------------|-------------------|----------------------|--------------------|--------------------|
| Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions | | | | | |
| Session 2 | Baseline | | | Mic Cal | 88 |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 42101 | 53.441 | 55.780 | 2.339 | 594.835 | 2999.539 |
| 42102 | 36.915 | 43.764 | 6.849 | 601.555 | 3050.925 |
| 42103 | 46.710 | 51.735 | 5.025 | 598.513 | 3050.372 |
| 42104 | 42.564 | 43.885 | 1.321 | 592.065 | 3052.729 |
| 42105 | 40.321 | 42.942 | 2.621 | 592.065 | 3017.099 |
| 42106 | 40.657 | 43.661 | 3.004 | 598.129 | 3046.403 |
| 42107 | 38.562 | 44.137 | 5.575 | 603.334 | 3102.925 |
| 42108 | 41.961 | 44.212 | 2.251 | 602.774 | 3070.114 |
| 42109 | 39.591 | 43.239 | 3.648 | 594.043 | 3042.492 |
| 42110 | 41.819 | 43.993 | 2.174 | 596.879 | 3040.720 |
| Average | 42.254 | 45.735 | 3.481 | 597.419 | 3047.332 |
| Session 2 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 42201 | 42.760 | 44.731 | 1.971 | 602.687 | 3023.195 |
| 42202 | 42.594 | 45.659 | 3.065 | 588.316 | 3018.688 |
| 42203 | 41.093 | 44.267 | 3.174 | 593.394 | 2942.348 |
| 42204 | 41.238 | 44.770 | 3.532 | 590.994 | 2989.389 |
| 42205 | 40.379 | 44.184 | 3.805 | 589.835 | 2742.268 |
| 42206 | 37.583 | 44.499 | 6.916 | 599.082 | 3035.143 |
| 42207 | 42.319 | 46.616 | 4.297 | 597.491 | 3041.487 |
| 42208 | 36.582 | 43.369 | 6.787 | 599.817 | 3041.684 |
| 42209 | 42.797 | 44.817 | 2.020 | 592.718 | 3058.170 |
| 42210 | 40.516 | 43.861 | 3.345 | 583.640 | 3042.778 |
| Average | 40.786 | 44.677 | 3.891 | 593.797 | 2993.515 |
| Session 2 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 42301 | 39.137 | 43.462 | 4.325 | 592.854 | 3015.045 |
| 42302 | 37.770 | 44.476 | 6.706 | 589.617 | 3007.723 |
| 42303 | 40.780 | 44.312 | 3.532 | 587.393 | 3026.944 |
| 42304 | 42.022 | 44.246 | 2.224 | 590.35 | 3028.544 |
| 42305 | 40.758 | 44.331 | 3.573 | 585.837 | 3008.891 |
| 42306 | 39.632 | 43.570 | 3.938 | 587.898 | 2763.054 |
| 42307 | 42.722 | 45.598 | 2.876 | 592.133 | 3030.567 |
| 42308 | 40.795 | 45.628 | 4.833 | 594.869 | 3046.925 |
| 42309 | 42.557 | 44.656 | 2.099 | 601.524 | 2050 |
| 42310 | 42.795 | 44.596 | 1.801 | 585.812 | 3000.502 |
| Average | 40.897 | 44.488 | 3.5907 | 590.8287 | 2897.82 |

| EXERCISE BALL SUBJECT 4 ACOUSTIC DATA | | | | | |
|--|---------------|------------------|--------------------|-------------------|--------------------|
| Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions | | | | | |
| Session 2 | Baseline | | | Mic Cal | 88 |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 42101 | 12.940 | 18.440 | 5.500 | 29.030 | 17.880 |
| 42102 | 5.630 | 12.360 | 6.730 | 18.550 | 12.310 |
| 42103 | 19.720 | 21.370 | 1.650 | 30.310 | 20.040 |
| 42104 | 3.790 | 11.560 | 7.770 | 18.940 | 11.230 |
| 42105 | 5.200 | 12.350 | 7.150 | 18.800 | 11.920 |
| 42106 | 5.510 | 12.900 | 7.390 | 19.870 | 12.500 |
| 42107 | 8.280 | 14.930 | 6.650 | 20.740 | 14.730 |
| 42108 | 6.110 | 13.190 | 7.080 | 20.420 | 13.480 |
| 42109 | 5.880 | 12.920 | 7.040 | 19.430 | 12.220 |
| 42110 | 6.070 | 13.620 | 7.550 | 18.270 | 12.430 |
| Average | 7.913 | 14.364 | 6.451 | 21.436 | 13.874 |
| Session 2 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 42201 | 4.640 | 12.820 | 8.180 | 18.030 | 13.280 |
| 42202 | 8.540 | 15.380 | 6.840 | 18.940 | 13.050 |
| 42203 | 7.290 | 14.090 | 6.800 | 18.280 | 12.010 |
| 42204 | 7.400 | 14.120 | 6.720 | 18.040 | 13.020 |
| 42205 | 7.610 | 13.990 | 6.380 | 18.550 | 12.040 |
| 42206 | 7.990 | 14.120 | 6.130 | 17.690 | 11.610 |
| 42207 | 8.660 | 15.510 | 6.850 | 20.540 | 14.580 |
| 42208 | 9.260 | 14.560 | 5.300 | 19.780 | 13.540 |
| 42209 | 6.570 | 13.560 | 6.990 | 18.950 | 13.360 |
| 42210 | 6.090 | 13.570 | 7.480 | 17.780 | 11.820 |
| Average | 7.405 | 14.172 | 6.767 | 18.658 | 12.831 |
| Session 2 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 42301 | 7.330 | 14.770 | 7.440 | 19.180 | 13.790 |
| 42302 | 5.250 | 12.710 | 7.460 | 16.910 | 12.520 |
| 42303 | 5.260 | 12.750 | 7.490 | 16.750 | 11.760 |
| 42304 | 5.020 | 12.650 | 7.630 | 16.820 | 12.360 |
| 42305 | 5.960 | 12.950 | 6.990 | 16.890 | 11.110 |
| 42306 | 6.260 | 13.640 | 7.380 | 17.510 | 12.430 |
| 42307 | 5.490 | 13.130 | 7.640 | 16.970 | 10.800 |
| 42308 | 7.160 | 14.030 | 6.870 | 19.090 | 12.860 |
| 42309 | 5.870 | 13.530 | 7.660 | 18.920 | 13.290 |
| 42310 | 6.590 | 13.740 | 7.150 | 18.550 | 13.770 |
| Average | 6.019 | 13.390 | 7.371 | 17.759 | 12.469 |

| EXERCISE BALL SUBJECT 4 ACOUSTIC DATA | | | | | |
|---|---------------|-------------------|----------------------|--------------------|--------------------|
| Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions | | | | | |
| Session 3 | Baseline | | | Mic Cal | 99 |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 43101 | 53.245 | 55.000 | 1.755 | 598.764 | 2794.403 |
| 43102 | 37.761 | 43.735 | 5.974 | 601.201 | 3023.203 |
| 43103 | 43.033 | 45.342 | 2.309 | 598.721 | 3000.833 |
| 43104 | 39.222 | 46.040 | 6.818 | 596.389 | 2868.854 |
| 43105 | 41.456 | 45.090 | 3.634 | 596.212 | 2980.531 |
| 43106 | 38.795 | 44.857 | 6.062 | 593.323 | 3003.952 |
| 43107 | 43.134 | 45.806 | 2.672 | 591.634 | 3013.398 |
| 43108 | 40.301 | 44.972 | 4.671 | 595.437 | 3033.591 |
| 43109 | 38.221 | 44.220 | 5.999 | 596.826 | 3013.295 |
| 43110 | 40.289 | 45.754 | 5.465 | 595.446 | 3032.147 |
| Average | 41.546 | 46.082 | 4.5359 | 596.395 | 2976.421 |
| Session 3 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 43201 | 40.108 | 43.826 | 3.718 | 587.872 | 2902.62 |
| 43202 | 39.783 | 44.265 | 4.482 | 592.049 | 3032.621 |
| 43203 | 40.101 | 44.411 | 4.31 | 590.397 | 3025.378 |
| 43204 | 39.730 | 44.660 | 4.93 | 592.918 | 3012.558 |
| 43205 | 40.528 | 45.258 | 4.73 | 592.286 | 3009.748 |
| 43206 | 40.344 | 44.510 | 4.166 | 589.388 | 3007.197 |
| 43207 | 39.343 | 45.313 | 5.97 | 594.284 | 2912.691 |
| 43208 | 39.292 | 45.543 | 6.251 | 598.716 | 2911.283 |
| 43209 | 37.862 | 44.514 | 6.652 | 594.731 | 2902.514 |
| 43210 | 37.702 | 43.774 | 6.072 | 595.081 | 2899.346 |
| Average | 39.479 | 44.607 | 5.1281 | 592.7722 | 2961.596 |
| Session 3 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 43301 | 41.488 | 44.013 | 2.525 | 589.27 | 2892.234 |
| 43302 | 37.258 | 43.665 | 6.407 | 593.188 | 2995.261 |
| 43303 | 38.321 | 44.099 | 5.778 | 595.096 | 2886.62 |
| 43304 | 37.673 | 44.060 | 6.387 | 592.483 | 2941.557 |
| 43305 | 39.839 | 45.424 | 5.585 | 593.94 | 3014.391 |
| 43306 | 38.664 | 45.705 | 7.041 | 598.902 | 3025.73 |
| 43307 | 38.222 | 44.492 | 6.27 | 580.637 | 3022.716 |
| 43308 | 40.153 | 43.991 | 3.838 | 582.465 | 2738.629 |
| 43309 | 37.924 | 43.196 | 5.272 | 583.63 | 2914.228 |
| 43310 | 39.108 | 44.096 | 4.988 | 582.819 | 2973.608 |
| Average | 38.865 | 44.274 | 5.4091 | 585.109 | 2625.198 |

| EXERCISE BALL SUBJECT 4 ACOUSTIC DATA | | | | | |
|--|---------------|------------------|--------------------|-------------------|--------------------|
| Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions | | | | | |
| Session 3 | Baseline | | | Mic Cal | 99 |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 43101 | 14.090 | 19.310 | 5.220 | 27.790 | 18.740 |
| 43102 | 8.400 | 14.960 | 6.560 | 20.810 | 14.550 |
| 43103 | 7.480 | 14.550 | 7.070 | 20.840 | 12.580 |
| 43104 | 7.780 | 14.510 | 6.730 | 21.780 | 13.420 |
| 43105 | 8.190 | 15.060 | 6.870 | 21.330 | 14.060 |
| 43106 | 7.700 | 13.990 | 6.290 | 20.240 | 11.980 |
| 43107 | 7.850 | 14.770 | 6.920 | 20.070 | 14.420 |
| 43108 | 8.770 | 15.060 | 6.290 | 20.370 | 14.330 |
| 43109 | 10.090 | 15.980 | 5.890 | 21.660 | 14.850 |
| 43110 | 10.020 | 16.160 | 6.140 | 21.530 | 14.030 |
| Average | 9.037 | 15.435 | 6.398 | 21.642 | 14.296 |
| Session 3 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 43201 | 7.490 | 13.870 | 6.380 | 19.740 | 12.140 |
| 43202 | 8.290 | 15.010 | 6.720 | 20.960 | 13.980 |
| 43203 | 6.850 | 13.840 | 6.990 | 19.800 | 13.080 |
| 43204 | 7.550 | 14.420 | 6.870 | 20.080 | 13.420 |
| 43205 | 7.350 | 13.990 | 6.640 | 19.700 | 12.010 |
| 43206 | 7.220 | 13.680 | 6.460 | 19.140 | 12.000 |
| 43207 | 8.750 | 15.120 | 6.370 | 19.570 | 14.010 |
| 43208 | 9.230 | 15.260 | 6.030 | 20.380 | 13.220 |
| 43209 | 8.940 | 15.180 | 6.240 | 21.110 | 14.360 |
| 43210 | 6.930 | 13.910 | 6.980 | 19.390 | 12.600 |
| Average | 7.860 | 14.428 | 6.568 | 19.987 | 13.082 |
| Session 3 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 43301 | 9.780 | 15.390 | 5.690 | 20.540 | 14.230 |
| 43302 | 9.450 | 15.060 | 5.940 | 17.970 | 15.420 |
| 43303 | 9.160 | 15.060 | 5.900 | 20.890 | 14.150 |
| 43304 | 8.740 | 15.840 | 6.320 | 21.220 | 14.330 |
| 43305 | 9.880 | 16.240 | 5.960 | 21.130 | 15.890 |
| 43306 | 10.360 | 15.430 | 5.880 | 22.900 | 16.260 |
| 43307 | 9.460 | 16.190 | 5.970 | 22.590 | 15.780 |
| 43308 | 9.470 | 14.900 | 6.720 | 18.820 | 13.670 |
| 43309 | 8.500 | 14.610 | 6.400 | 19.300 | 13.190 |
| 43310 | 8.450 | 15.419 | 6.160 | 19.270 | 14.160 |
| Average | 9.325 | 0.000 | 6.094 | 20.463 | 14.708 |

| EXERCISE BALL SUBJECT 5 ACOUSTIC DATA | | | | | |
|---|---------------|-------------------|----------------------|--------------------|--------------------|
| Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions | | | | | |
| Session 1 | Baseline | | | Mic Cal | 92 |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 51101 | 55.322 | 57.896 | 2.574 | 562.455 | 3034.560 |
| 51102 | 45.253 | 50.873 | 5.620 | 572.406 | 2007.202 |
| 51103 | 46.170 | 53.092 | 6.922 | 567.788 | 3001.800 |
| 51104 | 46.566 | 53.582 | 7.016 | 563.697 | 2908.847 |
| 51105 | 48.008 | 51.771 | 3.763 | 569.729 | 3079.426 |
| 51106 | 48.273 | 51.366 | 3.093 | 567.749 | 3081.924 |
| 51107 | 47.764 | 51.160 | 3.396 | 580.837 | 3093.648 |
| 51108 | 48.227 | 51.357 | 3.130 | 569.223 | 3087.370 |
| 51109 | 45.469 | 49.638 | 4.169 | 575.589 | 3063.005 |
| 51110 | 44.320 | 51.747 | 7.427 | 579.266 | 3093.412 |
| Average | 47.537 | 52.248 | 4.711 | 570.874 | 2945.119 |
| Session 1 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 51201 | 46.632 | 50.662 | 4.030 | 568.062 | 3676.460 |
| 51202 | 48.617 | 50.982 | 2.365 | 574.119 | 3098.876 |
| 51203 | 45.980 | 51.980 | 6.000 | 569.677 | 3030.037 |
| 51204 | 45.306 | 51.376 | 6.070 | 573.273 | 3226.797 |
| 51205 | 45.684 | 51.015 | 5.331 | 572.428 | 3313.944 |
| 51206 | 49.997 | 53.021 | 3.024 | 575.603 | 3159.177 |
| 51207 | 47.370 | 50.771 | 3.401 | 579.105 | 3078.468 |
| 51208 | 46.808 | 52.568 | 5.760 | 576.195 | 3013.094 |
| 51209 | 46.808 | 52.568 | 5.760 | 576.195 | 3013.094 |
| 51210 | 48.087 | 51.258 | 3.171 | 572.735 | 3098.755 |
| Average | 47.129 | 51.620 | 4.491 | 573.739 | 3170.870 |
| Session 1 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 51301 | 47.597 | 50.582 | 2.985 | 553.465 | 3251.513 |
| 51302 | 53.014 | 52.823 | -0.191 | 576.225 | 3080.211 |
| 51303 | 47.239 | 54.041 | 6.802 | 559.876 | 2888.325 |
| 51304 | 47.483 | 52.531 | 5.048 | 562.876 | 3492.170 |
| 51305 | 47.399 | 52.170 | 4.771 | 577.259 | 3046.373 |
| 51306 | 48.990 | 51.371 | 2.381 | 564.845 | 2897.675 |
| 51307 | 47.935 | 51.960 | 4.025 | 567.127 | 3086.948 |
| 51308 | 50.093 | 52.332 | 2.239 | 568.507 | 2962.207 |
| 51309 | 46.753 | 51.674 | 4.921 | 576.617 | 3363.388 |
| 51310 | 48.335 | 51.987 | 3.652 | 574.521 | 3089.181 |
| Average | 48.484 | 52.147 | 3.663 | 568.132 | 3115.799 |

| EXERCISE BALL SUBJECT 5 ACOUSTIC DATA | | | | | |
|---|---------------|------------------|--------------------|-------------------|--------------------|
| Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases All Test Sessions | | | | | |
| Session 1 | Baseline | | | Mic Cal | 92 |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 51101 | 23.000 | 18.470 | -4.530 | 21.090 | 15.410 |
| 51102 | 18.580 | 20.090 | 1.510 | 24.920 | 17.450 |
| 51103 | 16.740 | 20.100 | 3.360 | 24.010 | 16.290 |
| 51104 | 17.050 | 20.200 | 3.150 | 23.020 | 16.530 |
| 51105 | 19.550 | 18.760 | -0.790 | 23.430 | 16.170 |
| 51106 | 19.650 | 17.920 | -1.730 | 21.900 | 15.340 |
| 51107 | 20.850 | 18.820 | -2.030 | 27.280 | 17.520 |
| 51108 | 20.470 | 18.850 | -1.620 | 24.380 | 17.460 |
| 51109 | 19.430 | 18.700 | -0.730 | 25.410 | 16.840 |
| 51110 | 17.840 | 21.560 | 3.720 | 28.220 | 18.820 |
| Average | 19.316 | 19.347 | 0.031 | 24.366 | 16.783 |
| Session 1 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 51201 | 20.550 | 19.220 | -1.330 | 24.180 | 16.790 |
| 51202 | 20.790 | 18.190 | -2.600 | 24.570 | 16.270 |
| 51203 | 18.940 | 20.820 | 1.880 | 26.080 | 17.660 |
| 51204 | 20.310 | 21.100 | 0.790 | 27.510 | 18.650 |
| 51205 | 20.970 | 20.070 | -0.900 | 26.600 | 18.140 |
| 51206 | 19.850 | 17.660 | -2.190 | 25.020 | 14.460 |
| 51207 | 20.740 | 18.930 | -1.810 | 25.970 | 16.550 |
| 51208 | 18.070 | 20.250 | 2.180 | 26.610 | 17.130 |
| 51209 | 18.070 | 20.250 | 2.180 | 26.610 | 17.130 |
| 51210 | 20.410 | 18.660 | -1.750 | 24.930 | 16.410 |
| Average | 19.870 | 19.515 | -0.355 | 25.808 | 16.919 |
| Session 1 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 51301 | 20.210 | 18.370 | -1.840 | 17.980 | 15.950 |
| 51302 | 20.060 | 16.400 | -3.660 | 23.510 | 13.300 |
| 51303 | 17.530 | 20.920 | 3.390 | 23.410 | 17.390 |
| 51304 | 17.950 | 19.040 | 1.090 | 22.550 | 16.580 |
| 51305 | 19.870 | 19.400 | -0.470 | 26.930 | 18.270 |
| 51306 | 19.360 | 17.290 | -2.070 | 21.570 | 15.290 |
| 51307 | 19.730 | 18.510 | -1.220 | 23.330 | 17.010 |
| 51308 | 18.090 | 16.170 | -1.920 | 20.570 | 14.430 |
| 51309 | 20.480 | 19.290 | -1.190 | 25.980 | 18.370 |
| 51310 | 20.120 | 18.690 | -1.430 | 24.860 | 17.030 |
| Average | 19.340 | 18.408 | -0.932 | 23.069 | 16.362 |

EXERCISE BALL SUBJECT 5 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | Mic Cal | 100 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 52101 | 45.564 | 55.813 | 10.249 | 546.352 | 2014.550 |
| 52102 | 41.885 | 49.537 | 7.652 | 580.969 | 3253.262 |
| 52103 | 42.020 | 49.590 | 7.570 | 582.558 | 3016.168 |
| 52104 | 42.269 | 50.907 | 8.638 | 584.115 | 2999.041 |
| 52105 | 39.812 | 49.026 | 9.214 | 580.308 | 3381.551 |
| 52106 | 39.691 | 48.168 | 8.477 | 575.934 | 3169.263 |
| 52107 | 43.942 | 51.451 | 7.509 | 580.903 | 3059.640 |
| 52108 | 39.153 | 48.012 | 8.859 | 562.105 | 3353.861 |
| 52109 | 40.836 | 48.759 | 7.923 | 587.603 | 3043.448 |
| 52110 | 39.976 | 48.721 | 8.745 | 587.161 | 3277.291 |
| Average | 41.515 | 49.998 | 8.484 | 576.801 | 3056.807 |
| Session 2 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 52201 | 40.020 | 49.942 | 9.922 | 581.842 | 3424.366 |
| 52202 | 40.850 | 47.302 | 6.452 | 587.343 | 2316.275 |
| 52203 | 40.608 | 49.550 | 8.942 | 574.916 | 3340.849 |
| 52204 | 41.173 | 49.858 | 8.685 | 580.555 | 3325.562 |
| 52205 | 42.142 | 50.134 | 7.992 | 589.617 | 2302.028 |
| 52206 | 38.617 | 47.836 | 9.219 | 578.495 | 3295.099 |
| 52207 | 42.128 | 50.462 | 8.334 | 582.646 | 2319.532 |
| 52208 | 40.484 | 49.359 | 8.875 | 582.222 | 3319.508 |
| 52209 | 41.712 | 49.933 | 8.221 | 582.844 | 3266.842 |
| 52210 | 39.277 | 48.763 | 9.486 | 590.182 | 3382.488 |
| Average | 40.701 | 49.314 | 8.613 | 583.066 | 3029.255 |
| Session 2 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 52301 | 42.302 | 50.774 | 8.472 | 580.051 | 3098.087 |
| 52302 | 40.996 | 48.364 | 7.368 | 588.559 | 3245.874 |
| 52303 | 40.984 | 48.731 | 7.747 | 578.031 | 3098.199 |
| 52304 | 40.300 | 48.497 | 8.197 | 588.853 | 3086.555 |
| 52305 | 39.810 | 47.718 | 7.908 | 576.857 | 3089.197 |
| 52306 | 41.369 | 49.457 | 8.088 | 587.843 | 3084.067 |
| 52307 | 43.158 | 50.970 | 7.812 | 591.473 | 2344.332 |
| 52308 | 41.844 | 50.283 | 8.439 | 589.597 | 2317.781 |
| 52309 | 41.251 | 50.035 | 8.784 | 588.862 | 3093.913 |
| 52310 | 40.730 | 48.790 | 8.06 | 586.84 | 3221.541 |
| Average | 41.274 | 49.362 | 8.0875 | 585.6966 | 2967.954 |

EXERCISE BALL SUBJECT 5 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | Mic Cal | 100 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 52101 | 24.040 | 26.900 | 2.860 | 32.090 | 26.100 |
| 52102 | 19.030 | 21.100 | 2.070 | 29.300 | 23.740 |
| 52103 | 18.000 | 21.130 | 3.130 | 28.140 | 21.060 |
| 52104 | 19.640 | 22.190 | 2.550 | 30.690 | 24.420 |
| 52105 | 19.040 | 21.900 | 2.860 | 29.040 | 23.340 |
| 52106 | 19.680 | 22.410 | 2.730 | 28.130 | 23.810 |
| 52107 | 18.740 | 21.430 | 2.690 | 29.040 | 25.110 |
| 52108 | 17.760 | 20.500 | 2.740 | 23.250 | 22.250 |
| 52109 | 18.170 | 21.860 | 3.690 | 29.620 | 24.270 |
| 52110 | 19.780 | 22.460 | 2.680 | 31.000 | 26.110 |
| Average | 19.388 | 22.188 | 2.800 | 29.030 | 24.021 |
| Session 2 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 52201 | 22.310 | 25.110 | 2.800 | 31.010 | 25.670 |
| 52202 | 20.190 | 21.280 | 1.090 | 29.510 | 23.500 |
| 52203 | 21.510 | 24.100 | 2.590 | 29.290 | 24.410 |
| 52204 | 20.350 | 23.150 | 2.800 | 29.720 | 23.910 |
| 52205 | 18.940 | 22.690 | 3.750 | 30.420 | 23.110 |
| 52206 | 22.060 | 24.110 | 2.050 | 28.750 | 24.680 |
| 52207 | 18.520 | 22.490 | 3.970 | 28.440 | 22.450 |
| 52208 | 22.440 | 24.770 | 2.330 | 31.380 | 24.950 |
| 52209 | 20.200 | 22.740 | 2.540 | 30.140 | 25.330 |
| 52210 | 21.240 | 23.630 | 2.390 | 32.080 | 25.110 |
| Average | 20.776 | 23.407 | 2.631 | 30.074 | 24.312 |
| Session 2 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 52301 | 19.470 | 22.680 | 3.210 | 29.970 | 25.040 |
| 52302 | 21.300 | 23.180 | 1.880 | 30.890 | 26.350 |
| 52303 | 19.420 | 22.030 | 2.610 | 28.450 | 24.160 |
| 52304 | 20.390 | 23.250 | 2.860 | 31.150 | 25.990 |
| 52305 | 19.340 | 21.900 | 2.560 | 27.710 | 23.590 |
| 52306 | 20.840 | 23.460 | 2.620 | 31.350 | 25.370 |
| 52307 | 19.610 | 22.820 | 3.210 | 32.490 | 26.050 |
| 52308 | 20.730 | 23.780 | 3.050 | 31.890 | 27.180 |
| 52309 | 20.000 | 22.870 | 2.870 | 31.580 | 25.640 |
| 52310 | 20.380 | 23.230 | 2.850 | 30.900 | 26.920 |
| Average | 20.148 | 22.920 | 2.772 | 30.638 | 25.629 |

EXERCISE BALL SUBJECT 5 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | Mic Cal | 93 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 53101 | 48.435 | 59.406 | 10.971 | 574.717 | 2017.164 |
| 53102 | 39.318 | 47.326 | 8.008 | 585.972 | 3445.778 |
| 53103 | 41.562 | 50.333 | 8.771 | 561.931 | 3371.175 |
| 53104 | 39.450 | 49.576 | 10.126 | 585.751 | 3519.963 |
| 53105 | 40.584 | 50.265 | 9.681 | 584.006 | 3457.851 |
| 53106 | 39.145 | 47.897 | 8.752 | 598.697 | 3152.162 |
| 53107 | 38.156 | 49.215 | 11.059 | 553.734 | 3878.519 |
| 53108 | 42.339 | 50.145 | 7.806 | 586.562 | 2028.919 |
| 53109 | 38.899 | 48.618 | 9.719 | 579.170 | 3483.661 |
| 53110 | 40.163 | 48.216 | 8.053 | 592.162 | 2068.742 |
| Average | 40.805 | 50.100 | 9.2946 | 580.270 | 3042.393 |
| Session 3 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 53201 | 38.800 | 50.400 | 11.6 | 583.516 | 3886.126 |
| 53202 | 39.784 | 49.669 | 9.885 | 578.997 | 3513.52 |
| 53203 | 38.234 | 48.667 | 10.433 | 573.654 | 3812.278 |
| 53204 | 39.031 | 48.921 | 9.89 | 569.21 | 3181.319 |
| 53205 | 41.615 | 51.048 | 9.433 | 583.745 | 3409.997 |
| 53206 | 41.733 | 50.807 | 9.074 | 579.982 | 3530.273 |
| 53207 | 41.240 | 51.086 | 9.846 | 574.735 | 3525.358 |
| 53208 | 41.131 | 50.968 | 9.837 | 584.337 | 3512.874 |
| 53209 | 42.891 | 51.546 | 8.655 | 589.154 | 2225.211 |
| 53210 | 39.930 | 51.016 | 11.086 | 574.782 | 3883.913 |
| Average | 40.439 | 50.413 | 9.9739 | 579.2112 | 3448.087 |
| Session 3 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 53301 | 40.790 | 49.739 | 8.949 | 563.672 | 3452.304 |
| 53302 | 41.053 | 49.643 | 8.59 | 569.577 | 3169.51 |
| 53303 | 40.455 | 48.368 | 7.913 | 577.274 | 2212.421 |
| 53304 | 39.158 | 49.631 | 10.473 | 583.15 | 3082.698 |
| 53305 | 39.980 | 49.580 | 9.6 | 584.402 | 3160.123 |
| 53306 | 38.962 | 49.139 | 10.177 | 582.609 | 3535.55 |
| 53307 | 39.586 | 49.386 | 9.8 | 584.396 | 3538.45 |
| 53308 | 41.694 | 50.138 | 8.444 | 576.862 | 3435.514 |
| 53309 | 41.635 | 50.271 | 8.636 | 572.686 | 3438.475 |
| 53310 | 40.611 | 50.016 | 9.405 | 587.662 | 3446.461 |
| Average | 40.392 | 49.591 | 9.1987 | 585.109 | 2625.198 |

EXERCISE BALL SUBJECT 5 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | Mic Cal | 93 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 53101 | 23.150 | 24.510 | 1.360 | 32.780 | 24.760 |
| 53102 | 22.650 | 22.860 | 0.210 | 31.460 | 23.310 |
| 53103 | 20.280 | 21.930 | 1.650 | 25.720 | 21.330 |
| 53104 | 21.150 | 23.160 | 2.010 | 32.480 | 24.040 |
| 53105 | 22.140 | 23.960 | 1.820 | 32.690 | 25.100 |
| 53106 | 21.850 | 23.620 | 1.770 | 34.310 | 24.600 |
| 53107 | 21.930 | 23.820 | 1.890 | 24.250 | 22.590 |
| 53108 | 21.590 | 24.520 | 2.930 | 31.960 | 23.610 |
| 53109 | 22.620 | 24.400 | 1.780 | 31.240 | 24.810 |
| 53110 | 21.160 | 24.450 | 3.290 | 32.510 | 23.550 |
| Average | 21.852 | 23.723 | 1.871 | 30.940 | 23.770 |
| Session 3 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 53201 | 24.400 | 26.350 | 1.950 | 33.850 | 26.350 |
| 53202 | 22.360 | 24.110 | 1.750 | 31.690 | 24.630 |
| 53203 | 22.910 | 24.400 | 1.490 | 29.770 | 24.360 |
| 53204 | 23.110 | 25.420 | 2.310 | 31.770 | 24.900 |
| 53205 | 24.060 | 26.010 | 1.950 | 33.310 | 26.000 |
| 53206 | 23.660 | 24.960 | 1.300 | 31.830 | 24.390 |
| 53207 | 22.810 | 24.840 | 2.030 | 31.660 | 24.960 |
| 53208 | 22.260 | 24.900 | 2.640 | 33.500 | 25.550 |
| 53209 | 21.540 | 25.420 | 3.880 | 34.660 | 24.820 |
| 53210 | 24.200 | 25.510 | 1.310 | 31.700 | 24.640 |
| Average | 23.131 | 25.192 | 2.061 | 32.374 | 25.060 |
| Session 3 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 53301 | 21.930 | 22.430 | 1.640 | 27.860 | 23.750 |
| 53302 | 20.630 | 23.300 | 1.800 | 28.890 | 23.030 |
| 53303 | 22.570 | 25.410 | 0.730 | 30.470 | 24.690 |
| 53304 | 20.740 | 24.270 | 4.670 | 34.830 | 26.760 |
| 53305 | 22.020 | 24.660 | 2.250 | 32.860 | 25.550 |
| 53306 | 22.190 | 24.200 | 2.470 | 32.370 | 25.820 |
| 53307 | 22.220 | 23.940 | 1.980 | 32.410 | 25.260 |
| 53308 | 22.590 | 24.050 | 1.350 | 30.730 | 24.810 |
| 53309 | 22.510 | 24.630 | 1.540 | 30.360 | 24.750 |
| 53310 | 22.130 | 24.046 | 2.500 | 34.390 | 26.290 |
| Average | 21.953 | 0.000 | 2.093 | 31.517 | 25.071 |

EXERCISE BALL SUBJECT 6 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 1 | Baseline | | | Mic Cal | 80 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 61101 | 47.304 | 58.633 | 11.329 | 592.766 | 2994.127 |
| 61102 | 42.968 | 59.688 | 16.720 | 597.448 | 3022.417 |
| 61103 | 41.644 | 59.173 | 17.529 | 599.050 | 3099.670 |
| 61104 | 44.761 | 56.263 | 11.502 | 594.896 | 2998.306 |
| 61105 | 43.615 | 55.679 | 12.064 | 594.436 | 2985.132 |
| 61106 | 47.401 | 58.751 | 11.350 | 592.612 | 2995.213 |
| 61107 | 42.481 | 57.155 | 14.674 | 596.274 | 3010.234 |
| 61108 | 40.481 | 57.381 | 16.900 | 597.577 | 3037.296 |
| 61109 | 40.627 | 58.703 | 18.076 | 597.707 | 3039.558 |
| 61110 | 43.114 | 58.482 | 15.368 | 594.637 | 3018.913 |
| Average | 43.440 | 57.991 | 14.551 | 595.740 | 3020.087 |
| Session 1 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 61201 | 42.946 | 57.365 | 14.419 | 598.349 | 2899.194 |
| 61202 | 37.156 | 56.005 | 18.849 | 598.162 | 3003.364 |
| 61203 | 44.059 | 55.348 | 11.289 | 596.121 | 3099.705 |
| 61204 | 45.235 | 55.232 | 9.997 | 599.965 | 3074.803 |
| 61205 | 39.501 | 56.281 | 16.780 | 596.730 | 2918.705 |
| 61206 | 41.545 | 52.559 | 11.014 | 599.313 | 2956.793 |
| 61207 | 42.742 | 54.720 | 11.978 | 599.175 | 3022.040 |
| 61208 | 34.033 | 55.704 | 21.671 | 598.066 | 3050.987 |
| 61209 | 37.932 | 56.691 | 18.759 | 596.649 | 2929.726 |
| 61210 | 42.229 | 57.062 | 14.833 | 596.931 | 2919.724 |
| Average | 40.738 | 55.697 | 14.959 | 597.946 | 2987.504 |
| Session 1 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 61301 | 39.350 | 58.876 | 19.526 | 599.836 | 3085.743 |
| 61302 | 42.904 | 59.687 | 16.783 | 597.788 | 3024.677 |
| 61303 | 41.570 | 59.171 | 17.601 | 599.317 | 3098.063 |
| 61304 | 44.683 | 56.263 | 11.580 | 595.131 | 2991.751 |
| 61305 | 43.522 | 55.680 | 12.158 | 594.822 | 2966.583 |
| 61306 | 47.182 | 58.750 | 11.568 | 592.777 | 2993.480 |
| 61307 | 42.085 | 57.155 | 15.070 | 596.021 | 3011.517 |
| 61308 | 40.444 | 57.381 | 16.937 | 598.219 | 3040.873 |
| 61309 | 40.565 | 58.703 | 18.138 | 598.223 | 3038.071 |
| 61310 | 43.080 | 58.481 | 15.401 | 594.909 | 3017.320 |
| Average | 42.539 | 58.015 | 15.476 | 596.704 | 3026.808 |

EXERCISE BALL SUBJECT 6 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 1 | Baseline | | | Mic Cal | 80 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 61101 | 20.570 | 24.580 | 4.010 | 37.010 | 30.650 |
| 61102 | 24.060 | 24.220 | 0.160 | 39.970 | 32.550 |
| 61103 | 22.880 | 24.830 | 1.950 | 40.710 | 31.610 |
| 61104 | 18.780 | 21.390 | 2.610 | 35.860 | 28.340 |
| 61105 | 20.460 | 21.570 | 1.110 | 35.540 | 29.080 |
| 61106 | 22.660 | 22.990 | 0.330 | 37.010 | 30.700 |
| 61107 | 22.910 | 23.520 | 0.610 | 37.750 | 32.990 |
| 61108 | 22.290 | 22.860 | 0.570 | 39.350 | 30.480 |
| 61109 | 22.720 | 23.090 | 0.370 | 38.630 | 29.740 |
| 61110 | 21.680 | 22.190 | 0.510 | 37.760 | 30.800 |
| Average | 21.901 | 23.124 | 1.223 | 37.959 | 30.694 |
| Session 1 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 61201 | 21.000 | 26.690 | 5.690 | 38.920 | 33.390 |
| 61202 | 19.130 | 24.930 | 5.800 | 38.040 | 30.940 |
| 61203 | 20.230 | 24.440 | 4.210 | 36.230 | 29.630 |
| 61204 | 22.360 | 25.780 | 3.420 | 37.440 | 30.230 |
| 61205 | 19.800 | 25.130 | 5.330 | 36.920 | 30.770 |
| 61206 | 18.880 | 24.040 | 5.160 | 35.900 | 30.520 |
| 61207 | 20.410 | 23.990 | 3.580 | 36.180 | 29.350 |
| 61208 | 19.810 | 26.120 | 6.310 | 37.710 | 34.690 |
| 61209 | 20.000 | 26.730 | 6.730 | 39.700 | 33.930 |
| 61210 | 19.830 | 26.010 | 6.180 | 38.200 | 31.710 |
| Average | 20.145 | 25.386 | 5.241 | 37.524 | 31.516 |
| Session 1 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 61301 | 20.730 | 28.040 | 7.310 | 40.940 | 33.590 |
| 61302 | 20.520 | 25.950 | 5.430 | 40.060 | 32.630 |
| 61303 | 20.480 | 26.050 | 5.570 | 40.770 | 31.670 |
| 61304 | 20.080 | 23.380 | 3.300 | 36.020 | 28.390 |
| 61305 | 18.520 | 23.410 | 4.890 | 35.610 | 29.310 |
| 61306 | 19.920 | 24.760 | 4.840 | 37.130 | 30.780 |
| 61307 | 18.220 | 25.570 | 7.350 | 38.040 | 33.230 |
| 61308 | 20.330 | 25.070 | 4.740 | 39.440 | 30.520 |
| 61309 | 18.770 | 24.800 | 6.030 | 38.700 | 29.940 |
| 61310 | 20.270 | 24.490 | 4.220 | 37.910 | 30.850 |
| Average | 19.784 | 25.152 | 5.368 | 38.462 | 31.091 |

EXERCISE BALL SUBJECT 6 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | Mic Cal | 71 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 62101 | 44.060 | 46.079 | 2.019 | 595.019 | 2957.832 |
| 62102 | 42.380 | 45.720 | 3.340 | 598.565 | 3012.587 |
| 62103 | 42.581 | 46.921 | 4.340 | 594.520 | 3013.362 |
| 62104 | 40.533 | 46.426 | 5.893 | 597.008 | 3050.000 |
| 62105 | 37.615 | 46.060 | 8.445 | 596.432 | 3024.346 |
| 62106 | 40.795 | 45.251 | 4.456 | 598.893 | 3024.943 |
| 62107 | 43.178 | 43.630 | 0.452 | 598.523 | 3037.665 |
| 62108 | 37.698 | 44.961 | 7.263 | 597.614 | 3034.813 |
| 62109 | 37.900 | 47.325 | 9.425 | 597.629 | 3005.380 |
| 62110 | 37.581 | 46.877 | 9.296 | 596.989 | 3020.738 |
| Average | 40.432 | 45.925 | 5.493 | 597.119 | 3018.167 |
| Session 2 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 62201 | 35.733 | 46.992 | 11.259 | 597.057 | 3068.323 |
| 62202 | 33.391 | 49.212 | 15.821 | 597.591 | 3037.736 |
| 62203 | 32.645 | 47.019 | 14.374 | 597.738 | 3059.133 |
| 62204 | 34.761 | 47.523 | 12.762 | 595.766 | 3008.825 |
| 62205 | 35.194 | 48.349 | 13.155 | 596.313 | 3004.185 |
| 62206 | 34.280 | 49.398 | 15.118 | 596.500 | 3021.357 |
| 62207 | 31.160 | 49.408 | 18.248 | 597.503 | 3054.262 |
| 62208 | 34.220 | 47.915 | 13.695 | 597.997 | 3027.859 |
| 62209 | 35.923 | 50.588 | 14.665 | 597.224 | 3033.011 |
| 62210 | 34.808 | 49.518 | 14.710 | 595.936 | 3018.207 |
| Average | 34.212 | 48.592 | 14.381 | 596.963 | 3033.290 |
| Session 2 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 62301 | 40.333 | 50.526 | 10.193 | 590.537 | 2976.561 |
| 62302 | 35.213 | 49.763 | 14.55 | 597.392 | 3020.185 |
| 62303 | 39.878 | 50.286 | 10.408 | 594.996 | 2990.072 |
| 62304 | 35.842 | 49.181 | 13.339 | 598.595 | 3041.808 |
| 62305 | 38.368 | 50.012 | 11.644 | 593.478 | 3005.248 |
| 62306 | 41.385 | 50.278 | 8.893 | 596.669 | 3017.035 |
| 62307 | 40.373 | 50.909 | 10.536 | 597.084 | 3015.968 |
| 62308 | 36.430 | 48.981 | 12.551 | 596.868 | 3018.309 |
| 62309 | 34.307 | 48.655 | 14.348 | 599.032 | 3055.642 |
| 62310 | 32.281 | 50.937 | 18.656 | 599.46 | 3037.629 |
| Average | 37.441 | 49.953 | 12.5118 | 596.4111 | 3017.846 |

EXERCISE BALL SUBJECT 6 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | Mic Cal | 71 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 62101 | 20.760 | 13.630 | -7.130 | 28.220 | 22.730 |
| 62102 | 21.940 | 12.120 | -9.820 | 26.740 | 21.250 |
| 62103 | 22.290 | 15.460 | -6.830 | 27.440 | 26.190 |
| 62104 | 20.640 | 14.750 | -5.890 | 29.070 | 23.800 |
| 62105 | 19.570 | 11.530 | -8.040 | 25.760 | 19.640 |
| 62106 | 20.920 | 11.620 | -9.300 | 27.470 | 20.150 |
| 62107 | 21.510 | 12.020 | -9.490 | 27.830 | 22.130 |
| 62108 | 20.810 | 12.970 | -7.840 | 28.120 | 22.580 |
| 62109 | 21.320 | 13.910 | -7.410 | 29.440 | 23.150 |
| 62110 | 22.690 | 14.000 | -8.690 | 29.460 | 23.860 |
| Average | 21.245 | 13.201 | -8.044 | 27.955 | 22.548 |
| Session 2 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 62201 | 21.320 | 14.920 | -6.400 | 28.510 | 22.130 |
| 62202 | 18.830 | 14.750 | -4.080 | 29.510 | 22.390 |
| 62203 | 20.840 | 14.520 | -6.320 | 28.360 | 25.620 |
| 62204 | 21.550 | 14.360 | -7.190 | 28.700 | 24.270 |
| 62205 | 22.070 | 14.570 | -7.500 | 29.150 | 24.430 |
| 62206 | 20.960 | 15.510 | -5.450 | 29.760 | 25.540 |
| 62207 | 19.210 | 15.190 | -4.020 | 31.350 | 23.430 |
| 62208 | 20.340 | 14.410 | -5.930 | 29.400 | 23.840 |
| 62209 | 20.590 | 15.930 | -4.660 | 30.740 | 25.130 |
| 62210 | 19.870 | 15.350 | -4.520 | 29.170 | 26.740 |
| Average | 20.558 | 14.951 | -5.607 | 29.465 | 24.352 |
| Session 2 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 62301 | 18.340 | 16.080 | -2.260 | 26.950 | 25.440 |
| 62302 | 18.220 | 16.700 | -1.520 | 30.530 | 26.070 |
| 62303 | 20.690 | 17.720 | -2.970 | 27.970 | 27.060 |
| 62304 | 20.530 | 15.950 | -4.580 | 29.110 | 22.540 |
| 62305 | 18.820 | 15.760 | -3.060 | 28.510 | 27.510 |
| 62306 | 18.900 | 15.650 | -3.250 | 29.580 | 27.150 |
| 62307 | 18.070 | 14.430 | -3.640 | 29.600 | 23.610 |
| 62308 | 17.540 | 14.320 | -3.220 | 28.380 | 22.910 |
| 62309 | 17.360 | 14.770 | -2.590 | 30.420 | 24.020 |
| 62310 | 18.390 | 17.040 | -1.350 | 31.690 | 23.420 |
| Average | 18.686 | 15.842 | -2.844 | 29.274 | 24.973 |

EXERCISE BALL SUBJECT 6 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | Mic Cal | 78 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 63101 | 42.264 | 47.089 | 4.825 | 593.278 | 3004.992 |
| 63102 | 43.212 | 51.157 | 7.945 | 596.046 | 3018.312 |
| 63103 | 41.549 | 51.948 | 10.399 | 597.913 | 3029.329 |
| 63104 | 40.708 | 49.787 | 9.079 | 598.287 | 3020.220 |
| 63105 | 39.879 | 50.246 | 10.367 | 597.023 | 3015.531 |
| 63106 | 44.727 | 51.771 | 7.044 | 595.318 | 3034.631 |
| 63107 | 39.433 | 51.942 | 12.509 | 595.163 | 2987.054 |
| 63108 | 40.035 | 51.490 | 11.455 | 596.669 | 3007.195 |
| 63109 | 43.005 | 50.995 | 7.99 | 593.844 | 2985.694 |
| 63110 | 43.787 | 49.367 | 5.58 | 598.810 | 3018.106 |
| Average | 41.860 | 50.579 | 8.7193 | 596.235 | 3012.106 |
| Session 3 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 63201 | 35.234 | 51.859 | 16.625 | 594.009 | 3009.073 |
| 63202 | 35.348 | 52.432 | 17.084 | 597.773 | 3033.494 |
| 63203 | 38.269 | 52.196 | 13.927 | 600.8 | 3080.393 |
| 63204 | 34.762 | 50.378 | 15.616 | 599.113 | 3074.376 |
| 63205 | 34.119 | 50.980 | 16.861 | 597.904 | 3032.04 |
| 63206 | 39.024 | 51.389 | 12.365 | 597.286 | 3023.965 |
| 63207 | 32.460 | 52.146 | 19.686 | 597.741 | 3016.166 |
| 63208 | 41.186 | 53.741 | 12.555 | 594.171 | 2986.83 |
| 63209 | 39.639 | 51.053 | 11.414 | 598.912 | 3060.87 |
| 63210 | 35.323 | 53.870 | 18.547 | 596.25 | 3055.062 |
| Average | 36.536 | 52.004 | 15.468 | 597.3959 | 3037.227 |
| Session 3 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 63301 | 41.337 | 54.145 | 12.808 | 593.459 | 3000.363 |
| 63302 | 40.269 | 52.270 | 12.001 | 595.48 | 3024.906 |
| 63303 | 41.537 | 53.866 | 12.329 | 600.715 | 3058.987 |
| 63304 | 40.819 | 52.500 | 11.681 | 597.156 | 3019.638 |
| 63305 | 39.608 | 52.278 | 12.67 | 597.387 | 3038.883 |
| 63306 | 41.285 | 51.248 | 9.963 | 595.217 | 3004.622 |
| 63307 | 39.292 | 51.976 | 12.684 | 595.516 | 3016.842 |
| 63308 | 36.621 | 52.194 | 15.573 | 598.645 | 3021.778 |
| 63309 | 36.065 | 51.625 | 15.56 | 597.858 | 3015.657 |
| 63310 | 37.612 | 52.843 | 15.231 | 597.238 | 3016.689 |
| Average | 39.445 | 52.495 | 13.05 | 585.109 | 2625.198 |

EXERCISE BALL SUBJECT 6 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | Mic Cal | 78 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 63101 | 19.930 | 14.170 | -5.760 | 26.120 | 24.100 |
| 63102 | 19.400 | 14.310 | -5.090 | 29.180 | 21.860 |
| 63103 | 19.670 | 15.800 | -3.870 | 32.010 | 25.730 |
| 63104 | 19.240 | 14.250 | -4.990 | 29.520 | 23.620 |
| 63105 | 20.260 | 15.220 | -5.040 | 31.720 | 24.940 |
| 63106 | 19.560 | 15.080 | -4.480 | 30.240 | 25.300 |
| 63107 | 20.320 | 16.180 | -4.140 | 31.570 | 26.070 |
| 63108 | 21.230 | 16.300 | -4.930 | 31.930 | 25.460 |
| 63109 | 19.580 | 13.490 | -6.090 | 28.570 | 23.000 |
| 63110 | 20.210 | 13.970 | -6.240 | 29.850 | 23.030 |
| Average | 19.940 | 14.877 | -5.063 | 30.071 | 24.311 |
| Session 3 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 63201 | 21.080 | 18.420 | -2.660 | 32.010 | 29.390 |
| 63202 | 18.000 | 15.700 | -2.300 | 31.500 | 24.190 |
| 63203 | 19.810 | 15.920 | -3.890 | 32.860 | 24.030 |
| 63204 | 18.330 | 14.120 | -4.210 | 31.050 | 23.050 |
| 63205 | 17.810 | 13.670 | -4.140 | 31.310 | 21.860 |
| 63206 | 19.090 | 16.380 | -2.710 | 29.890 | 23.730 |
| 63207 | 19.770 | 17.130 | -2.640 | 32.380 | 23.850 |
| 63208 | 19.650 | 16.390 | -3.260 | 31.990 | 26.030 |
| 63209 | 19.620 | 16.290 | -3.330 | 32.600 | 24.120 |
| 63210 | 19.550 | 17.770 | -1.780 | 32.400 | 27.800 |
| Average | 19.271 | 16.179 | -3.092 | 31.799 | 24.805 |
| Session 3 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 63301 | 17.400 | 18.850 | 3.410 | 32.580 | 28.370 |
| 63302 | 14.390 | 20.700 | 4.460 | 31.310 | 24.110 |
| 63303 | 16.500 | 18.770 | 4.200 | 34.780 | 24.820 |
| 63304 | 15.600 | 18.670 | 3.170 | 32.490 | 23.310 |
| 63305 | 13.440 | 18.650 | 5.230 | 31.250 | 23.510 |
| 63306 | 16.910 | 20.320 | 1.740 | 30.940 | 23.220 |
| 63307 | 17.660 | 19.300 | 2.660 | 31.570 | 25.760 |
| 63308 | 16.640 | 18.510 | 2.660 | 32.580 | 24.930 |
| 63309 | 14.630 | 18.830 | 3.880 | 31.210 | 23.850 |
| 63310 | 14.360 | 19.341 | 4.470 | 32.700 | 23.750 |
| Average | 15.753 | 0.000 | 3.588 | 32.141 | 24.563 |

EXERCISE BALL SUBJECT 7 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 1 | Baseline | | | Mic Cal | 69 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 71101 | 44.964 | 50.273 | 5.309 | 584.409 | 2384.665 |
| 71102 | 41.185 | 49.774 | 8.589 | 583.877 | 2363.353 |
| 71103 | 43.525 | 48.672 | 5.147 | 580.912 | 2648.397 |
| 71104 | 43.894 | 48.844 | 4.950 | 586.543 | 2658.479 |
| 71105 | 46.442 | 50.079 | 3.637 | 572.507 | 2639.222 |
| 71106 | 44.188 | 50.558 | 6.370 | 571.438 | 2634.651 |
| 71107 | 34.694 | 50.781 | 16.087 | 573.382 | 2624.621 |
| 71108 | 46.364 | 50.783 | 4.419 | 573.563 | 2638.209 |
| 71109 | 46.880 | 51.042 | 4.162 | 567.977 | 2632.747 |
| 71110 | 49.516 | 51.187 | 1.671 | 573.980 | 2364.495 |
| Average | 44.165 | 50.199 | 6.034 | 576.859 | 2558.884 |
| Session 1 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 71201 | 46.897 | 50.284 | 3.387 | 582.148 | 3833.066 |
| 71202 | 42.950 | 51.262 | 8.312 | 585.769 | 2654.442 |
| 71203 | 47.636 | 51.287 | 3.651 | 564.862 | 2039.351 |
| 71204 | 43.049 | 50.076 | 7.027 | 578.509 | 2356.594 |
| 71205 | 47.088 | 52.204 | 5.116 | 580.523 | 2369.038 |
| 71206 | 46.322 | 50.932 | 4.610 | 573.952 | 2355.095 |
| 71207 | 48.064 | 50.752 | 2.688 | 580.337 | 2357.185 |
| 71208 | 39.243 | 51.522 | 12.279 | 573.246 | 2646.563 |
| 71209 | 39.015 | 50.592 | 11.577 | 579.371 | 2653.707 |
| 71210 | 44.089 | 50.319 | 6.230 | 578.513 | 2648.829 |
| Average | 44.435 | 50.923 | 6.488 | 577.723 | 2591.387 |
| Session 1 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 71301 | 40.989 | 50.608 | 9.619 | 569.319 | 2642.722 |
| 71302 | 42.712 | 50.337 | 7.625 | 580.644 | 2363.549 |
| 71303 | 38.901 | 50.542 | 11.641 | 582.388 | 2647.188 |
| 71304 | 43.337 | 50.302 | 6.965 | 583.112 | 2371.212 |
| 71305 | 43.368 | 50.065 | 6.697 | 589.875 | 2392.388 |
| 71306 | 42.690 | 51.343 | 8.653 | 576.711 | 2650.902 |
| 71307 | 40.624 | 51.319 | 10.695 | 589.630 | 2661.699 |
| 71308 | 38.082 | 50.543 | 12.461 | 566.644 | 2640.980 |
| 71309 | 41.089 | 51.396 | 10.307 | 577.398 | 2647.054 |
| 71310 | 40.331 | 50.193 | 9.862 | 582.195 | 2647.753 |
| Average | 41.212 | 50.665 | 9.453 | 579.792 | 2566.545 |

EXERCISE BALL SUBJECT 7 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 1 | Baseline | | | Mic Cal | 69 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 71101 | 13.390 | 21.960 | 8.570 | 30.320 | 24.120 |
| 71102 | 10.860 | 19.450 | 8.590 | 24.140 | 21.370 |
| 71103 | 10.390 | 19.600 | 9.210 | 24.630 | 20.800 |
| 71104 | 11.720 | 21.390 | 9.670 | 27.210 | 23.970 |
| 71105 | 8.810 | 18.680 | 9.870 | 22.920 | 18.780 |
| 71106 | 10.920 | 17.550 | 6.630 | 21.160 | 15.840 |
| 71107 | 16.030 | 19.030 | 3.000 | 22.370 | 18.370 |
| 71108 | 11.320 | 18.110 | 6.790 | 21.220 | 16.600 |
| 71109 | 11.240 | 18.080 | 6.840 | 20.260 | 16.670 |
| 71110 | 8.140 | 17.820 | 9.680 | 21.490 | 17.460 |
| Average | 11.282 | 19.167 | 7.885 | 23.572 | 19.398 |
| Session 1 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 71201 | 15.680 | 21.650 | 5.970 | 27.910 | 23.580 |
| 71202 | 16.350 | 21.430 | 5.080 | 27.750 | 24.490 |
| 71203 | 12.710 | 19.600 | 6.890 | 22.330 | 18.950 |
| 71204 | 10.890 | 20.140 | 9.250 | 24.460 | 21.370 |
| 71205 | 11.870 | 19.840 | 7.970 | 25.610 | 21.090 |
| 71206 | 11.470 | 18.680 | 7.210 | 22.380 | 18.790 |
| 71207 | 12.830 | 19.900 | 7.070 | 25.010 | 21.580 |
| 71208 | 17.440 | 20.730 | 3.290 | 25.130 | 21.840 |
| 71209 | 15.150 | 20.510 | 5.360 | 25.630 | 22.270 |
| 71210 | 12.650 | 19.940 | 7.290 | 24.650 | 21.090 |
| Average | 13.704 | 20.242 | 6.538 | 25.086 | 21.505 |
| Session 1 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 71301 | 11.920 | 19.520 | 7.600 | 24.040 | 18.970 |
| 71302 | 13.160 | 20.300 | 7.140 | 25.750 | 22.270 |
| 71303 | 16.100 | 22.730 | 6.630 | 30.160 | 24.600 |
| 71304 | 13.530 | 21.020 | 7.490 | 27.900 | 23.240 |
| 71305 | 15.650 | 22.480 | 6.830 | 29.210 | 24.960 |
| 71306 | 10.020 | 18.490 | 8.470 | 24.480 | 18.330 |
| 71307 | 17.300 | 22.460 | 5.160 | 30.520 | 25.420 |
| 71308 | 11.000 | 18.250 | 7.250 | 20.740 | 18.020 |
| 71309 | 12.940 | 19.930 | 6.990 | 23.710 | 20.560 |
| 71310 | 26.260 | 20.200 | -6.060 | 25.120 | 21.540 |
| Average | 14.788 | 20.538 | 5.750 | 26.163 | 21.791 |

EXERCISE BALL SUBJECT 7 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | Mic Cal | 89 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 72101 | 40.457 | 49.185 | 8.728 | 575.568 | 3597.253 |
| 72102 | 38.865 | 46.792 | 7.927 | 565.787 | 3533.744 |
| 72103 | 43.265 | 50.648 | 7.383 | 578.770 | 3862.900 |
| 72104 | 40.764 | 50.141 | 9.377 | 571.884 | 3853.225 |
| 72105 | 39.674 | 49.880 | 10.206 | 574.115 | 3854.911 |
| 72106 | 41.727 | 49.391 | 7.664 | 570.250 | 3519.412 |
| 72107 | 44.255 | 50.052 | 5.797 | 569.705 | 3819.199 |
| 72108 | 39.927 | 47.388 | 7.461 | 569.815 | 3561.309 |
| 72109 | 39.393 | 46.748 | 7.355 | 569.361 | 2652.656 |
| 72110 | 36.267 | 45.602 | 9.335 | 564.815 | 3533.123 |
| Average | 40.459 | 48.583 | 8.123 | 571.007 | 3578.773 |
| Session 2 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 72201 | 37.426 | 46.886 | 9.460 | 568.223 | 3751.547 |
| 72202 | 33.622 | 48.037 | 14.415 | 556.542 | 2633.943 |
| 72203 | 40.529 | 47.425 | 6.896 | 585.846 | 3669.763 |
| 72204 | 39.983 | 47.984 | 8.001 | 574.722 | 3548.484 |
| 72205 | 39.739 | 47.208 | 7.469 | 569.758 | 2653.463 |
| 72206 | 39.077 | 47.846 | 8.769 | 578.098 | 3547.500 |
| 72207 | 36.730 | 47.719 | 10.989 | 575.120 | 2649.989 |
| 72208 | 32.932 | 48.428 | 15.496 | 577.042 | 2653.577 |
| 72209 | 32.744 | 47.549 | 14.805 | 568.365 | 2645.952 |
| 72210 | 31.323 | 48.135 | 16.812 | 575.915 | 2659.752 |
| Average | 36.411 | 47.722 | 11.311 | 592.640 | 2934.121 |
| Session 2 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 72301 | 43.058 | 51.898 | 8.84 | 582.914 | 3527.223 |
| 72302 | 42.336 | 51.110 | 8.774 | 564.471 | 2630.926 |
| 72303 | 41.863 | 51.076 | 9.213 | 576.036 | 3575.73 |
| 72304 | 40.813 | 51.591 | 10.778 | 567.231 | 2650.16 |
| 72305 | 38.965 | 50.701 | 11.736 | 583.096 | 2648.139 |
| 72306 | 43.045 | 51.522 | 8.477 | 579.638 | 2655.121 |
| 72307 | 43.624 | 50.895 | 7.271 | 577.37 | 3808.605 |
| 72308 | 43.128 | 50.871 | 7.743 | 570.299 | 2653.661 |
| 72309 | 43.448 | 51.712 | 8.264 | 575.473 | 3514.933 |
| 72310 | 42.908 | 51.389 | 8.481 | 582.793 | 2652.634 |
| Average | 42.319 | 51.277 | 8.9577 | 575.9321 | 3031.713 |

EXERCISE BALL SUBJECT 7 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | Mic Cal | 89 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 72101 | 19.230 | 21.810 | 2.580 | 26.440 | 20.850 |
| 72102 | 14.050 | 18.450 | 4.400 | 20.010 | 14.260 |
| 72103 | 16.640 | 22.080 | 5.440 | 25.950 | 19.870 |
| 72104 | 17.690 | 22.160 | 4.470 | 23.030 | 17.810 |
| 72105 | 17.180 | 23.960 | 6.780 | 25.350 | 20.220 |
| 72106 | 17.210 | 19.860 | 2.650 | 22.190 | 16.470 |
| 72107 | 16.150 | 19.230 | 3.080 | 23.010 | 16.240 |
| 72108 | 17.490 | 18.670 | 1.180 | 21.320 | 14.470 |
| 72109 | 16.710 | 18.170 | 1.460 | 20.420 | 14.380 |
| 72110 | 15.520 | 19.300 | 3.780 | 20.080 | 16.140 |
| Average | 16.787 | 20.369 | 3.582 | 22.780 | 17.071 |
| Session 2 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 72201 | 16.230 | 20.380 | 4.150 | 22.250 | 18.130 |
| 72202 | 13.130 | 17.790 | 4.660 | 15.710 | 13.910 |
| 72203 | 18.730 | 20.820 | 2.090 | 27.160 | 20.410 |
| 72204 | 15.870 | 20.550 | 4.680 | 23.690 | 17.190 |
| 72205 | 17.420 | 19.140 | 1.720 | 21.980 | 16.150 |
| 72206 | 16.450 | 19.890 | 3.440 | 23.190 | 17.600 |
| 72207 | 17.180 | 19.470 | 2.290 | 22.050 | 17.900 |
| 72208 | 16.300 | 20.520 | 4.220 | 23.060 | 18.210 |
| 72209 | 14.060 | 20.130 | 6.070 | 19.850 | 17.330 |
| 72210 | 15.670 | 20.160 | 4.490 | 21.930 | 18.410 |
| Average | 16.104 | 19.885 | 3.781 | 22.087 | 17.524 |
| Session 2 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 72301 | 18.460 | 22.710 | 4.250 | 27.440 | 21.220 |
| 72302 | 16.640 | 22.310 | 5.670 | 26.470 | 19.920 |
| 72303 | 18.860 | 22.420 | 3.560 | 26.040 | 21.450 |
| 72304 | 17.180 | 22.830 | 5.650 | 25.860 | 20.060 |
| 72305 | 19.620 | 24.560 | 4.940 | 28.680 | 24.450 |
| 72306 | 19.220 | 23.030 | 3.810 | 26.850 | 21.490 |
| 72307 | 19.590 | 22.880 | 3.290 | 26.510 | 21.780 |
| 72308 | 16.980 | 22.120 | 5.140 | 23.620 | 19.970 |
| 72309 | 19.080 | 23.020 | 3.940 | 27.460 | 22.200 |
| 72310 | 20.360 | 23.110 | 2.750 | 28.900 | 22.550 |
| Average | 18.599 | 22.899 | 4.300 | 26.783 | 21.509 |

EXERCISE BALL SUBJECT 7 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | Mic Cal | 86 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 73101 | 45.481 | 53.452 | 7.971 | 582.249 | 2640.758 |
| 73102 | 48.866 | 55.766 | 6.9 | 573.582 | 2357.849 |
| 73103 | 47.087 | 53.578 | 6.491 | 572.748 | 2618.590 |
| 73104 | 42.939 | 53.327 | 10.388 | 576.027 | 2641.960 |
| 73105 | 46.137 | 52.976 | 6.839 | 576.929 | 2638.548 |
| 73106 | 44.521 | 53.880 | 9.359 | 575.779 | 2645.212 |
| 73107 | 44.655 | 53.798 | 9.143 | 576.136 | 2644.667 |
| 73108 | 47.325 | 53.776 | 6.451 | 577.979 | 2363.136 |
| 73109 | 46.787 | 55.756 | 8.969 | 575.584 | 2646.342 |
| 73110 | 48.141 | 55.894 | 7.753 | 572.363 | 2357.098 |
| Average | 46.194 | 54.220 | 8.0264 | 575.938 | 2555.416 |
| Session 3 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 73201 | 47.696 | 55.161 | 7.465 | 572.948 | 2639.199 |
| 73202 | 45.345 | 55.717 | 10.372 | 573.762 | 2638.391 |
| 73203 | 44.270 | 53.560 | 9.29 | 575.927 | 2643.992 |
| 73204 | 47.463 | 53.981 | 6.518 | 575.549 | 2645.581 |
| 73205 | 46.394 | 53.821 | 7.427 | 269.488 | 2638.33 |
| 73206 | 49.121 | 56.245 | 7.124 | 578.649 | 2649.687 |
| 73207 | 47.538 | 55.306 | 7.768 | 570.821 | 2356.519 |
| 73208 | 45.808 | 54.692 | 8.884 | 574.312 | 2357.244 |
| 73209 | 46.802 | 54.398 | 7.596 | 568.349 | 2639.753 |
| 73210 | 43.752 | 54.225 | 10.473 | 568.039 | 2634.654 |
| Average | 46.419 | 54.711 | 8.2917 | 542.7844 | 2584.335 |
| Session 3 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 73301 | 43.515 | 55.991 | 12.476 | 561.13 | 2623.08 |
| 73302 | 41.607 | 55.145 | 13.538 | 571.019 | 2646.165 |
| 73303 | 43.322 | 54.618 | 11.296 | 260.439 | 2607.13 |
| 73304 | 43.040 | 54.498 | 11.458 | 257.703 | 2618.983 |
| 73305 | 44.930 | 54.276 | 9.346 | 574.365 | 2628.545 |
| 73306 | 42.039 | 54.175 | 12.136 | 265.142 | 2644.365 |
| 73307 | 45.926 | 54.058 | 8.132 | 570.097 | 2634.186 |
| 73308 | 44.167 | 53.975 | 9.808 | 574.972 | 2624.23 |
| 73309 | 47.147 | 54.291 | 7.144 | 263.957 | 2637.314 |
| 73310 | 44.774 | 55.305 | 10.531 | 573.399 | 2645.479 |
| Average | 44.047 | 54.633 | 10.5865 | 585.109 | 2625.198 |

EXERCISE BALL SUBJECT 7 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | Mic Cal | 86 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 73101 | 16.120 | 21.940 | 5.820 | 27.790 | 23.090 |
| 73102 | 19.320 | 21.620 | 2.300 | 27.450 | 20.040 |
| 73103 | 15.870 | 20.420 | 4.550 | 25.210 | 20.660 |
| 73104 | 16.440 | 20.960 | 4.520 | 26.240 | 21.660 |
| 73105 | 15.860 | 20.900 | 5.040 | 26.530 | 21.450 |
| 73106 | 17.050 | 21.430 | 4.380 | 27.110 | 22.000 |
| 73107 | 15.970 | 20.880 | 4.910 | 26.120 | 21.250 |
| 73108 | 15.330 | 20.840 | 5.510 | 26.450 | 20.950 |
| 73109 | 20.520 | 22.260 | 1.740 | 27.690 | 21.240 |
| 73110 | 17.840 | 21.190 | 3.350 | 26.410 | 19.080 |
| Average | 17.032 | 21.244 | 4.212 | 26.700 | 21.142 |
| Session 3 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 73201 | 19.700 | 23.580 | 3.880 | 28.630 | 24.180 |
| 73202 | 21.520 | 22.840 | 1.320 | 28.550 | 22.350 |
| 73203 | 16.130 | 21.480 | 5.350 | 27.170 | 22.530 |
| 73204 | 16.070 | 21.390 | 5.320 | 26.520 | 22.520 |
| 73205 | 15.020 | 19.820 | 4.800 | 23.790 | 18.530 |
| 73206 | 19.000 | 22.130 | 3.130 | 28.790 | 21.480 |
| 73207 | 17.720 | 20.970 | 3.250 | 26.600 | 19.140 |
| 73208 | 19.940 | 22.710 | 2.770 | 29.870 | 22.400 |
| 73209 | 19.760 | 21.680 | 1.920 | 26.480 | 19.810 |
| 73210 | 19.240 | 20.800 | 1.560 | 25.630 | 19.800 |
| Average | 18.410 | 21.740 | 3.330 | 27.203 | 21.274 |
| Session 3 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 73301 | 21.740 | 21.310 | 1.090 | 26.230 | 21.680 |
| 73302 | 20.940 | 21.290 | 0.370 | 26.680 | 20.080 |
| 73303 | 18.490 | 20.070 | 2.800 | 25.660 | 19.380 |
| 73304 | 17.290 | 20.480 | 2.780 | 21.080 | 17.880 |
| 73305 | 16.630 | 20.460 | 3.850 | 25.290 | 19.550 |
| 73306 | 15.470 | 20.450 | 4.990 | 23.520 | 19.370 |
| 73307 | 16.690 | 22.060 | 3.760 | 26.630 | 19.140 |
| 73308 | 17.980 | 19.170 | 4.080 | 28.340 | 22.050 |
| 73309 | 14.340 | 21.130 | 4.830 | 23.160 | 17.000 |
| 73310 | 20.030 | 20.925 | 1.100 | 27.220 | 20.320 |
| Average | 17.960 | 0.000 | 2.965 | 25.381 | 19.645 |

EXERCISE BALL SUBJECT 8 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 1 | Baseline | | | Mic Cal | 81 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 81101 | 41.163 | 57.017 | 15.853 | 1150.473 | 2778.591 |
| 81102 | 36.565 | 58.148 | 21.582 | 1154.035 | 2774.565 |
| 81103 | 36.382 | 58.388 | 22.006 | 1158.049 | 2792.135 |
| 81104 | 37.194 | 55.271 | 18.077 | 1170.538 | 2822.015 |
| 81105 | 36.704 | 55.205 | 18.501 | 1152.461 | 2768.739 |
| 81106 | 33.410 | 57.236 | 23.826 | 1140.276 | 2782.270 |
| 81107 | 37.246 | 55.890 | 18.644 | 1143.490 | 2804.919 |
| 81108 | 38.569 | 57.342 | 18.773 | 1155.239 | 2783.577 |
| 81109 | 39.479 | 57.336 | 17.858 | 1150.264 | 2816.730 |
| 81110 | 35.214 | 57.464 | 22.249 | 1142.958 | 2774.769 |
| Average | 37.193 | 56.930 | 19.737 | 1151.778 | 2789.831 |
| Session 1 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 81201 | 35.008 | 59.463 | 24.455 | 1150.078 | 2785.647 |
| 81202 | 30.389 | 59.892 | 29.503 | 590.035 | 2781.749 |
| 81203 | 30.234 | 58.984 | 28.749 | 1151.502 | 2797.488 |
| 81204 | 33.284 | 58.955 | 25.671 | 1155.170 | 2834.378 |
| 81205 | 28.948 | 58.222 | 29.274 | 1142.231 | 2790.829 |
| 81206 | 28.950 | 58.222 | 29.272 | 1142.225 | 2790.822 |
| 81207 | 30.126 | 59.107 | 28.981 | 588.776 | 2780.143 |
| 81208 | 32.546 | 59.499 | 26.953 | 1134.711 | 2766.981 |
| 81209 | 33.571 | 57.248 | 23.677 | 1151.453 | 2788.217 |
| 81210 | 30.352 | 59.628 | 29.275 | 590.920 | 2827.747 |
| Average | 31.341 | 58.922 | 27.581 | 979.710 | 2794.400 |
| Session 1 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 81301 | 32.567 | 59.227 | 26.660 | 1130.314 | 2778.472 |
| 81302 | 33.919 | 60.390 | 26.471 | 588.943 | 2774.907 |
| 81303 | 36.925 | 60.083 | 23.159 | 591.609 | 2780.000 |
| 81304 | 36.681 | 62.390 | 25.708 | 594.464 | 2835.560 |
| 81305 | 34.579 | 57.014 | 22.435 | 589.022 | 2760.178 |
| 81306 | 35.164 | 58.818 | 23.654 | 581.273 | 2801.683 |
| 81307 | 34.944 | 58.475 | 23.530 | 588.218 | 2791.072 |
| 81308 | 38.989 | 58.769 | 19.781 | 587.770 | 2829.411 |
| 81309 | 42.833 | 58.859 | 16.027 | 590.535 | 2806.328 |
| 81310 | 39.978 | 57.437 | 17.459 | 584.646 | 2840.537 |
| Average | 36.658 | 59.146 | 22.488 | 642.679 | 2799.815 |

EXERCISE BALL SUBJECT 8 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 1 | Baseline | | | Mic Cal | 81 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 81101 | 11.508 | 18.228 | 6.720 | 24.845 | 33.136 |
| 81102 | 13.649 | 18.724 | 5.075 | 25.994 | 33.976 |
| 81103 | 11.970 | 19.466 | 7.496 | 27.377 | 34.242 |
| 81104 | 15.475 | 18.055 | 2.580 | 25.904 | 32.170 |
| 81105 | 17.165 | 17.387 | 0.221 | 24.901 | 32.127 |
| 81106 | 12.453 | 17.922 | 5.469 | 23.748 | 32.755 |
| 81107 | 13.443 | 18.110 | 4.668 | 23.926 | 32.375 |
| 81108 | 14.469 | 18.437 | 3.968 | 25.002 | 32.512 |
| 81109 | 16.144 | 17.866 | 1.722 | 24.194 | 32.165 |
| 81110 | 15.018 | 22.347 | 7.329 | 26.255 | 38.320 |
| Average | 14.129 | 18.654 | 4.525 | 25.215 | 33.378 |
| Session 1 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 81201 | 12.886 | 22.096 | 9.209 | 30.764 | 38.320 |
| 81202 | 8.491 | 23.137 | 14.645 | 30.907 | 39.818 |
| 81203 | 9.601 | 23.945 | 14.344 | 30.663 | 42.199 |
| 81204 | 11.726 | 21.479 | 9.753 | 29.491 | 36.563 |
| 81205 | 9.770 | 25.786 | 16.016 | 30.449 | 39.767 |
| 81206 | 7.392 | 22.706 | 15.314 | 29.215 | 39.719 |
| 81207 | 7.888 | 20.707 | 12.818 | 29.381 | 36.301 |
| 81208 | 12.189 | 24.589 | 12.400 | 28.700 | 39.843 |
| 81209 | 14.412 | 22.987 | 8.575 | 29.542 | 39.837 |
| 81210 | 9.026 | 23.452 | 14.426 | 30.963 | 39.048 |
| Average | 10.338 | 23.088 | 12.750 | 30.007 | 39.142 |
| Session 1 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 81301 | 6.972 | 19.362 | 12.391 | 24.505 | 33.691 |
| 81302 | 9.080 | 21.418 | 12.338 | 30.094 | 36.283 |
| 81303 | 13.596 | 21.450 | 7.853 | 30.052 | 38.335 |
| 81304 | 10.977 | 21.846 | 10.869 | 31.944 | 37.799 |
| 81305 | 1.090 | 15.272 | 14.181 | 28.153 | 14.304 |
| 81306 | 9.872 | 19.559 | 9.687 | 26.728 | 33.718 |
| 81307 | 12.316 | 19.132 | 6.815 | 28.005 | 34.252 |
| 81308 | 16.049 | 19.179 | 3.130 | 28.623 | 34.345 |
| 81309 | 18.111 | 18.705 | 0.594 | 28.287 | 33.766 |
| 81310 | 15.168 | 18.759 | 3.591 | 26.698 | 32.521 |
| Average | 11.323 | 19.468 | 8.145 | 28.309 | 32.901 |

EXERCISE BALL SUBJECT 8 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | Mic Cal | 72 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 82101 | 31.925 | 53.579 | 21.653 | 592.323 | 2802.821 |
| 82102 | 36.831 | 53.232 | 16.401 | 594.505 | 2817.886 |
| 82103 | 38.282 | 55.358 | 17.076 | 599.165 | 2830.533 |
| 82104 | 33.239 | 55.300 | 22.061 | 597.508 | 2784.578 |
| 82105 | 31.716 | 53.983 | 22.267 | 594.745 | 2771.824 |
| 82106 | 43.164 | 62.670 | 19.506 | 586.705 | 2749.897 |
| 82107 | 30.617 | 54.553 | 23.936 | 586.606 | 2780.068 |
| 82108 | 31.880 | 55.322 | 23.442 | 586.710 | 2781.987 |
| 82109 | 31.511 | 55.501 | 23.990 | 1149.152 | 2768.368 |
| 82110 | 32.019 | 54.644 | 22.625 | 591.201 | 2771.365 |
| Average | 34.118 | 55.414 | 21.296 | 647.862 | 2785.932 |
| Session 2 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 82201 | 34.105 | 55.816 | 21.711 | 595.593 | 2798.311 |
| 82202 | 36.291 | 56.525 | 20.234 | 1166.651 | 2792.324 |
| 82203 | 37.506 | 55.111 | 17.604 | 1188.940 | 2838.634 |
| 82204 | 35.555 | 56.139 | 20.583 | 598.123 | 2814.266 |
| 82205 | 35.053 | 55.184 | 20.131 | 596.535 | 2833.516 |
| 82206 | 32.889 | 55.561 | 22.672 | 594.163 | 2794.251 |
| 82207 | 28.522 | 56.254 | 27.732 | 590.803 | 2849.024 |
| 82208 | 32.424 | 57.448 | 25.025 | 594.400 | 2842.908 |
| 82209 | 28.291 | 55.819 | 27.528 | 1142.837 | 2890.853 |
| 82210 | 45.281 | 57.488 | 12.207 | 591.465 | 2793.164 |
| Average | 34.592 | 56.134 | 21.543 | 765.951 | 2824.725 |
| Session 2 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 82301 | 29.202 | 57.602 | 28.3998 | 586.561 | 2772.647 |
| 82302 | 30.248 | 55.288 | 25.04063 | 586.2218 | 2820.944 |
| 82303 | 32.738 | 57.779 | 25.04063 | 594.637 | 2830.316 |
| 82304 | 29.689 | 56.938 | 27.24958 | 587.3027 | 2747.862 |
| 82305 | 30.145 | 56.501 | 26.35624 | 590.91 | 2772.427 |
| 82306 | 32.426 | 55.820 | 23.3936 | 591.606 | 2788.025 |
| 82307 | 30.761 | 55.359 | 24.59827 | 594.103 | 2784.791 |
| 82308 | 31.118 | 54.694 | 23.57629 | 591.2809 | 2828.117 |
| 82309 | 31.359 | 55.382 | 24.02333 | 1159.264 | 2780.08 |
| 82310 | 32.118 | 56.234 | 24.11525 | 585.3629 | 2779.47 |
| Average | 30.980 | 56.160 | 25.17936 | 646.7249 | 2790.468 |

EXERCISE BALL SUBJECT 8 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | Mic Cal | 72 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 82101 | 9.552 | 18.068 | 8.515 | 26.286 | 33.315 |
| 82102 | 13.680 | 15.840 | 2.160 | 26.450 | 29.990 |
| 82103 | 13.320 | 15.430 | 2.110 | 29.200 | 31.870 |
| 82104 | 7.780 | 15.830 | 8.050 | 29.290 | 32.930 |
| 82105 | 8.980 | 16.200 | 7.220 | 27.500 | 31.600 |
| 82106 | 18.400 | 20.470 | 2.070 | 26.220 | 24.370 |
| 82107 | 8.200 | 15.820 | 7.620 | 25.540 | 32.000 |
| 82108 | 6.810 | 15.960 | 9.150 | 25.750 | 31.420 |
| 82109 | 7.640 | 15.360 | 7.720 | 25.860 | 31.870 |
| 82110 | 10.020 | 16.560 | 6.540 | 25.710 | 31.880 |
| Average | 10.438 | 16.554 | 6.116 | 26.781 | 31.125 |
| Session 2 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 82201 | 8.210 | 18.770 | 10.560 | 29.030 | 34.890 |
| 82202 | 9.292 | 20.105 | 10.814 | 30.444 | 35.306 |
| 82203 | 10.267 | 18.083 | 7.816 | 29.630 | 33.728 |
| 82204 | 10.578 | 20.225 | 9.647 | 29.478 | 39.622 |
| 82205 | 10.597 | 19.702 | 9.105 | 29.478 | 36.309 |
| 82206 | 9.552 | 20.325 | 10.773 | 29.406 | 35.718 |
| 82207 | 3.996 | 19.118 | 15.123 | 27.911 | 37.017 |
| 82208 | 6.322 | 19.320 | 12.998 | 29.963 | 37.112 |
| 82209 | 3.251 | 19.128 | 15.878 | 27.103 | 36.361 |
| 82210 | 19.930 | 17.690 | -2.240 | 27.000 | 21.050 |
| Average | 9.199 | 19.247 | 10.047 | 28.944 | 34.711 |
| Session 2 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 82301 | 5.471 | 17.504 | 12.034 | 27.370 | 34.279 |
| 82302 | 8.501 | 15.161 | 6.660 | 24.484 | 30.710 |
| 82303 | 10.040 | 16.615 | 6.575 | 28.812 | 32.976 |
| 82304 | 7.808 | 17.792 | 9.984 | 27.697 | 35.824 |
| 82305 | 9.311 | 16.745 | 7.434 | 26.731 | 33.440 |
| 82306 | 9.840 | 15.689 | 5.849 | 25.770 | 33.048 |
| 82307 | 10.230 | 15.947 | 5.717 | 26.429 | 31.884 |
| 82308 | 8.278 | 15.807 | 7.529 | 25.194 | 31.944 |
| 82309 | 10.386 | 15.257 | 4.871 | 24.661 | 31.350 |
| 82310 | 8.630 | 15.590 | 6.960 | 24.309 | 31.434 |
| Average | 8.850 | 16.211 | 7.361 | 26.146 | 32.689 |

EXERCISE BALL SUBJECT 8 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | Mic Cal | 65 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 83101 | 36.981 | 55.161 | 18.18 | 1137.887 | 2763.687 |
| 83102 | 39.720 | 54.443 | 14.723 | 1116.404 | 2751.342 |
| 83103 | 33.008 | 55.206 | 22.198 | 1127.129 | 2774.915 |
| 83104 | 32.643 | 55.322 | 22.679 | 1143.918 | 2773.713 |
| 83105 | 32.201 | 54.633 | 22.432 | 1138.302 | 2744.149 |
| 83106 | 29.521 | 55.644 | 26.123 | 1137.087 | 2767.031 |
| 83107 | 28.496 | 54.264 | 25.768 | 1143.660 | 2770.025 |
| 83108 | 30.129 | 55.063 | 24.934 | 1152.192 | 2823.424 |
| 83109 | 34.974 | 56.676 | 21.702 | 1147.710 | 2774.611 |
| 83110 | 31.163 | 56.870 | 25.707 | 590.931 | 2775.544 |
| Average | 32.884 | 55.328 | 22.4446 | 1083.522 | 2771.844 |
| Session 3 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 83201 | 30.678 | 54.510 | 23.832 | 1160.665 | 2788.973 |
| 83202 | 31.924 | 53.393 | 21.469 | 1132.174 | 2859.474 |
| 83203 | 30.174 | 54.710 | 24.536 | 1139.341 | 2822.089 |
| 83204 | 37.599 | 57.269 | 19.67 | 1167.87 | 2794.945 |
| 83205 | 35.023 | 55.931 | 20.908 | 1131.665 | 2849.702 |
| 83206 | 29.521 | 55.644 | 26.123 | 1137.087 | 2767.031 |
| 83207 | 30.092 | 57.247 | 27.155 | 1140.227 | 2840.608 |
| 83208 | 28.431 | 56.221 | 27.79 | 1126.239 | 2843.749 |
| 83209 | 27.381 | 56.811 | 29.43 | 1133.562 | 2873.116 |
| 83210 | 24.970 | 57.321 | 32.351 | 1147.732 | 2859.473 |
| Average | 30.579 | 55.906 | 25.3264 | 1141.656 | 2829.916 |
| Session 3 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 83301 | 30.946 | 56.705 | 25.759 | 1137.402 | 2786.034 |
| 83302 | 28.931 | 55.991 | 27.06 | 1146.739 | 2785.765 |
| 83303 | 30.395 | 56.441 | 26.046 | 1163.844 | 2804.096 |
| 83304 | 29.135 | 56.581 | 27.446 | 1159.855 | 2832.234 |
| 83305 | 33.888 | 57.354 | 23.466 | 1152.717 | 2836.613 |
| 83306 | 31.448 | 56.477 | 25.029 | 1153.923 | 2827.661 |
| 83307 | 29.138 | 56.957 | 27.819 | 1142.915 | 2788.584 |
| 83308 | 30.666 | 54.509 | 23.843 | 1160.66 | 2788.485 |
| 83309 | 30.174 | 54.710 | 24.536 | 1139.341 | 2822.089 |
| 83310 | 30.179 | 56.289 | 26.11 | 1149.762 | 2802.635 |
| Average | 30.490 | 56.201 | 25.7114 | 585.109 | 2625.198 |

EXERCISE BALL SUBJECT 8 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | Mic Cal | 65 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 83101 | 11.900 | 16.870 | 4.970 | 24.990 | 32.810 |
| 83102 | 13.510 | 17.920 | 4.410 | 24.970 | 32.900 |
| 83103 | 10.120 | 17.160 | 7.040 | 24.820 | 32.820 |
| 83104 | 9.970 | 17.640 | 7.670 | 26.040 | 33.450 |
| 83105 | 9.830 | 16.720 | 6.890 | 24.700 | 32.100 |
| 83106 | 9.650 | 16.250 | 6.600 | 24.270 | 33.020 |
| 83107 | 8.520 | 16.460 | 7.940 | 26.460 | 32.360 |
| 83108 | 11.090 | 16.870 | 5.780 | 26.800 | 31.550 |
| 83109 | 13.740 | 18.370 | 4.630 | 26.860 | 33.420 |
| 83110 | 8.280 | 17.310 | 9.030 | 26.680 | 32.900 |
| Average | 10.661 | 17.157 | 6.496 | 25.659 | 32.733 |
| Session 3 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 83201 | 11.990 | 17.170 | 5.180 | 25.620 | 31.120 |
| 83202 | 11.120 | 20.590 | 9.470 | 25.070 | 32.220 |
| 83203 | 9.990 | 21.980 | 11.990 | 26.750 | 33.780 |
| 83204 | 14.040 | 22.390 | 8.350 | 29.490 | 35.150 |
| 83205 | 12.770 | 22.550 | 9.780 | 25.200 | 34.400 |
| 83206 | 9.650 | 16.250 | 6.600 | 24.270 | 33.020 |
| 83207 | 10.990 | 23.800 | 12.810 | 29.740 | 36.280 |
| 83208 | 9.160 | 22.180 | 13.020 | 26.570 | 33.940 |
| 83209 | 8.780 | 23.400 | 14.620 | 28.470 | 38.740 |
| 83210 | 7.430 | 22.520 | 15.090 | 28.850 | 35.260 |
| Average | 10.592 | 21.283 | 10.691 | 27.003 | 34.391 |
| Session 3 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 83301 | 10.680 | 22.510 | 11.230 | 27.970 | 34.470 |
| 83302 | 12.010 | 21.230 | 10.500 | 29.070 | 34.610 |
| 83303 | 11.450 | 22.150 | 9.780 | 30.240 | 33.080 |
| 83304 | 11.860 | 22.180 | 10.290 | 29.110 | 33.890 |
| 83305 | 13.720 | 22.350 | 8.460 | 28.640 | 33.840 |
| 83306 | 11.760 | 22.730 | 10.590 | 28.900 | 34.650 |
| 83307 | 11.630 | 21.680 | 11.100 | 28.800 | 36.260 |
| 83308 | 13.400 | 21.980 | 8.280 | 28.100 | 32.180 |
| 83309 | 9.990 | 21.410 | 11.990 | 26.750 | 33.780 |
| 83310 | 9.950 | 22.013 | 11.460 | 29.440 | 34.160 |
| Average | 11.645 | 0.000 | 10.368 | 28.702 | 34.092 |

EXERCISE BALL SUBJECT 9 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 1 | Baseline | | | Mic Cal | 73 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 91101 | 30.478 | 53.234 | 22.756 | 597.729 | 3004.262 |
| 91102 | 25.369 | 53.481 | 28.112 | 583.064 | 2969.640 |
| 91103 | 25.120 | 51.498 | 26.378 | 598.964 | 2987.050 |
| 91104 | 26.488 | 52.987 | 26.499 | 592.659 | 2986.907 |
| 91105 | 24.380 | 53.855 | 29.475 | 610.178 | 3038.015 |
| 91106 | 25.129 | 51.894 | 26.765 | 605.771 | 3001.742 |
| 91107 | 24.717 | 52.502 | 27.785 | 596.614 | 3001.590 |
| 91108 | 25.039 | 52.124 | 27.085 | 603.723 | 3019.114 |
| 91109 | 26.133 | 51.893 | 25.760 | 601.317 | 2992.184 |
| 91110 | 24.212 | 52.246 | 28.034 | 602.331 | 3007.232 |
| Average | 25.707 | 52.571 | 26.865 | 599.235 | 3000.774 |
| Session 1 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 91201 | 25.563 | 50.669 | 25.106 | 603.810 | 2998.441 |
| 91202 | 25.404 | 50.564 | 25.160 | 595.367 | 2975.719 |
| 91203 | 21.014 | 48.236 | 27.222 | 602.280 | 3005.180 |
| 91204 | 23.546 | 49.397 | 25.851 | 597.205 | 2962.501 |
| 91205 | 24.471 | 50.390 | 25.919 | 598.118 | 2994.226 |
| 91206 | 23.586 | 50.252 | 26.666 | 600.894 | 2996.614 |
| 91207 | 25.788 | 50.010 | 24.222 | 595.410 | 2988.156 |
| 91208 | 24.315 | 51.138 | 26.823 | 601.123 | 2996.314 |
| 91209 | 23.674 | 52.208 | 28.534 | 603.565 | 3007.175 |
| 91210 | 26.886 | 52.801 | 25.915 | 595.486 | 2983.215 |
| Average | 24.425 | 50.567 | 26.142 | 599.326 | 2990.754 |
| Session 1 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 91301 | 24.199 | 51.143 | 26.944 | 587.621 | 2950.640 |
| 91302 | 23.101 | 52.431 | 29.330 | 608.624 | 3056.390 |
| 91303 | 22.026 | 46.786 | 24.760 | 599.700 | 2984.928 |
| 91304 | 23.959 | 49.738 | 25.779 | 601.558 | 2979.735 |
| 91305 | 24.100 | 49.809 | 25.709 | 598.390 | 2987.920 |
| 91306 | 22.096 | 50.869 | 28.773 | 597.823 | 2968.364 |
| 91307 | 21.637 | 49.813 | 28.176 | 603.827 | 3017.200 |
| 91308 | 22.084 | 49.677 | 27.593 | 601.011 | 2990.351 |
| 91309 | 23.973 | 50.463 | 26.490 | 595.735 | 2977.961 |
| 91310 | 24.190 | 50.463 | 26.273 | 594.704 | 2968.901 |
| Average | 23.137 | 50.119 | 26.983 | 598.899 | 2988.239 |

EXERCISE BALL SUBJECT 9 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 1 | Baseline | | | Mic Cal | 73 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| v | 17.250 | 27.820 | 10.570 | 35.670 | 30.790 |
| 31102 | 15.130 | 23.280 | 8.150 | 29.440 | 28.910 |
| 31103 | 15.010 | 23.680 | 8.670 | 32.890 | 29.530 |
| 31104 | 15.300 | 23.360 | 8.060 | 31.570 | 29.250 |
| 31105 | 14.740 | 23.220 | 8.480 | 35.230 | 29.730 |
| 31106 | 14.830 | 23.330 | 8.500 | 33.200 | 28.250 |
| 31107 | 15.040 | 23.510 | 8.470 | 33.330 | 28.990 |
| 31108 | 15.110 | 22.970 | 7.860 | 33.540 | 28.260 |
| 31109 | 14.330 | 23.410 | 9.080 | 33.300 | 28.650 |
| 31110 | 15.310 | 23.250 | 7.940 | 33.860 | 28.470 |
| Average | 15.205 | 23.783 | 8.578 | 33.203 | 29.083 |
| Session 1 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 31201 | 16.350 | 25.840 | 9.490 | 33.630 | 29.600 |
| 31202 | 14.100 | 22.030 | 7.930 | 30.390 | 26.580 |
| 31203 | 13.720 | 23.020 | 9.300 | 30.060 | 28.400 |
| 31204 | 11.370 | 22.410 | 11.040 | 29.140 | 28.110 |
| 31205 | 13.680 | 22.140 | 8.460 | 30.990 | 26.770 |
| 31206 | 13.590 | 22.790 | 9.200 | 31.550 | 27.770 |
| 31207 | 13.580 | 22.080 | 8.500 | 28.980 | 26.880 |
| 31208 | 12.600 | 22.310 | 9.710 | 32.330 | 27.530 |
| 31209 | 15.050 | 24.260 | 9.210 | 33.770 | 28.260 |
| 31210 | 14.360 | 23.640 | 9.280 | 32.390 | 28.180 |
| Average | 13.840 | 23.052 | 9.212 | 31.323 | 27.808 |
| Session 1 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 31301 | 13.540 | 22.720 | 9.180 | 29.040 | 27.740 |
| 31302 | 12.190 | 22.020 | 9.830 | 33.260 | 26.100 |
| 31303 | 15.370 | 22.010 | 6.640 | 30.110 | 24.580 |
| 31304 | 14.440 | 23.660 | 9.220 | 31.910 | 28.340 |
| 31305 | 12.040 | 21.720 | 9.680 | 31.360 | 25.740 |
| 31306 | 14.630 | 24.060 | 9.430 | 32.080 | 29.400 |
| 31307 | 13.150 | 21.560 | 8.410 | 31.590 | 25.870 |
| 31308 | 12.670 | 21.880 | 9.210 | 31.830 | 26.440 |
| 31309 | 12.580 | 21.920 | 9.340 | 30.890 | 26.310 |
| 31310 | 13.650 | 22.720 | 9.070 | 30.700 | 27.470 |
| Average | 13.426 | 22.427 | 9.001 | 31.277 | 26.799 |

EXERCISE BALL SUBJECT 9 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | Mic Cal | 88 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| v | 28.441 | 52.213 | 23.772 | 594.270 | 2974.582 |
| 32102 | 26.228 | 51.852 | 25.624 | 589.760 | 2926.989 |
| 32103 | 25.654 | 51.663 | 26.009 | 593.659 | 2959.995 |
| 32104 | 27.182 | 51.262 | 24.080 | 596.713 | 2972.931 |
| 32105 | 25.257 | 51.160 | 25.903 | 591.765 | 2953.406 |
| 32106 | 24.939 | 51.264 | 26.325 | 593.471 | 2950.431 |
| 32107 | 26.784 | 51.399 | 24.615 | 593.721 | 2955.957 |
| 32108 | 25.365 | 50.783 | 25.418 | 604.938 | 3020.220 |
| 32109 | 26.033 | 50.852 | 24.819 | 595.186 | 2951.790 |
| 32110 | 24.286 | 51.128 | 26.842 | 589.467 | 2951.772 |
| Average | 26.017 | 51.358 | 25.341 | 594.295 | 2961.807 |
| Session 2 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 32201 | 24.228 | 50.036 | 25.808 | 592.640 | 2934.121 |
| 32202 | 26.091 | 53.098 | 27.007 | 595.148 | 2992.635 |
| 32203 | 23.489 | 51.280 | 27.791 | 591.389 | 2975.817 |
| 32204 | 24.889 | 51.929 | 27.040 | 592.837 | 2957.838 |
| 32205 | 26.474 | 52.257 | 25.783 | 593.447 | 2964.413 |
| 32206 | 23.101 | 51.462 | 28.361 | 600.012 | 3005.739 |
| 32207 | 23.810 | 51.952 | 28.142 | 593.812 | 2984.379 |
| 32208 | 24.730 | 52.017 | 27.287 | 596.093 | 2977.944 |
| 32209 | 26.056 | 54.195 | 28.139 | 589.222 | 2980.522 |
| 32210 | 23.101 | 51.465 | 28.364 | 600.012 | 3005.739 |
| Average | 24.597 | 51.969 | 27.372 | 592.640 | 2934.121 |
| Session 2 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 32301 | 23.265 | 50.871 | 27.606 | 599.907 | 2979.393 |
| 32302 | 26.641 | 51.093 | 24.452 | 600.076 | 3005.629 |
| 32303 | 50.215 | 60.188 | 9.973 | 50 | 2979.057 |
| 32304 | 23.011 | 51.722 | 28.711 | 596.029 | 2996.174 |
| 32305 | 23.050 | 51.771 | 28.721 | 596.015 | 2974.48 |
| 32306 | 23.480 | 51.981 | 28.501 | 586.636 | 2972.701 |
| 32307 | 24.355 | 50.246 | 25.891 | 601.657 | 3029.248 |
| 32308 | 25.548 | 50.279 | 24.731 | 596.78 | 2962.74 |
| 32309 | 24.680 | 50.426 | 25.746 | 600.811 | 3020.15 |
| 32310 | 25.380 | 51.834 | 26.454 | 594.011 | 2987.647 |
| Average | 26.963 | 52.041 | 25.0786 | 542.1922 | 2990.722 |

EXERCISE BALL SUBJECT 9 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | Mic Cal | 88 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 92101 | 14.920 | 26.350 | 11.430 | 32.340 | 30.550 |
| 92102 | 11.500 | 21.910 | 10.410 | 29.260 | 27.280 |
| 92103 | 13.710 | 23.390 | 9.680 | 31.050 | 29.490 |
| 92104 | 14.190 | 22.890 | 8.700 | 31.900 | 28.270 |
| 92105 | 11.730 | 21.670 | 9.940 | 29.660 | 27.510 |
| 92106 | 12.810 | 22.440 | 9.630 | 30.580 | 28.760 |
| 92107 | 13.210 | 21.460 | 8.250 | 30.340 | 26.000 |
| 92108 | 14.480 | 21.740 | 7.260 | 31.930 | 27.240 |
| 92109 | 12.840 | 20.910 | 8.070 | 29.850 | 26.790 |
| 92110 | 13.660 | 21.640 | 7.980 | 29.090 | 28.010 |
| Average | 13.305 | 22.440 | 9.135 | 30.600 | 27.990 |
| Session 2 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 92201 | 12.900 | 22.530 | 9.630 | 29.100 | 28.760 |
| 92202 | 14.170 | 27.730 | 13.560 | 34.340 | 29.470 |
| 92203 | 13.590 | 23.480 | 9.890 | 29.300 | 29.580 |
| 92204 | 13.370 | 22.820 | 9.450 | 29.850 | 27.660 |
| 92205 | 14.350 | 23.450 | 9.100 | 30.500 | 28.760 |
| 92206 | 13.190 | 22.170 | 8.980 | 32.610 | 26.990 |
| 92207 | 13.690 | 22.890 | 9.200 | 31.310 | 28.530 |
| 92208 | 13.890 | 23.060 | 9.170 | 31.180 | 28.380 |
| 92209 | 14.480 | 23.270 | 8.790 | 31.170 | 27.820 |
| 92210 | 13.200 | 22.180 | 8.980 | 32.610 | 26.990 |
| Average | 13.683 | 23.358 | 9.675 | 31.197 | 28.294 |
| Session 2 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 92301 | 14.140 | 23.410 | 9.270 | 32.910 | 30.420 |
| 92302 | 14.350 | 23.050 | 8.700 | 32.170 | 28.660 |
| 92303 | 20.480 | 17.510 | -2.970 | 26.260 | 15.790 |
| 92304 | 12.380 | 22.670 | 10.290 | 31.390 | 29.000 |
| 92305 | 13.600 | 22.880 | 9.280 | 32.220 | 29.110 |
| 92306 | 12.970 | 22.530 | 9.560 | 28.900 | 28.710 |
| 92307 | 12.560 | 22.120 | 9.560 | 32.370 | 27.110 |
| 92308 | 14.500 | 22.350 | 7.850 | 31.540 | 28.160 |
| 92309 | 13.850 | 22.860 | 9.010 | 32.100 | 28.320 |
| 92310 | 13.470 | 22.190 | 8.720 | 31.180 | 28.010 |
| Average | 14.230 | 22.157 | 7.927 | 31.104 | 27.329 |

EXERCISE BALL SUBJECT 9 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | Mic Cal | 87 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 93101 | 28.269 | 56.983 | 28.714 | 1182.525 | 2935.903 |
| 93102 | 28.868 | 56.450 | 27.582 | 1192.475 | 2965.203 |
| 93103 | 28.363 | 55.363 | 27 | 589.522 | 2923.145 |
| 93104 | 28.330 | 54.495 | 26.165 | 1189.138 | 2962.822 |
| 93105 | 28.662 | 57.319 | 28.657 | 1179.566 | 2950.692 |
| 93106 | 27.441 | 56.919 | 29.478 | 590.872 | 2941.448 |
| 93107 | 27.021 | 57.492 | 30.471 | 582.747 | 2935.447 |
| 93108 | 28.255 | 57.130 | 28.875 | 586.955 | 2936.179 |
| 93109 | 30.496 | 56.253 | 25.757 | 587.943 | 2961.051 |
| 93110 | 29.639 | 56.051 | 26.412 | 589.612 | 2922.473 |
| Average | 28.534 | 56.446 | 27.9111 | 827.136 | 2943.436 |
| Session 3 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 93201 | 30.105 | 55.519 | 25.414 | 594.245 | 2918.765 |
| 93202 | 27.591 | 56.166 | 28.575 | 592.113 | 2950.17 |
| 93203 | 30.860 | 56.096 | 25.236 | 589.155 | 2960.698 |
| 93204 | 29.657 | 55.856 | 26.199 | 597.003 | 2985.482 |
| 93205 | 26.618 | 55.011 | 28.393 | 596.513 | 2966.479 |
| 93206 | 27.552 | 55.537 | 27.985 | 596.463 | 2932.9 |
| 93207 | 28.552 | 56.140 | 27.588 | 589.63 | 2946.465 |
| 93208 | 27.174 | 55.525 | 28.351 | 598.001 | 2972.765 |
| 93209 | 28.532 | 55.740 | 27.208 | 590.161 | 2941.936 |
| 93210 | 30.164 | 56.104 | 25.94 | 592.945 | 2973.411 |
| Average | 28.681 | 55.769 | 27.0889 | 593.6229 | 2954.907 |
| Session 3 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 93301 | 31.780 | 55.224 | 23.444 | 594.27 | 2946.061 |
| 93302 | 23.247 | 54.492 | 31.245 | 590.728 | 2971.289 |
| 93303 | 28.307 | 54.312 | 26.005 | 591.712 | 2978.122 |
| 93304 | 28.638 | 53.389 | 24.751 | 599.835 | 3007.209 |
| 93305 | 26.965 | 53.719 | 26.754 | 1195.481 | 2959.708 |
| 93306 | 25.813 | 54.038 | 28.225 | 1191.637 | 2972.112 |
| 93307 | 24.099 | 53.873 | 29.774 | 592.222 | 2956.979 |
| 93308 | 23.733 | 54.021 | 30.288 | 594.011 | 2955.234 |
| 93309 | 24.008 | 54.440 | 30.432 | 589.043 | 2972.391 |
| 93310 | 23.646 | 54.757 | 31.111 | 597.062 | 2961.745 |
| Average | 26.024 | 54.227 | 28.2029 | 585.109 | 2625.198 |

EXERCISE BALL SUBJECT 9 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | Mic Cal | 87 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 93101 | 15.730 | 25.730 | 10.000 | 33.310 | 33.170 |
| 93102 | 16.800 | 25.200 | 8.400 | 34.110 | 33.490 |
| 93103 | 16.200 | 26.710 | 10.510 | 33.340 | 34.530 |
| 93104 | 16.550 | 23.780 | 7.230 | 32.200 | 30.730 |
| 93105 | 17.060 | 25.810 | 8.750 | 32.980 | 34.280 |
| 93106 | 16.680 | 25.820 | 9.140 | 33.250 | 33.800 |
| 93107 | 16.780 | 25.500 | 8.720 | 32.980 | 33.140 |
| 93108 | 16.620 | 25.370 | 8.750 | 33.280 | 32.960 |
| 93109 | 16.600 | 25.230 | 8.630 | 32.710 | 33.750 |
| 93110 | 16.680 | 25.680 | 9.000 | 34.250 | 33.230 |
| Average | 16.570 | 25.483 | 8.913 | 33.241 | 33.308 |
| Session 3 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 93201 | 15.240 | 25.420 | 10.180 | 34.220 | 32.650 |
| 93202 | 16.020 | 25.810 | 9.790 | 33.760 | 33.710 |
| 93203 | 16.040 | 26.210 | 10.170 | 33.830 | 34.410 |
| 93204 | 15.770 | 25.850 | 10.080 | 35.670 | 33.750 |
| 93205 | 15.700 | 25.340 | 9.640 | 34.110 | 33.810 |
| 93206 | 14.800 | 25.450 | 10.650 | 34.560 | 33.540 |
| 93207 | 15.800 | 25.310 | 9.510 | 33.140 | 33.240 |
| 93208 | 16.250 | 26.150 | 9.900 | 35.450 | 35.390 |
| 93209 | 16.090 | 25.680 | 9.590 | 32.840 | 33.680 |
| 93210 | 15.240 | 26.000 | 10.760 | 33.690 | 33.970 |
| Average | 15.695 | 25.722 | 10.027 | 34.127 | 33.815 |
| Session 3 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 93301 | 16.230 | 23.860 | 9.840 | 33.330 | 34.940 |
| 93302 | 14.250 | 25.910 | 9.610 | 32.050 | 31.170 |
| 93303 | 16.500 | 24.790 | 9.410 | 32.180 | 34.870 |
| 93304 | 15.780 | 24.270 | 9.010 | 34.250 | 32.640 |
| 93305 | 13.950 | 24.440 | 10.320 | 33.330 | 32.150 |
| 93306 | 14.510 | 24.870 | 9.930 | 31.930 | 32.490 |
| 93307 | 15.940 | 25.000 | 8.930 | 31.910 | 32.670 |
| 93308 | 15.350 | 24.420 | 9.650 | 34.320 | 32.080 |
| 93309 | 14.930 | 24.740 | 9.490 | 32.550 | 31.370 |
| 93310 | 13.690 | 24.837 | 11.050 | 33.810 | 32.170 |
| Average | 15.113 | 0.000 | 9.724 | 32.966 | 32.655 |

EXERCISE BALL SUBJECT 10 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 1 | Baseline | | | Mic Cal | 84 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 101101 | 39.082 | 50.23 | 11.151 | 585.487 | 2652.197 |
| 101102 | 40.045 | 48.930 | 8.885 | 569.296 | 3685.655 |
| 101103 | 40.884 | 50.784 | 9.900 | 572.433 | 3532.088 |
| 101104 | 40.778 | 51.784 | 11.006 | 568.384 | 3850.536 |
| 101105 | 42.155 | 51.641 | 9.486 | 567.024 | 2645.332 |
| 101106 | 41.357 | 50.065 | 8.708 | 562.728 | 3512.145 |
| 101107 | 41.949 | 49.907 | 7.958 | 577.729 | 3814.109 |
| 101108 | 40.548 | 49.963 | 9.415 | 563.162 | 3774.231 |
| 101109 | 40.205 | 49.345 | 9.140 | 578.173 | 3838.311 |
| 101110 | 40.908 | 49.341 | 8.433 | 264.454 | 3515.428 |
| Average | 40.791 | 50.199 | 9.408 | 540.887 | 3482.003 |
| Session 1 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 101201 | 45.084 | 54.16 | 9.075 | 580.088 | 3515.727 |
| 101202 | 44.865 | 54.054 | 9.189 | 579.807 | 3859.404 |
| 101203 | 44.214 | 53.423 | 9.209 | 580.455 | 3514.445 |
| 101204 | 45.485 | 53.428 | 7.943 | 580.553 | 3858.53 |
| 101205 | 44.965 | 53.594 | 8.629 | 269.104 | 3879.251 |
| 101206 | 43.192 | 53.301 | 10.109 | 579.835 | 3867.75 |
| 101207 | 43.611 | 53.564 | 9.953 | 570.513 | 2646.601 |
| 101208 | 43.016 | 53.772 | 10.756 | 584.643 | 2646.428 |
| 101209 | 43.053 | 54.096 | 11.043 | 585.865 | 2651.241 |
| 101210 | 44.610 | 53.757 | 9.147 | 580.625 | 2641.538 |
| Average | 44.210 | 53.715 | 9.505 | 549.149 | 3308.092 |
| Session 1 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 101301 | 41.542 | 51.26 | 9.719 | 580.939 | 2640.128 |
| 101302 | 40.034 | 51.986 | 11.952 | 584.841 | 2650.577 |
| 101303 | 41.509 | 51.365 | 9.856 | 574.943 | 2641.379 |
| 101304 | 41.911 | 50.785 | 8.874 | 575.277 | 3587.336 |
| 101305 | 40.905 | 50.929 | 10.024 | 571.205 | 3697.018 |
| 101306 | 41.694 | 51.014 | 9.320 | 583.349 | 3648.104 |
| 101307 | 40.905 | 50.932 | 10.027 | 568.954 | 3683.664 |
| 101308 | 41.495 | 51.632 | 10.137 | 582.76 | 2648.293 |
| 101309 | 41.717 | 49.780 | 8.063 | 574.931 | 3822.094 |
| 101310 | 40.854 | 50.773 | 9.919 | 562.417 | 3614.129 |
| Average | 41.257 | 51.046 | 9.789 | 575.962 | 3263.272 |

EXERCISE BALL SUBJECT 10 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 1 | Baseline | | | Mic Cal | 93 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 101101 | 19.380 | 23.770 | 4.390 | 28.780 | 24.760 |
| 101102 | 16.980 | 20.360 | 3.380 | 21.560 | 17.360 |
| 101103 | 18.570 | 22.820 | 4.250 | 24.590 | 20.520 |
| 101104 | 17.750 | 23.510 | 5.760 | 23.820 | 20.680 |
| 101105 | 16.380 | 21.600 | 5.220 | 23.020 | 17.980 |
| 101106 | 16.070 | 20.680 | 4.610 | 21.220 | 17.520 |
| 101107 | 17.440 | 22.590 | 5.150 | 26.400 | 20.960 |
| 101108 | 17.550 | 20.880 | 3.330 | 20.890 | 17.310 |
| 101109 | 18.280 | 22.380 | 4.100 | 25.410 | 20.250 |
| 101110 | 15.700 | 20.000 | 4.300 | 21.080 | 16.820 |
| Average | 17.410 | 21.859 | 4.449 | 23.677 | 19.416 |
| Session 1 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 101201 | 20.500 | 24.870 | 4.370 | 29.760 | 24.780 |
| 101202 | 21.170 | 25.290 | 4.120 | 29.810 | 25.540 |
| 101203 | 20.210 | 25.580 | 5.370 | 30.650 | 25.750 |
| 101204 | 21.220 | 23.990 | 2.770 | 29.120 | 24.230 |
| 101205 | 20.860 | 23.810 | 2.950 | 27.580 | 22.110 |
| 101206 | 20.100 | 25.180 | 5.080 | 28.830 | 23.960 |
| 101207 | 20.330 | 25.030 | 4.700 | 28.200 | 23.650 |
| 101208 | 20.270 | 25.940 | 5.670 | 31.760 | 25.730 |
| 101209 | 19.280 | 26.250 | 6.970 | 32.140 | 26.590 |
| 101210 | 19.210 | 25.000 | 5.790 | 30.630 | 24.430 |
| Average | 20.315 | 25.094 | 4.779 | 29.848 | 24.677 |
| Session 1 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 101301 | 19.350 | 23.360 | 4.010 | 26.900 | 22.350 |
| 101302 | 18.230 | 25.010 | 6.780 | 29.270 | 25.140 |
| 101303 | 17.050 | 23.020 | 5.970 | 26.300 | 20.850 |
| 101304 | 18.340 | 22.350 | 4.010 | 25.500 | 20.310 |
| 101305 | 17.520 | 22.890 | 5.370 | 24.850 | 20.070 |
| 101306 | 18.180 | 23.780 | 5.600 | 29.050 | 22.910 |
| 101307 | 17.440 | 22.130 | 4.690 | 22.570 | 18.640 |
| 101308 | 16.860 | 23.890 | 7.030 | 27.640 | 22.560 |
| 101309 | 18.290 | 22.420 | 4.130 | 24.810 | 20.690 |
| 101310 | 16.820 | 21.670 | 4.850 | 20.180 | 18.980 |
| Average | 17.808 | 23.052 | 5.244 | 25.707 | 21.250 |

EXERCISE BALL SUBJECT 10 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | Mic Cal | 75 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 102101 | 37.891 | 46.44 | 8.551 | 579.605 | 3522.476 |
| 102102 | 39.750 | 48.170 | 8.420 | 582.274 | 2653.908 |
| 102103 | 38.271 | 47.742 | 9.471 | 573.502 | 3843.834 |
| 102104 | 35.804 | 45.654 | 9.850 | 586.594 | 3586.204 |
| 102105 | 37.171 | 46.636 | 9.465 | 570.019 | 3837.184 |
| 102106 | 37.016 | 46.783 | 9.767 | 578.229 | 3828.365 |
| 102107 | 38.502 | 46.053 | 7.551 | 578.132 | 3852.149 |
| 102108 | 39.254 | 46.048 | 6.794 | 574.436 | 3862.085 |
| 102109 | 39.303 | 46.863 | 7.560 | 586.663 | 3852.32 |
| 102110 | 37.396 | 47.731 | 10.335 | 579.533 | 3609.479 |
| Average | 38.036 | 46.812 | 8.776 | 578.899 | 3644.800 |
| Session 2 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 102201 | 38.221 | 47.14 | 8.917 | 570.313 | 3703.665 |
| 102202 | 39.177 | 47.667 | 8.490 | 578.162 | 2646.859 |
| 102203 | 39.401 | 47.502 | 8.101 | 578.837 | 3692.014 |
| 102204 | 39.654 | 46.991 | 7.337 | 568.978 | 3732.495 |
| 102205 | 40.382 | 47.743 | 7.361 | 575.445 | 3702.925 |
| 102206 | 38.867 | 46.821 | 7.954 | 563.34 | 3512.282 |
| 102207 | 39.785 | 47.683 | 7.898 | 577.694 | 3694.145 |
| 102208 | 38.168 | 46.285 | 8.117 | 578.049 | 3526.903 |
| 102209 | 40.001 | 47.542 | 7.541 | 576.9 | 3710.324 |
| 102210 | 36.094 | 47.129 | 11.035 | 578.79 | 3538.787 |
| Average | 38.975 | 47.250 | 8.275 | 574.651 | 3546.040 |
| Session 2 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 102301 | 39.142 | 49.44 | 10.294 | 589.694 | 3545.828 |
| 102302 | 40.176 | 49.284 | 9.108 | 581.716 | 3688.472 |
| 102303 | 39.723 | 49.387 | 9.664 | 556.743 | 3724.876 |
| 102304 | 39.723 | 49.387 | 9.664 | 556.743 | 3724.876 |
| 102305 | 42.479 | 49.666 | 7.187 | 566.33 | 3803.957 |
| 102306 | 39.962 | 49.131 | 9.169 | 578.322 | 3821.568 |
| 102307 | 41.257 | 49.472 | 8.215 | 578.993 | 2649.112 |
| 102308 | 39.705 | 48.895 | 9.190 | 582.442 | 3685.882 |
| 102309 | 42.036 | 50.022 | 7.986 | 581.92 | 3844.734 |
| 102310 | 40.482 | 49.467 | 8.985 | 572.707 | 3628.108 |
| Average | 40.469 | 49.415 | 8.946 | 574.561 | 3611.741 |

EXERCISE BALL SUBJECT 10 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | Mic Cal | 75 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 102101 | 17.970 | 20.220 | 2.250 | 23.320 | 18.990 |
| 102102 | 17.000 | 20.760 | 3.760 | 25.480 | 20.310 |
| 102103 | 17.820 | 20.300 | 2.480 | 22.430 | 18.460 |
| 102104 | 16.060 | 22.200 | 6.140 | 24.790 | 19.830 |
| 102105 | 15.130 | 19.250 | 4.120 | 19.190 | 15.960 |
| 102106 | 16.900 | 20.840 | 3.940 | 22.920 | 18.960 |
| 102107 | 15.050 | 19.520 | 4.470 | 22.700 | 17.410 |
| 102108 | 16.810 | 19.030 | 2.220 | 21.970 | 17.340 |
| 102109 | 17.110 | 20.660 | 3.550 | 25.900 | 20.000 |
| 102110 | 17.190 | 21.860 | 4.670 | 24.270 | 21.230 |
| Average | 16.704 | 20.464 | 3.760 | 23.297 | 18.849 |
| Session 2 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 102201 | 18.160 | 20.260 | 2.100 | 21.250 | 18.670 |
| 102202 | 16.650 | 23.050 | 6.400 | 24.270 | 19.490 |
| 102203 | 19.340 | 21.310 | 1.970 | 25.150 | 21.370 |
| 102204 | 18.540 | 19.970 | 1.430 | 21.190 | 17.910 |
| 102205 | 16.250 | 20.400 | 4.150 | 23.890 | 18.610 |
| 102206 | 13.790 | 18.840 | 5.050 | 18.990 | 16.100 |
| 102207 | 16.360 | 20.990 | 4.630 | 24.040 | 19.490 |
| 102208 | 15.800 | 20.120 | 4.320 | 23.100 | 18.970 |
| 102209 | 16.360 | 20.270 | 3.910 | 23.790 | 18.660 |
| 102210 | 16.250 | 24.370 | 8.120 | 25.730 | 20.820 |
| Average | 16.750 | 20.958 | 4.208 | 23.140 | 19.009 |
| Session 2 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 102301 | 17.610 | 21.290 | 3.680 | 24.550 | 20.010 |
| 102302 | 16.600 | 21.940 | 5.340 | 24.580 | 20.810 |
| 102303 | 17.040 | 20.080 | 3.040 | 21.980 | 18.200 |
| 102304 | 16.710 | 20.700 | 3.990 | 24.240 | 19.340 |
| 102305 | 15.800 | 18.730 | 2.930 | 19.570 | 15.770 |
| 102306 | 15.920 | 19.440 | 3.520 | 21.350 | 17.620 |
| 102307 | 16.630 | 19.290 | 2.660 | 21.580 | 16.740 |
| 102308 | 17.070 | 20.660 | 3.590 | 25.350 | 19.110 |
| 102309 | 15.380 | 18.810 | 3.430 | 20.530 | 15.720 |
| 102310 | 15.520 | 18.090 | 2.570 | 19.350 | 15.080 |
| Average | 16.428 | 19.903 | 3.475 | 22.308 | 17.840 |

EXERCISE BALL SUBJECT 10 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | Mic Cal | 84 |
|-----------|---------------|------------|---------------|-------------|-------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 103101 | 39.392 | 49.60 | 10.211 | 569.885 | 2648.019 |
| 103102 | 39.471 | 48.811 | 9.34 | 575.292 | 2651.24 |
| 103103 | 40.489 | 49.058 | 8.569 | 585.291 | 2652.419 |
| 103104 | 39.858 | 48.748 | 8.890 | 565.874 | 3533.602 |
| 103105 | 39.201 | 49.126 | 9.925 | 573.119 | 2640.805 |
| 103106 | 38.557 | 49.587 | 11.030 | 583.866 | 2650.812 |
| 103107 | 39.954 | 49.108 | 9.154 | 582.359 | 3623.528 |
| 103108 | 39.020 | 48.669 | 9.649 | 567.924 | 2648.325 |
| 103109 | 37.190 | 50.016 | 12.826 | 577.006 | 2650.292 |
| 103110 | 37.557 | 48.861 | 11.304 | 568.868 | 2650.547 |
| Average | 39.069 | 49.159 | 10.090 | 574.948 | 2834.959 |
| Session 3 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 103201 | 38.873 | 48.64 | 9.762 | 573.117 | 3630.242 |
| 103202 | 41.006 | 49.969 | 8.963 | 575.726 | 2650.938 |
| 103203 | 40.435 | 49.545 | 9.110 | 573.611 | 2645.261 |
| 103204 | 39.084 | 50.981 | 11.897 | 569.269 | 2655.409 |
| 103205 | 42.375 | 49.345 | 6.970 | 580.454 | 3840.568 |
| 103206 | 39.273 | 49.813 | 10.540 | 579.315 | 3660.023 |
| 103207 | 42.211 | 49.618 | 7.407 | 576.124 | 3833.78 |
| 103208 | 41.128 | 49.453 | 8.325 | 573.307 | 2644.284 |
| 103209 | 40.958 | 47.991 | 7.033 | 578.103 | 3661.455 |
| 103210 | 39.142 | 49.436 | 10.294 | 589.694 | 3545.828 |
| Average | 40.449 | 49.479 | 9.030 | 576.872 | 3276.779 |
| Session 3 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 103301 | 37.933 | 47.04 | 9.103 | 580.504 | 3854.566 |
| 103302 | 39.148 | 48.520 | 9.372 | 581.04 | 3672.328 |
| 103303 | 38.127 | 47.425 | 9.298 | 572.056 | 3513.263 |
| 103304 | 37.832 | 46.462 | 8.630 | 581.919 | 3584.933 |
| 103305 | 36.961 | 46.144 | 9.183 | 567.915 | 3530.658 |
| 103306 | 37.535 | 46.587 | 9.052 | 574.714 | 3512.632 |
| 103307 | 37.791 | 47.002 | 9.211 | 573.838 | 3508.537 |
| 103308 | 39.561 | 48.499 | 8.938 | 580.928 | 3843.748 |
| 103309 | 40.204 | 46.572 | 6.368 | 570.207 | 3829.788 |
| 103310 | 39.483 | 46.351 | 6.868 | 567.856 | 2652.596 |
| Average | 38.458 | 47.060 | 8.602 | 575.098 | 3550.305 |

EXERCISE BALL SUBJECT 10 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | Mic Cal | 84 |
|-----------|---------------|-----------|-------------|------------|-------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 103101 | 17.970 | 20.220 | 2.250 | 23.320 | 18.990 |
| 103102 | 17.000 | 20.760 | 3.760 | 25.480 | 20.310 |
| 103103 | 17.820 | 20.300 | 2.480 | 22.430 | 18.460 |
| 103104 | 16.060 | 22.200 | 6.140 | 24.790 | 19.830 |
| 103105 | 15.130 | 19.250 | 4.120 | 19.190 | 15.960 |
| 103106 | 16.900 | 20.840 | 3.940 | 22.920 | 18.960 |
| 103107 | 15.050 | 19.520 | 4.470 | 22.700 | 17.410 |
| 103108 | 16.810 | 19.030 | 2.220 | 21.970 | 17.340 |
| 103109 | 17.110 | 20.660 | 3.550 | 25.900 | 20.000 |
| 103110 | 17.190 | 21.860 | 4.670 | 24.270 | 21.230 |
| Average | 16.704 | 20.464 | 3.760 | 23.297 | 18.849 |
| Session 3 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 103201 | 18.160 | 20.260 | 2.100 | 21.250 | 18.670 |
| 103202 | 16.650 | 23.050 | 6.400 | 24.270 | 19.490 |
| 103203 | 19.340 | 21.310 | 1.970 | 25.150 | 21.370 |
| 103204 | 18.540 | 19.970 | 1.430 | 21.190 | 17.910 |
| 103205 | 16.250 | 20.400 | 4.150 | 23.890 | 18.610 |
| 103206 | 13.790 | 18.840 | 5.050 | 18.990 | 16.100 |
| 103207 | 16.360 | 20.990 | 4.630 | 24.040 | 19.490 |
| 103208 | 15.800 | 20.120 | 4.320 | 23.100 | 18.970 |
| 103209 | 16.360 | 20.270 | 3.910 | 23.790 | 18.660 |
| 103210 | 16.250 | 24.370 | 8.120 | 25.730 | 20.820 |
| Average | 16.750 | 20.958 | 4.208 | 23.140 | 19.009 |
| Session 3 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 103301 | 17.610 | 21.290 | 3.680 | 24.550 | 20.010 |
| 103302 | 16.600 | 21.940 | 5.340 | 24.580 | 20.810 |
| 103303 | 17.040 | 20.080 | 3.040 | 21.980 | 18.200 |
| 103304 | 16.710 | 20.700 | 3.990 | 24.240 | 19.340 |
| 103305 | 15.800 | 18.730 | 2.930 | 19.570 | 15.770 |
| 103306 | 15.920 | 19.440 | 3.520 | 21.350 | 17.620 |
| 103307 | 16.630 | 19.290 | 2.660 | 21.580 | 16.740 |
| 103308 | 17.070 | 20.660 | 3.590 | 25.350 | 19.110 |
| 103309 | 15.380 | 18.810 | 3.430 | 20.530 | 15.720 |
| 103310 | 15.520 | 18.090 | 2.570 | 19.350 | 15.080 |
| Average | 16.428 | 19.903 | 3.475 | 22.308 | 17.840 |

BALANCE BALL SUBJECT 11 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 1 | Baseline | | | Mic Cal | 94 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 31101 | 42.111 | 53.675 | 11.564 | 595.996 | 3482.302 |
| 31102 | 38.117 | 55.016 | 16.899 | 589.448 | 2796.761 |
| 31103 | 40.199 | 53.462 | 13.263 | 595.172 | 2874.167 |
| 31104 | 41.562 | 54.761 | 13.199 | 586.810 | 2745.379 |
| 31105 | 43.461 | 54.949 | 11.488 | 593.710 | 2792.922 |
| 31106 | 43.347 | 54.783 | 11.436 | 588.927 | 3500.406 |
| 31107 | 42.649 | 54.277 | 11.628 | 587.950 | 2765.880 |
| 31108 | 44.311 | 55.322 | 11.011 | 593.454 | 2787.082 |
| 31109 | 39.259 | 56.612 | 17.353 | 587.704 | 2789.079 |
| 31110 | 40.049 | 55.313 | 15.264 | 590.676 | 2785.994 |
| Average | 41.507 | 54.817 | 13.311 | 590.985 | 2931.997 |
| Session 1 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 31201 | 37.795 | 54.280 | 16.485 | 595.236 | 2712.086 |
| 31202 | 38.950 | 51.794 | 12.844 | 590.118 | 2763.316 |
| 31203 | 37.794 | 54.288 | 16.494 | 595.236 | 2712.086 |
| 31204 | 40.236 | 54.045 | 13.809 | 594.152 | 2826.454 |
| 31205 | 42.095 | 55.255 | 13.160 | 596.945 | 3529.018 |
| 31206 | 44.259 | 53.758 | 9.499 | 590.495 | 3663.552 |
| 31207 | 44.554 | 54.261 | 9.707 | 594.812 | 2709.374 |
| 31208 | 46.423 | 54.109 | 7.686 | 593.620 | 3475.349 |
| 31209 | 44.669 | 55.282 | 10.613 | 593.273 | 3502.049 |
| 31210 | 44.563 | 52.508 | 7.945 | 595.026 | 3480.401 |
| Average | 42.134 | 53.958 | 11.824 | 593.891 | 3137.369 |
| Session 1 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 31301 | 39.620 | 55.095 | 15.475 | 591.844 | 2784.132 |
| 31302 | 38.039 | 55.481 | 17.442 | 594.385 | 2803.084 |
| 31303 | 38.396 | 54.988 | 16.592 | 586.652 | 2775.058 |
| 31304 | 40.813 | 55.157 | 14.344 | 593.109 | 2781.819 |
| 31305 | 36.870 | 55.064 | 18.194 | 596.939 | 2741.044 |
| 31306 | 35.894 | 52.913 | 17.019 | 590.251 | 2768.235 |
| 31307 | 41.063 | 54.257 | 13.194 | 594.429 | 2799.458 |
| 31308 | 41.202 | 54.002 | 12.800 | 596.657 | 2810.265 |
| 31309 | 42.505 | 53.377 | 10.872 | 594.907 | 2757.693 |
| 31310 | 45.142 | 54.678 | 9.536 | 600.907 | 2849.949 |
| Average | 39.954 | 54.501 | 14.547 | 594.008 | 2787.074 |

BALANCE BALL SUBJECT 11 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 1 | Baseline | | | Mic Cal | 94 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 31101 | 16.230 | 21.810 | 5.580 | 27.350 | 33.280 |
| 31102 | 11.790 | 20.990 | 9.200 | 28.040 | 32.210 |
| 31103 | 13.910 | 21.610 | 7.700 | 27.520 | 33.080 |
| 31104 | 15.480 | 21.490 | 6.010 | 26.290 | 32.890 |
| 31105 | 14.700 | 20.500 | 5.800 | 28.570 | 31.980 |
| 31106 | 15.280 | 21.400 | 6.120 | 27.610 | 34.170 |
| 31107 | 16.230 | 21.280 | 5.050 | 27.770 | 31.620 |
| 31108 | 16.390 | 21.930 | 5.540 | 29.590 | 35.880 |
| 31109 | 12.070 | 21.090 | 9.020 | 28.220 | 32.520 |
| 31110 | 14.470 | 20.700 | 6.230 | 28.310 | 32.260 |
| Average | 14.655 | 21.280 | 6.625 | 27.927 | 32.989 |
| Session 1 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 31201 | 13.880 | 21.550 | 7.670 | 29.440 | 33.460 |
| 31202 | 14.210 | 21.440 | 7.230 | 26.160 | 31.570 |
| 31203 | 13.880 | 21.560 | 7.680 | 29.440 | 33.470 |
| 31204 | 14.800 | 21.530 | 6.730 | 29.500 | 32.500 |
| 31205 | 15.390 | 21.840 | 6.450 | 29.530 | 33.000 |
| 31206 | 16.600 | 21.140 | 4.540 | 26.840 | 32.380 |
| 31207 | 15.460 | 21.530 | 6.070 | 28.910 | 32.990 |
| 31208 | 17.210 | 21.230 | 4.020 | 29.350 | 32.650 |
| 31209 | 16.320 | 21.400 | 5.080 | 28.220 | 32.720 |
| 31210 | 15.980 | 19.940 | 3.960 | 28.800 | 29.880 |
| Average | 15.373 | 21.316 | 5.943 | 28.619 | 32.462 |
| Session 1 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 31301 | 13.780 | 23.500 | 9.720 | 30.420 | 34.520 |
| 31302 | 14.250 | 21.200 | 6.950 | 30.900 | 31.960 |
| 31303 | 13.560 | 21.520 | 7.960 | 27.860 | 32.240 |
| 31304 | 14.680 | 22.050 | 7.370 | 29.300 | 32.930 |
| 31305 | 11.660 | 21.760 | 10.100 | 31.480 | 33.350 |
| 31306 | 11.740 | 20.470 | 8.730 | 27.790 | 30.290 |
| 31307 | 15.960 | 23.130 | 7.170 | 29.350 | 32.110 |
| 31308 | 15.540 | 22.150 | 6.610 | 30.040 | 32.290 |
| 31309 | 16.350 | 20.920 | 4.570 | 28.860 | 31.740 |
| 31310 | 16.420 | 22.200 | 5.780 | 31.000 | 34.380 |
| Average | 14.394 | 21.890 | 7.496 | 29.700 | 32.581 |

EXERCISE BALL SUBJECT 11 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | Mic Cal | 78 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 32101 | 35.085 | 52.167 | 17.082 | 592.550 | 2739.490 |
| 32102 | 28.581 | 52.817 | 24.236 | 583.509 | 2796.797 |
| 32103 | 35.488 | 53.895 | 18.407 | 594.147 | 2779.397 |
| 32104 | 38.497 | 53.522 | 15.025 | 594.341 | 2793.281 |
| 32105 | 33.969 | 53.848 | 19.879 | 589.925 | 2807.949 |
| 32106 | 33.001 | 51.879 | 18.878 | 583.111 | 2806.285 |
| 32107 | 35.238 | 52.138 | 16.900 | 578.641 | 2786.882 |
| 32108 | 29.862 | 52.324 | 22.462 | 584.333 | 2790.129 |
| 32109 | 32.336 | 53.681 | 21.345 | 592.572 | 2796.913 |
| 32110 | 32.217 | 54.173 | 21.956 | 589.386 | 2808.506 |
| Average | 33.427 | 53.044 | 19.617 | 588.252 | 2790.563 |
| Session 2 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 32201 | 32.979 | 53.983 | 21.004 | 594.695 | 2768.541 |
| 32202 | 28.090 | 52.695 | 24.605 | 597.195 | 2807.970 |
| 32203 | 28.632 | 53.446 | 24.814 | 595.345 | 2817.610 |
| 32204 | 31.519 | 51.240 | 19.721 | 593.894 | 2791.534 |
| 32205 | 29.055 | 52.826 | 23.771 | 595.556 | 2845.963 |
| 32206 | 28.457 | 52.762 | 24.305 | 593.481 | 2843.295 |
| 32207 | 29.031 | 52.908 | 23.877 | 594.419 | 2823.023 |
| 32208 | 27.243 | 53.098 | 25.855 | 592.959 | 2795.888 |
| 32209 | 29.829 | 53.136 | 23.307 | 590.300 | 2798.653 |
| 32210 | 27.386 | 53.897 | 26.511 | 592.807 | 2837.778 |
| Average | 29.222 | 52.999 | 23.777 | 594.065 | 2813.026 |
| Session 2 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 32301 | 27.996 | 55.922 | 27.926 | 590.28 | 2857.061 |
| 32302 | 26.529 | 55.123 | 28.594 | 589.175 | 2857.589 |
| 32303 | 27.706 | 55.977 | 28.271 | 588.731 | 2866.051 |
| 32304 | 27.454 | 56.756 | 29.302 | 590.879 | 2832.078 |
| 32305 | 28.413 | 55.118 | 26.705 | 591.899 | 2807.982 |
| 32306 | 27.663 | 55.454 | 27.791 | 593.118 | 2824.062 |
| 32307 | 28.192 | 55.383 | 27.191 | 587.37 | 2860.934 |
| 32308 | 27.878 | 54.680 | 26.802 | 594.255 | 2842.629 |
| 32309 | 25.966 | 53.925 | 27.959 | 592.465 | 2842.827 |
| 32310 | 28.338 | 54.747 | 26.409 | 586.872 | 2825.154 |
| Average | 27.614 | 55.309 | 27.695 | 590.5044 | 2841.637 |

BALANCE BALL SUBJECT 11 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | Mic Cal | 78 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 302101 | 13.510 | 20.530 | 7.020 | 26.080 | 32.140 |
| 302102 | 12.840 | 20.960 | 8.120 | 26.780 | 31.770 |
| 302103 | 15.290 | 21.170 | 5.880 | 28.930 | 32.090 |
| 302104 | 15.550 | 21.620 | 6.070 | 28.160 | 31.280 |
| 302105 | 14.270 | 20.530 | 6.260 | 27.260 | 31.270 |
| 302106 | 12.770 | 19.770 | 7.000 | 24.770 | 30.030 |
| 302107 | 14.370 | 19.200 | 4.830 | 23.660 | 28.650 |
| 302108 | 12.650 | 20.050 | 7.400 | 24.680 | 30.280 |
| 302109 | 13.450 | 21.040 | 7.590 | 27.680 | 31.900 |
| 302110 | 13.640 | 21.290 | 7.650 | 28.040 | 32.580 |
| Average | 13.834 | 20.616 | 6.782 | 26.604 | 31.199 |
| Session 2 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 302201 | 14.310 | 22.070 | 7.760 | 28.920 | 33.360 |
| 302202 | 13.730 | 22.320 | 8.590 | 30.860 | 32.580 |
| 302203 | 13.190 | 22.710 | 9.520 | 29.080 | 33.710 |
| 302204 | 15.160 | 21.860 | 6.700 | 27.840 | 33.820 |
| 302205 | 13.430 | 21.950 | 8.520 | 28.650 | 33.530 |
| 302206 | 13.550 | 22.140 | 8.590 | 28.330 | 33.510 |
| 302207 | 14.120 | 21.710 | 7.590 | 29.410 | 32.650 |
| 302208 | 12.900 | 22.320 | 9.420 | 29.460 | 33.860 |
| 302209 | 12.550 | 21.400 | 8.850 | 27.450 | 32.540 |
| 302210 | 11.850 | 22.000 | 10.150 | 28.590 | 33.440 |
| Average | 13.479 | 22.048 | 8.569 | 28.859 | 33.300 |
| Session 2 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 302301 | 11.160 | 22.870 | 11.710 | 29.040 | 34.760 |
| 302302 | 11.750 | 23.250 | 11.500 | 29.290 | 34.260 |
| 302303 | 10.750 | 22.280 | 11.530 | 27.730 | 33.830 |
| 302304 | 11.340 | 23.420 | 12.080 | 29.390 | 34.560 |
| 302305 | 12.790 | 23.270 | 10.480 | 29.420 | 35.720 |
| 302306 | 11.590 | 21.930 | 10.340 | 30.820 | 33.550 |
| 302307 | 11.410 | 21.920 | 10.510 | 28.330 | 33.450 |
| 302308 | 12.870 | 23.080 | 10.210 | 30.620 | 35.200 |
| 302309 | 11.620 | 22.850 | 11.230 | 30.480 | 34.050 |
| 302310 | 13.490 | 22.640 | 9.150 | 28.170 | 33.750 |
| Average | 11.877 | 22.751 | 10.874 | 29.329 | 34.313 |

BALANCE BALL SUBJECT 11 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | Mic Cal | 77 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 303101 | 35.496 | 53.684 | 18.188 | 591.672 | 2751.443 |
| 303102 | 33.695 | 54.035 | 20.34 | 585.731 | 2783.786 |
| 303103 | 21.627 | 50.536 | 28.909 | 1293.458 | 2546.572 |
| 303104 | 23.655 | 55.370 | 31.715 | 1268.022 | 2514.480 |
| 303105 | 33.144 | 53.658 | 20.514 | 587.421 | 2796.050 |
| 303106 | 33.260 | 54.768 | 21.508 | 592.970 | 2800.080 |
| 303107 | 32.728 | 53.979 | 21.251 | 593.007 | 2799.491 |
| 303108 | 33.440 | 53.086 | 19.646 | 590.211 | 2811.718 |
| 303109 | 32.310 | 54.459 | 22.149 | 592.850 | 2798.851 |
| 303110 | 33.539 | 52.992 | 19.453 | 588.528 | 2750.939 |
| Average | 31.289 | 53.657 | 22.3673 | 728.387 | 2735.341 |
| Session 3 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 303201 | 31.672 | 55.493 | 23.821 | 592.327 | 2784.091 |
| 303202 | 30.650 | 53.637 | 22.987 | 586.394 | 2877.154 |
| 303203 | 28.785 | 55.037 | 26.252 | 590.696 | 2854.204 |
| 303204 | 30.146 | 55.238 | 25.092 | 591.686 | 2774.476 |
| 303205 | 32.794 | 54.327 | 21.533 | 588.268 | 2786.25 |
| 303206 | 31.918 | 54.427 | 22.509 | 591.361 | 2762.579 |
| 303207 | 31.808 | 54.510 | 22.702 | 595.785 | 2744.845 |
| 303208 | 31.339 | 55.772 | 24.433 | 592.854 | 2781.089 |
| 303209 | 33.229 | 55.383 | 22.154 | 591.912 | 2799.385 |
| 303210 | 31.213 | 54.375 | 23.162 | 590.27 | 2788.266 |
| Average | 31.355 | 54.820 | 23.4645 | 591.1553 | 2795.234 |
| Session 3 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 303301 | 35.759 | 54.625 | 18.866 | 592.006 | 2774.63 |
| 303302 | 33.734 | 53.269 | 19.535 | 587.328 | 2791.539 |
| 303303 | 33.734 | 53.269 | 19.535 | 587.328 | 2791.539 |
| 303304 | 33.931 | 54.978 | 21.047 | 593.154 | 2800.617 |
| 303305 | 33.447 | 55.913 | 22.466 | 595.123 | 2795.038 |
| 303306 | 33.893 | 54.881 | 20.988 | 595.135 | 2803.485 |
| 303307 | 33.947 | 53.784 | 19.837 | 596.354 | 2810.08 |
| 303308 | 32.984 | 54.259 | 21.275 | 594.072 | 2812.054 |
| 303309 | 35.482 | 54.479 | 18.997 | 596.43 | 2802.524 |
| 303310 | 34.903 | 54.199 | 19.296 | 595.649 | 2809.369 |
| Average | 34.181 | 54.366 | 20.1842 | 585.109 | 2625.198 |

BALANCE BALL SUBJECT 11 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | Mic Cal | 77 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 303101 | 13.380 | 21.900 | 8.520 | 29.120 | 33.670 |
| 303102 | 13.690 | 22.940 | 9.250 | 27.080 | 33.830 |
| 303103 | 7.840 | 18.460 | 10.620 | 13.130 | 33.190 |
| 303104 | 7.740 | 17.920 | 10.180 | 12.230 | 34.260 |
| 303105 | 13.320 | 23.720 | 10.400 | 28.260 | 33.850 |
| 303106 | 13.390 | 22.440 | 9.050 | 30.290 | 32.520 |
| 303107 | 13.640 | 23.260 | 9.620 | 30.230 | 32.920 |
| 303108 | 13.820 | 22.310 | 8.490 | 28.040 | 31.920 |
| 303109 | 12.230 | 22.710 | 10.480 | 29.360 | 33.680 |
| 303110 | 12.950 | 21.990 | 9.040 | 27.600 | 32.860 |
| Average | 12.200 | 21.765 | 9.565 | 25.534 | 33.270 |
| Session 3 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 303201 | 11.970 | 22.180 | 10.210 | 27.560 | 37.560 |
| 303202 | 12.000 | 22.400 | 10.400 | 26.890 | 33.380 |
| 303203 | 11.870 | 24.040 | 12.170 | 29.820 | 34.980 |
| 303204 | 11.760 | 23.750 | 11.990 | 29.830 | 35.790 |
| 303205 | 12.280 | 22.440 | 10.160 | 28.050 | 33.570 |
| 303206 | 13.230 | 23.410 | 10.180 | 29.000 | 34.930 |
| 303207 | 12.990 | 23.990 | 11.000 | 30.540 | 35.330 |
| 303208 | 13.160 | 24.420 | 11.260 | 31.110 | 39.730 |
| 303209 | 12.780 | 23.220 | 10.440 | 29.230 | 35.030 |
| 303210 | 11.950 | 23.140 | 11.190 | 29.460 | 34.130 |
| Average | 12.399 | 23.299 | 10.900 | 29.149 | 35.443 |
| Session 3 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 303301 | 13.400 | 23.110 | 8.630 | 29.070 | 33.440 |
| 303302 | 14.830 | 23.110 | 8.280 | 32.850 | 36.850 |
| 303303 | 14.830 | 22.170 | 8.280 | 32.850 | 36.850 |
| 303304 | 13.630 | 22.790 | 8.540 | 28.850 | 33.180 |
| 303305 | 12.670 | 24.020 | 10.120 | 29.950 | 34.040 |
| 303306 | 14.870 | 22.360 | 9.150 | 31.010 | 37.400 |
| 303307 | 14.000 | 23.330 | 8.360 | 29.900 | 34.300 |
| 303308 | 13.660 | 24.000 | 9.670 | 29.310 | 34.620 |
| 303309 | 15.320 | 23.640 | 8.680 | 29.630 | 37.570 |
| 303310 | 14.430 | 23.056 | 9.210 | 30.610 | 36.260 |
| Average | 14.164 | 0.000 | 8.892 | 30.403 | 35.451 |

BALANCE BALL SUBJECT 12 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 1 | Baseline | | | Mic Cal | 94 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 31101 | 37.103 | 53.997 | 16.894 | 588.686 | 2905.355 |
| 31102 | 31.735 | 53.878 | 22.143 | 582.475 | 2910.845 |
| 31103 | 28.788 | 53.331 | 24.543 | 589.065 | 2924.570 |
| 31104 | 29.081 | 52.884 | 23.803 | 588.775 | 2915.679 |
| 31105 | 31.908 | 55.127 | 23.219 | 583.523 | 2934.505 |
| 31106 | 32.754 | 56.183 | 23.429 | 579.700 | 2931.664 |
| 31107 | 32.540 | 54.308 | 21.768 | 581.495 | 2900.653 |
| 31108 | 32.636 | 54.377 | 21.741 | 590.262 | 2904.548 |
| 31109 | 30.342 | 53.694 | 23.352 | 581.113 | 2908.708 |
| 31110 | 30.506 | 54.369 | 23.863 | 586.923 | 2910.436 |
| Average | 31.739 | 54.215 | 22.476 | 585.202 | 2914.696 |
| Session 1 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 31201 | 33.380 | 55.042 | 21.662 | 583.572 | 2889.737 |
| 31202 | 29.095 | 53.621 | 24.526 | 591.876 | 2925.176 |
| 31203 | 32.159 | 53.658 | 21.499 | 590.361 | 2929.752 |
| 31204 | 31.138 | 53.927 | 22.789 | 588.633 | 2914.472 |
| 31205 | 30.358 | 54.530 | 24.172 | 590.096 | 2932.931 |
| 31206 | 30.477 | 52.645 | 22.168 | 595.721 | 2931.367 |
| 31207 | 31.415 | 55.384 | 23.969 | 581.721 | 2927.185 |
| 31208 | 33.045 | 53.857 | 20.812 | 588.483 | 2906.891 |
| 31209 | 29.951 | 53.784 | 23.833 | 591.440 | 2912.116 |
| 31210 | 32.117 | 53.713 | 21.596 | 594.502 | 2953.281 |
| Average | 31.314 | 54.016 | 22.703 | 589.641 | 2922.291 |
| Session 1 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 31301 | 32.677 | 55.922 | 23.245 | 581.878 | 2909.357 |
| 31302 | 29.195 | 54.153 | 24.958 | 588.395 | 2922.555 |
| 31303 | 29.954 | 54.635 | 24.681 | 581.231 | 2873.181 |
| 31304 | 34.742 | 57.639 | 22.897 | 582.307 | 2917.966 |
| 31305 | 34.024 | 56.860 | 22.836 | 588.582 | 2946.167 |
| 31306 | 32.390 | 56.028 | 23.638 | 590.862 | 2941.527 |
| 31307 | 31.415 | 55.384 | 23.969 | 581.721 | 2927.185 |
| 31308 | 30.555 | 55.489 | 24.934 | 586.427 | 2929.565 |
| 31309 | 43.268 | 56.971 | 13.703 | 50.000 | 2922.345 |
| 31310 | 29.141 | 53.910 | 24.769 | 586.341 | 2917.713 |
| Average | 32.736 | 55.699 | 22.963 | 531.774 | 2920.756 |

BALANCE BALL SUBJECT 12 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 1 | Baseline | | | Mic Cal | 94 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 31101 | 16.070 | 18.540 | 2.470 | 29.430 | 26.240 |
| 31102 | 16.660 | 19.500 | 2.840 | 27.640 | 26.490 |
| 31103 | 15.890 | 18.310 | 2.420 | 29.170 | 25.680 |
| 31104 | 16.040 | 18.440 | 2.400 | 29.110 | 27.550 |
| 31105 | 16.510 | 19.520 | 3.010 | 28.790 | 29.100 |
| 31106 | 15.690 | 19.800 | 4.110 | 28.560 | 28.440 |
| 31107 | 15.990 | 19.250 | 3.260 | 27.770 | 27.980 |
| 31108 | 14.960 | 20.320 | 5.360 | 31.020 | 28.590 |
| 31109 | 15.560 | 18.750 | 3.190 | 27.020 | 26.120 |
| 31110 | 16.190 | 21.220 | 5.030 | 29.700 | 30.410 |
| Average | 15.956 | 19.365 | 3.409 | 28.821 | 27.660 |
| Session 1 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 31201 | 17.170 | 22.050 | 4.880 | 29.690 | 28.190 |
| 31202 | 18.140 | 19.690 | 1.550 | 31.410 | 25.530 |
| 31203 | 16.710 | 20.800 | 4.090 | 31.230 | 24.080 |
| 31204 | 17.910 | 21.090 | 3.180 | 30.660 | 27.230 |
| 31205 | 18.040 | 20.450 | 2.410 | 32.990 | 24.870 |
| 31206 | 18.240 | 19.480 | 1.240 | 32.310 | 25.960 |
| 31207 | 15.600 | 19.870 | 4.270 | 27.950 | 29.320 |
| 31208 | 17.940 | 19.950 | 2.010 | 30.370 | 26.930 |
| 31209 | 17.810 | 19.440 | 1.630 | 32.140 | 24.490 |
| 31210 | 19.150 | 19.690 | 0.540 | 32.410 | 25.500 |
| Average | 17.671 | 20.251 | 2.580 | 31.116 | 26.210 |
| Session 1 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 31301 | 14.690 | 21.740 | 7.050 | 29.100 | 30.620 |
| 31302 | 14.790 | 21.750 | 6.960 | 30.170 | 30.320 |
| 31303 | 15.420 | 20.630 | 5.210 | 28.350 | 28.790 |
| 31304 | 13.780 | 21.660 | 7.880 | 29.530 | 29.430 |
| 31305 | 16.610 | 20.750 | 4.140 | 30.680 | 29.580 |
| 31306 | 14.640 | 20.530 | 5.890 | 31.650 | 28.620 |
| 31307 | 15.600 | 19.870 | 4.270 | 27.950 | 29.320 |
| 31308 | 14.450 | 19.680 | 5.230 | 29.900 | 28.790 |
| 31309 | 19.390 | 18.670 | -0.720 | 24.100 | 17.390 |
| 31310 | 16.340 | 20.380 | 4.040 | 29.480 | 29.390 |
| Average | 15.571 | 20.566 | 4.995 | 29.091 | 28.225 |

BALANCE BALL SUBJECT 12 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | Mic Cal | 87 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 32101 | 25.003 | 53.445 | 28.442 | 591.711 | 2930.868 |
| 32102 | 22.699 | 52.266 | 29.567 | 590.221 | 2949.018 |
| 32103 | 24.424 | 52.052 | 27.628 | 1195.842 | 2948.891 |
| 32104 | 23.441 | 52.657 | 29.216 | 590.110 | 2970.484 |
| 32105 | 25.291 | 49.786 | 24.495 | 601.354 | 2998.244 |
| 32106 | 26.298 | 51.286 | 24.988 | 599.716 | 2981.187 |
| 32107 | 23.466 | 51.954 | 28.488 | 605.998 | 3014.655 |
| 32108 | 23.061 | 53.422 | 30.361 | 584.145 | 2962.422 |
| 32109 | 23.486 | 52.401 | 28.915 | 593.778 | 2983.976 |
| 32110 | 25.072 | 52.636 | 27.564 | 588.520 | 2948.945 |
| Average | 24.224 | 52.191 | 27.966 | 654.140 | 2968.869 |
| Session 2 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 32201 | 25.003 | 53.442 | 28.439 | 591.711 | 2930.868 |
| 32202 | 28.260 | 51.605 | 23.345 | 598.107 | 2985.484 |
| 32203 | 24.424 | 52.049 | 27.625 | 1195.842 | 2948.891 |
| 32204 | 23.441 | 52.657 | 29.216 | 590.110 | 2970.484 |
| 32205 | 25.291 | 49.786 | 24.495 | 601.354 | 2998.244 |
| 32206 | 23.466 | 51.954 | 28.488 | 605.998 | 3014.655 |
| 32207 | 26.297 | 51.282 | 24.985 | 599.716 | 2981.112 |
| 32208 | 24.685 | 51.449 | 26.764 | 1195.456 | 2982.825 |
| 32209 | 25.206 | 51.433 | 26.227 | 603.929 | 3053.922 |
| 32210 | 28.473 | 51.185 | 22.712 | 594.981 | 2967.942 |
| Average | 25.455 | 51.684 | 26.230 | 717.720 | 2983.443 |
| Session 2 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 32301 | 25.128 | 54.183 | 29.055 | 600.912 | 3005.29 |
| 32302 | 27.759 | 54.924 | 27.165 | 597.231 | 2981.314 |
| 32303 | 22.213 | 54.511 | 32.298 | 597.015 | 2990.488 |
| 32304 | 25.261 | 54.645 | 29.384 | 602.556 | 2993.113 |
| 32305 | 27.587 | 57.344 | 29.757 | 606.943 | 3029.649 |
| 32306 | 28.730 | 57.687 | 28.957 | 613.23 | 3058.055 |
| 32307 | 24.336 | 54.398 | 30.062 | 595.701 | 2977.047 |
| 32308 | 27.825 | 56.056 | 28.231 | 610.306 | 3061.448 |
| 32309 | 27.239 | 53.297 | 26.058 | 600.839 | 3013.952 |
| 32310 | 26.889 | 55.040 | 28.151 | 606.339 | 3021.186 |
| Average | 26.297 | 55.209 | 28.9118 | 603.1072 | 3013.154 |

BALANCE BALL SUBJECT 12 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | Mic Cal | 87 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 302101 | 15.230 | 24.420 | 9.190 | 32.580 | 30.670 |
| 302102 | 14.360 | 23.060 | 8.700 | 30.540 | 28.960 |
| 302103 | 15.080 | 22.910 | 7.830 | 31.990 | 29.470 |
| 302104 | 13.680 | 22.450 | 8.770 | 30.020 | 28.710 |
| 302105 | 16.530 | 23.690 | 7.160 | 32.710 | 30.650 |
| 302106 | 15.530 | 22.950 | 7.420 | 32.540 | 28.390 |
| 302107 | 15.630 | 23.280 | 7.650 | 34.090 | 28.600 |
| 302108 | 14.940 | 24.540 | 9.600 | 30.030 | 32.490 |
| 302109 | 13.830 | 22.970 | 9.140 | 31.670 | 29.280 |
| 302110 | 14.420 | 22.630 | 8.210 | 29.870 | 28.190 |
| Average | 14.923 | 23.290 | 8.367 | 31.604 | 29.541 |
| Session 2 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 302201 | 15.230 | 24.420 | 9.190 | 32.570 | 30.670 |
| 302202 | 15.750 | 22.940 | 7.190 | 33.030 | 29.010 |
| 302203 | 15.080 | 22.900 | 7.820 | 31.980 | 29.460 |
| 302204 | 13.680 | 22.450 | 8.770 | 30.020 | 28.710 |
| 302205 | 16.530 | 23.690 | 7.160 | 32.710 | 30.650 |
| 302206 | 15.630 | 23.280 | 7.650 | 34.090 | 28.600 |
| 302207 | 15.540 | 22.940 | 7.400 | 32.540 | 28.380 |
| 302208 | 13.420 | 23.170 | 9.750 | 31.670 | 28.600 |
| 302209 | 14.650 | 23.650 | 9.000 | 33.120 | 28.630 |
| 302210 | 16.480 | 23.170 | 6.690 | 31.980 | 28.660 |
| Average | 15.199 | 23.261 | 8.062 | 32.371 | 29.137 |
| Session 2 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 302301 | 15.070 | 25.180 | 10.110 | 35.690 | 30.850 |
| 302302 | 14.220 | 24.590 | 10.370 | 34.160 | 31.950 |
| 302303 | 14.420 | 25.580 | 11.160 | 34.760 | 31.690 |
| 302304 | 14.880 | 24.270 | 9.390 | 35.300 | 30.470 |
| 302305 | 14.340 | 25.050 | 10.710 | 36.880 | 31.840 |
| 302306 | 13.200 | 23.460 | 10.260 | 36.510 | 29.470 |
| 302307 | 14.950 | 24.550 | 9.600 | 33.900 | 30.520 |
| 302308 | 14.360 | 25.200 | 10.840 | 36.090 | 32.190 |
| 302309 | 15.010 | 24.120 | 9.110 | 34.600 | 30.270 |
| 302310 | 15.670 | 24.220 | 8.550 | 35.650 | 30.410 |
| Average | 14.612 | 24.622 | 10.010 | 35.354 | 30.966 |

BALANCE BALL SUBJECT 12 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | Mic Cal | 89 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 303101 | 27.301 | 55.718 | 28.417 | 590.102 | 2956.933 |
| 303102 | 26.181 | 54.765 | 28.584 | 595.513 | 2953.034 |
| 303103 | 25.298 | 55.643 | 30.345 | 606.244 | 3011.886 |
| 303104 | 26.950 | 56.027 | 29.077 | 594.064 | 2987.583 |
| 303105 | 25.232 | 54.413 | 29.181 | 593.789 | 2969.066 |
| 303106 | 25.686 | 53.989 | 28.303 | 593.969 | 2986.208 |
| 303107 | 24.149 | 53.767 | 29.618 | 594.882 | 2972.661 |
| 303108 | 25.311 | 54.096 | 28.785 | 600.564 | 3009.598 |
| 303109 | 24.743 | 54.322 | 29.579 | 602.466 | 3003.390 |
| 303110 | 25.146 | 54.441 | 29.295 | 596.635 | 2981.832 |
| Average | 25.600 | 54.718 | 29.1184 | 596.823 | 2983.219 |
| Session 3 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 303201 | 34.285 | 55.706 | 21.421 | 591.87 | 2948.668 |
| 303202 | 29.821 | 52.688 | 22.867 | 593.835 | 2986.01 |
| 303203 | 29.728 | 53.147 | 23.419 | 594.39 | 2970.317 |
| 303204 | 28.358 | 55.242 | 26.884 | 602.745 | 2999.123 |
| 303205 | 29.774 | 53.599 | 23.825 | 593.058 | 2997.335 |
| 303206 | 31.120 | 53.382 | 22.262 | 599.859 | 2992.279 |
| 303207 | 28.777 | 54.512 | 25.735 | 589.221 | 2951.84 |
| 303208 | 27.762 | 53.391 | 25.629 | 596.032 | 2988.773 |
| 303209 | 31.440 | 53.074 | 21.634 | 600.393 | 2986.795 |
| 303210 | 31.282 | 55.292 | 24.01 | 590.257 | 2955.674 |
| Average | 30.235 | 54.003 | 23.7686 | 595.166 | 2977.681 |
| Session 3 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 303301 | 27.338 | 55.387 | 28.049 | 592.705 | 2982.788 |
| 303302 | 25.693 | 53.671 | 27.978 | 596.651 | 2976.666 |
| 303303 | 24.654 | 55.543 | 30.889 | 595.87 | 2960.886 |
| 303304 | 24.637 | 55.041 | 30.404 | 597.19 | 2988.77 |
| 303305 | 23.622 | 53.942 | 30.32 | 595.712 | 2970.662 |
| 303306 | 25.523 | 54.080 | 28.557 | 590.934 | 2931.844 |
| 303307 | 24.217 | 55.101 | 30.884 | 592.18 | 2976.652 |
| 303308 | 24.844 | 54.909 | 30.065 | 587.064 | 2974.557 |
| 303309 | 25.235 | 54.147 | 28.912 | 596.936 | 2990.287 |
| 303310 | 25.223 | 54.144 | 28.921 | 596.893 | 2989.682 |
| Average | 25.099 | 54.597 | 29.4979 | 585.109 | 2625.198 |

BALANCE BALL SUBJECT 12 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | Mic Cal | 89 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 303101 | 15.230 | 29.050 | 13.820 | 36.380 | 32.330 |
| 303102 | 14.690 | 23.560 | 8.870 | 34.520 | 28.400 |
| 303103 | 14.730 | 24.030 | 9.300 | 35.700 | 30.170 |
| 303104 | 14.000 | 23.960 | 9.960 | 33.860 | 29.180 |
| 303105 | 15.000 | 24.610 | 9.610 | 33.590 | 30.490 |
| 303106 | 13.930 | 23.730 | 9.800 | 32.710 | 29.200 |
| 303107 | 14.160 | 22.860 | 8.700 | 32.950 | 27.770 |
| 303108 | 14.080 | 24.130 | 10.050 | 35.200 | 28.830 |
| 303109 | 15.850 | 23.940 | 8.090 | 35.740 | 29.580 |
| 303110 | 14.760 | 23.380 | 8.620 | 34.480 | 28.140 |
| Average | 14.643 | 24.325 | 9.682 | 34.513 | 29.409 |
| Session 3 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 303201 | 13.910 | 23.160 | 9.250 | 32.800 | 26.000 |
| 303202 | 15.070 | 22.290 | 7.220 | 31.760 | 26.480 |
| 303203 | 14.490 | 22.740 | 8.250 | 32.660 | 27.310 |
| 303204 | 14.400 | 24.990 | 10.590 | 38.060 | 29.630 |
| 303205 | 14.130 | 22.110 | 7.980 | 32.200 | 25.750 |
| 303206 | 15.470 | 25.560 | 10.090 | 34.980 | 27.000 |
| 303207 | 13.370 | 21.940 | 8.570 | 31.470 | 25.990 |
| 303208 | 13.840 | 22.870 | 9.030 | 32.350 | 27.590 |
| 303209 | 14.560 | 22.220 | 7.660 | 34.370 | 25.900 |
| 303210 | 14.240 | 22.750 | 8.510 | 32.480 | 26.250 |
| Average | 14.348 | 23.063 | 8.715 | 33.313 | 26.790 |
| Session 3 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 303301 | 15.470 | 24.140 | 9.090 | 33.310 | 30.080 |
| 303302 | 15.110 | 23.810 | 9.030 | 33.120 | 29.580 |
| 303303 | 13.940 | 24.940 | 9.870 | 34.320 | 28.680 |
| 303304 | 15.020 | 24.520 | 9.920 | 35.260 | 32.590 |
| 303305 | 14.550 | 24.090 | 9.970 | 34.240 | 30.290 |
| 303306 | 14.540 | 24.890 | 9.550 | 32.060 | 28.840 |
| 303307 | 14.460 | 22.960 | 10.430 | 33.620 | 30.430 |
| 303308 | 12.400 | 24.090 | 10.560 | 31.680 | 28.100 |
| 303309 | 13.060 | 25.700 | 11.030 | 34.320 | 29.630 |
| 303310 | 13.420 | 24.370 | 12.280 | 34.450 | 29.970 |
| Average | 14.197 | 0.000 | 10.173 | 33.638 | 29.819 |

CASE STUDY SUBJECT 1 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 1 | Baseline | | | Mic Cal | 69 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 11101 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 11102 | SPR | Max I 0-2kHz | Max2-4kHz | Peak Hz 0-2kHz | Peak Hz 2-4kHz |
| 11103 | 36.435 | 53.021 | 16.586 | 569.569 | 2933.251 |
| 11104 | 40.464 | 52.014 | 11.550 | 585.862 | 2970.870 |
| 11105 | 39.757 | 52.510 | 12.753 | 581.722 | 2914.519 |
| 11106 | 37.323 | 54.794 | 17.471 | 582.894 | 2975.382 |
| 11107 | 37.657 | 54.599 | 16.942 | 570.975 | 2946.117 |
| 11108 | 39.649 | 54.598 | 14.949 | 573.517 | 2966.062 |
| 11109 | 37.713 | 53.173 | 15.460 | 570.839 | 2943.063 |
| 11110 | 38.775 | 52.539 | 13.764 | 580.122 | 2964.364 |
| Average | 36.986 | 52.863 | 15.877 | 573.597 | 2932.735 |
| Session 1 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 11201 | 38.120 | 53.314 | 15.194 | 575.881 | 2947.958 |
| 11202 | 35.377 | 50.758 | 15.381 | 585.051 | 2926.055 |
| 11203 | 36.045 | 52.305 | 16.260 | 1169.963 | 2874.378 |
| 11204 | 35.133 | 52.566 | 17.433 | 1164.217 | 2885.744 |
| 11205 | 36.790 | 52.788 | 15.998 | 1161.113 | 2887.445 |
| 11206 | 32.204 | 51.711 | 19.507 | 1178.339 | 2964.929 |
| 11207 | 33.885 | 52.988 | 19.103 | 1174.169 | 2951.665 |
| 11208 | 35.135 | 52.494 | 17.359 | 1174.211 | 2948.733 |
| 11209 | 33.554 | 52.011 | 18.457 | 573.370 | 2952.245 |
| 11210 | 32.323 | 52.116 | 19.793 | 574.691 | 2945.210 |
| Average | 32.718 | 51.974 | 19.256 | 568.655 | 2935.513 |
| Session 1 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 11301 | 38.400 | 50.239 | 11.839 | 1175.256 | 2879.173 |
| 11302 | 39.912 | 51.545 | 11.633 | 1160.941 | 3441.698 |
| 11303 | 36.737 | 50.859 | 14.122 | 1154.785 | 2937.607 |
| 11304 | 38.720 | 49.787 | 11.067 | 1175.158 | 2939.340 |
| 11305 | 36.137 | 51.486 | 15.349 | 1175.676 | 2956.588 |
| 11306 | 37.222 | 50.095 | 12.873 | 575.426 | 2954.546 |
| 11307 | 37.215 | 50.111 | 12.896 | 575.428 | 2959.711 |
| 11308 | 34.895 | 49.779 | 14.884 | 583.628 | 2967.276 |
| 11309 | 37.026 | 50.237 | 13.211 | 577.551 | 2962.632 |
| 11310 | 39.183 | 50.263 | 11.080 | 565.444 | 2958.229 |
| Average | 37.545 | 50.440 | 12.895 | 871.929 | 2995.680 |

CASE STUDY SUBJECT 1 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 1 | Baseline | | | Mic Cal | 97 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 11101 | 36.435 | 53.021 | 16.586 | 569.569 | 2933.251 |
| 11102 | 40.464 | 52.014 | 11.550 | 585.862 | 2970.870 |
| 11103 | 39.757 | 52.510 | 12.753 | 581.722 | 2914.519 |
| 11104 | 37.323 | 54.794 | 17.471 | 582.894 | 2975.382 |
| 11105 | 37.657 | 54.599 | 16.942 | 570.975 | 2946.117 |
| 11106 | 39.649 | 54.598 | 14.949 | 573.517 | 2966.062 |
| 11107 | 37.713 | 53.173 | 15.460 | 570.839 | 2943.063 |
| 11108 | 38.775 | 52.539 | 13.764 | 580.122 | 2964.364 |
| 11109 | 36.986 | 52.863 | 15.877 | 573.597 | 2932.735 |
| 11110 | 36.442 | 53.027 | 16.585 | 569.709 | 2933.215 |
| Average | 38.120 | 53.314 | 15.194 | 575.881 | 2947.958 |
| Session 1 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 11201 | 35.377 | 50.758 | 15.381 | 585.051 | 2926.055 |
| 11202 | 36.045 | 52.305 | 16.260 | 1169.963 | 2874.378 |
| 11203 | 35.133 | 52.566 | 17.433 | 1164.217 | 2885.744 |
| 11204 | 36.790 | 52.788 | 15.998 | 1161.113 | 2887.445 |
| 11205 | 32.204 | 51.711 | 19.507 | 1178.339 | 2964.929 |
| 11206 | 33.885 | 52.988 | 19.103 | 1174.169 | 2951.665 |
| 11207 | 35.135 | 52.494 | 17.359 | 1174.211 | 2948.733 |
| 11208 | 33.554 | 52.011 | 18.457 | 573.370 | 2952.245 |
| 11209 | 32.323 | 52.116 | 19.793 | 574.691 | 2945.210 |
| 11210 | 32.718 | 51.974 | 19.256 | 568.655 | 2935.513 |
| Average | 34.316 | 52.171 | 17.855 | 932.378 | 2927.192 |
| Session 1 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 11301 | 38.400 | 50.239 | 11.839 | 1175.256 | 2879.173 |
| 11302 | 39.912 | 51.545 | 11.633 | 1160.941 | 3441.698 |
| 11303 | 36.737 | 50.859 | 14.122 | 1154.785 | 2937.607 |
| 11304 | 38.720 | 49.787 | 11.067 | 1175.158 | 2939.340 |
| 11305 | 36.137 | 51.486 | 15.349 | 1175.676 | 2956.588 |
| 11306 | 37.222 | 50.095 | 12.873 | 575.426 | 2954.546 |
| 11307 | 37.215 | 50.111 | 12.896 | 575.428 | 2959.711 |
| 11308 | 34.895 | 49.779 | 14.884 | 583.628 | 2967.276 |
| 11309 | 37.026 | 50.237 | 13.211 | 577.551 | 2962.632 |
| 11310 | 39.183 | 50.263 | 11.080 | 565.444 | 2958.229 |
| Average | 37.545 | 50.440 | 12.895 | 871.929 | 2995.680 |

CASE STUDY SUBJECT 1 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 1 | Baseline | | | Mic Cal | 97 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 11101 | 16.140 | 5.510 | 21.650 | 28.710 | 26.150 |
| 11102 | 15.910 | 5.920 | 21.830 | 33.210 | 27.990 |
| 11103 | 15.500 | 6.090 | 21.590 | 32.300 | 26.600 |
| 11104 | 17.810 | 5.010 | 22.820 | 34.670 | 28.630 |
| 11105 | 15.520 | 5.530 | 21.050 | 29.500 | 25.970 |
| 11106 | 15.300 | 6.090 | 21.390 | 30.150 | 26.880 |
| 11107 | 16.110 | 4.110 | 20.220 | 28.720 | 25.250 |
| 11108 | 16.710 | 4.850 | 21.560 | 30.840 | 27.690 |
| 11109 | 14.650 | 6.260 | 20.910 | 29.450 | 26.400 |
| 11110 | 15.690 | 5.390 | 21.080 | 28.700 | 26.130 |
| Average | 15.934 | 5.476 | 21.410 | 30.625 | 26.769 |
| Session 1 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 11201 | 15.300 | 5.880 | 21.180 | 31.550 | 27.560 |
| 11202 | 14.840 | 6.120 | 20.960 | 28.890 | 26.170 |
| 11203 | 15.460 | 4.910 | 20.370 | 28.190 | 25.510 |
| 11204 | 15.620 | 4.890 | 20.510 | 27.540 | 25.840 |
| 11205 | 15.740 | 5.770 | 21.510 | 30.120 | 27.360 |
| 11206 | 13.680 | 7.830 | 21.510 | 30.290 | 27.430 |
| 11207 | 15.610 | 5.900 | 21.510 | 29.730 | 26.880 |
| 11208 | 14.940 | 5.990 | 20.930 | 29.240 | 25.800 |
| 11209 | 14.030 | 7.100 | 21.130 | 29.440 | 25.990 |
| 11210 | 13.400 | 5.710 | 19.110 | 26.800 | 23.740 |
| Average | 14.862 | 6.010 | 20.872 | 29.179 | 26.228 |
| Session 1 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 11301 | 13.400 | 5.220 | 18.620 | 26.670 | 24.310 |
| 11302 | 15.760 | 3.260 | 19.020 | 24.770 | 23.230 |
| 11303 | 11.330 | 6.780 | 18.110 | 24.680 | 22.220 |
| 11304 | 15.550 | 3.760 | 19.310 | 28.260 | 24.260 |
| 11305 | 14.940 | 5.640 | 20.580 | 29.610 | 25.630 |
| 11306 | 15.280 | 4.260 | 19.540 | 28.510 | 23.470 |
| 11307 | 15.050 | 5.410 | 20.460 | 28.670 | 25.040 |
| 11308 | 17.530 | 2.990 | 20.520 | 30.080 | 25.130 |
| 11309 | 16.720 | 3.490 | 20.210 | 28.780 | 25.080 |
| 11310 | 15.020 | 4.150 | 19.170 | 24.540 | 22.760 |
| Average | 15.058 | 4.496 | 19.554 | 27.457 | 24.113 |

CASE STUDY SUBJECT 1 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | Mic Cal | 90 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 12101 | 32.432 | 50.732 | 18.300 | 583.925 | 2974.387 |
| 12102 | 31.588 | 50.536 | 18.948 | 580.362 | 2925.165 |
| 12103 | 36.639 | 50.191 | 13.552 | 575.391 | 2902.824 |
| 12104 | 32.597 | 49.822 | 17.225 | 579.431 | 2963.124 |
| 12105 | 31.571 | 50.824 | 19.253 | 586.003 | 2972.202 |
| 12106 | 33.518 | 51.316 | 17.798 | 579.435 | 2952.327 |
| 12107 | 32.045 | 51.019 | 18.974 | 585.747 | 2959.677 |
| 12108 | 33.701 | 50.271 | 16.570 | 572.938 | 2945.804 |
| 12109 | 32.432 | 49.419 | 16.987 | 583.930 | 2974.399 |
| 12110 | 34.095 | 50.381 | 16.286 | 579.441 | 2960.370 |
| Average | 33.062 | 50.451 | 17.389 | 580.660 | 2953.028 |
| Session 2 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 12201 | 34.089 | 50.954 | 16.865 | 584.226 | 3512.138 |
| 12202 | 31.537 | 48.654 | 17.117 | 583.151 | 2974.201 |
| 12203 | 34.112 | 50.839 | 16.727 | 576.180 | 2958.685 |
| 12204 | 34.069 | 51.045 | 16.976 | 574.842 | 2940.928 |
| 12205 | 36.622 | 50.805 | 14.183 | 581.092 | 2953.904 |
| 12206 | 33.047 | 49.920 | 16.873 | 584.697 | 2950.123 |
| 12207 | 33.351 | 50.205 | 16.854 | 570.751 | 2919.071 |
| 12208 | 35.019 | 50.319 | 15.300 | 568.972 | 2945.744 |
| 12209 | 34.393 | 50.270 | 15.877 | 573.212 | 2921.992 |
| 12210 | 35.076 | 50.260 | 15.184 | 571.896 | 2939.615 |
| Average | 34.132 | 50.327 | 16.196 | 576.902 | 3001.640 |
| Session 2 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 12301 | 29.635 | 49.777 | 20.142 | 579.474 | 2961.171 |
| 12302 | 29.492 | 49.643 | 20.151 | 584.225 | 2948.724 |
| 12303 | 34.031 | 50.973 | 16.942 | 576.081 | 3470.251 |
| 12304 | 34.698 | 51.337 | 16.639 | 565.980 | 2927.520 |
| 12305 | 33.816 | 51.644 | 17.828 | 578.912 | 2957.887 |
| 12306 | 35.683 | 50.867 | 15.184 | 566.639 | 2922.326 |
| 12307 | 35.569 | 50.578 | 15.009 | 572.961 | 2930.766 |
| 12308 | 34.435 | 52.215 | 17.780 | 569.868 | 3468.706 |
| 12309 | 34.884 | 51.140 | 16.256 | 571.867 | 2939.239 |
| 12310 | 33.202 | 51.063 | 17.861 | 566.862 | 3495.065 |
| Average | 33.545 | 50.924 | 17.379 | 573.287 | 3102.166 |

CASE STUDY SUBJECT 1 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | Mic Cal | 90 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 12101 | 11.540 | 7.590 | 19.130 | 28.400 | 22.820 |
| 12102 | 12.710 | 5.950 | 18.660 | 26.560 | 22.220 |
| 12103 | 14.150 | 3.800 | 17.950 | 25.500 | 21.680 |
| 12104 | 14.480 | 4.570 | 19.050 | 26.550 | 22.220 |
| 12105 | 13.730 | 5.800 | 19.530 | 28.630 | 23.140 |
| 12106 | 14.600 | 4.830 | 19.430 | 28.050 | 22.750 |
| 12107 | 14.200 | 5.500 | 19.700 | 28.450 | 23.420 |
| 12108 | 12.810 | 4.990 | 17.800 | 25.780 | 20.940 |
| 12109 | 11.540 | 6.280 | 17.820 | 27.090 | 21.510 |
| 12110 | 13.980 | 4.780 | 18.760 | 26.240 | 22.340 |
| Average | 13.374 | 5.409 | 18.783 | 27.125 | 22.304 |
| Session 2 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 12201 | 14.590 | 5.080 | 19.670 | 27.730 | 23.430 |
| 12202 | 13.780 | 5.330 | 19.110 | 28.130 | 23.650 |
| 12203 | 14.310 | 3.770 | 18.080 | 25.930 | 20.930 |
| 12204 | 13.770 | 4.950 | 18.720 | 25.220 | 21.760 |
| 12205 | 12.420 | 6.860 | 19.280 | 27.270 | 23.640 |
| 12206 | 14.140 | 5.110 | 19.250 | 29.160 | 23.170 |
| 12207 | 12.870 | 5.330 | 18.200 | 24.650 | 22.170 |
| 12208 | 14.590 | 3.530 | 18.120 | 24.780 | 21.300 |
| 12209 | 13.990 | 4.600 | 18.590 | 25.420 | 21.800 |
| 12210 | 14.720 | 3.620 | 18.340 | 25.450 | 21.210 |
| Average | 13.918 | 4.818 | 18.736 | 26.374 | 22.306 |
| Session 2 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 12301 | 10.230 | 8.650 | 18.880 | 26.300 | 23.010 |
| 12302 | 14.570 | 4.680 | 19.250 | 27.410 | 23.240 |
| 12303 | 11.370 | 7.370 | 18.740 | 25.300 | 22.780 |
| 12304 | 13.520 | 4.360 | 17.880 | 23.900 | 20.230 |
| 12305 | 14.030 | 6.560 | 20.590 | 28.100 | 25.150 |
| 12306 | 14.160 | 3.770 | 17.930 | 24.380 | 20.740 |
| 12307 | 12.700 | 5.920 | 18.620 | 24.720 | 22.060 |
| 12308 | 12.760 | 5.970 | 18.730 | 25.840 | 21.670 |
| 12309 | 14.180 | 4.950 | 19.130 | 25.370 | 22.560 |
| 12310 | 13.230 | 4.710 | 17.940 | 23.190 | 21.490 |
| Average | 13.075 | 5.694 | 18.769 | 25.451 | 22.293 |

CASE STUDY SUBJECT 1 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | Mic Cal | 94 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 13101 | 39.577 | 59.695 | 20.118 | 582.337 | 2971.807 |
| 13102 | 37.968 | 57.911 | 19.943 | 580.591 | 2960.272 |
| 13103 | 39.694 | 58.568 | 18.874 | 569.997 | 2943.750 |
| 13104 | 43.162 | 59.642 | 16.48 | 582.500 | 3562.157 |
| 13105 | 41.684 | 59.585 | 17.901 | 577.555 | 3552.314 |
| 13106 | 43.779 | 59.079 | 15.3 | 573.358 | 2956.714 |
| 13107 | 43.203 | 59.780 | 16.577 | 574.868 | 2944.865 |
| 13108 | 44.284 | 59.667 | 15.383 | 578.539 | 3539.433 |
| 13109 | 42.762 | 60.049 | 17.287 | 576.249 | 3550.020 |
| 13110 | 42.589 | 59.551 | 16.962 | 577.757 | 3563.041 |
| Average | 41.870 | 59.353 | 17.4825 | 577.375 | 3254.437 |
| Session 3 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 13201 | 43.276 | 59.690 | 16.414 | 572.050 | 2902.376 |
| 13202 | 41.515 | 59.038 | 17.523 | 587.062 | 3002.880 |
| 13203 | 41.971 | 59.212 | 17.241 | 571.210 | 2925.335 |
| 13204 | 41.684 | 58.423 | 16.739 | 571.198 | 2890.804 |
| 13205 | 39.275 | 58.581 | 19.306 | 573.232 | 2956.041 |
| 13206 | 40.146 | 58.879 | 18.733 | 574.388 | 2944.667 |
| 13207 | 36.257 | 58.381 | 22.124 | 573.983 | 2926.675 |
| 13208 | 38.459 | 58.787 | 20.328 | 572.108 | 2916.006 |
| 13209 | 37.327 | 58.954 | 21.627 | 574.988 | 2952.350 |
| 13210 | 40.292 | 59.073 | 18.781 | 574.510 | 2953.703 |
| Average | 40.020 | 58.902 | 18.882 | 574.473 | 2937.084 |
| Session 3 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 13301 | 38.804 | 56.044 | 17.240 | 574.085 | 2899.923 |
| 13302 | 40.580 | 55.842 | 15.262 | 567.599 | 2897.077 |
| 13303 | 39.071 | 56.860 | 17.789 | 573.856 | 2935.826 |
| 13304 | 38.978 | 49.789 | 10.811 | 1175.137 | 2933.306 |
| 13305 | 40.729 | 56.505 | 15.776 | 571.984 | 3507.305 |
| 13306 | 40.097 | 56.491 | 16.394 | 583.339 | 3487.573 |
| 13307 | 38.522 | 57.148 | 18.626 | 571.740 | 3475.047 |
| 13308 | 40.665 | 56.803 | 16.138 | 569.454 | 3481.610 |
| 13309 | 37.090 | 50.240 | 13.150 | 577.623 | 2961.718 |
| 13310 | 41.255 | 56.682 | 15.427 | 573.411 | 3524.926 |
| Average | 39.579 | 55.240 | 15.661 | 633.823 | 3210.431 |

CASE STUDY SUBJECT 1 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | Mic Cal | 94 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 13101 | 20.180 | 4.400 | 24.580 | 35.750 | 30.270 |
| 13102 | 18.990 | 4.510 | 23.500 | 34.400 | 29.470 |
| 13103 | 17.490 | 4.190 | 21.680 | 31.710 | 27.090 |
| 13104 | 21.630 | 2.010 | 23.640 | 36.330 | 29.030 |
| 13105 | 20.420 | 3.150 | 23.570 | 35.280 | 28.940 |
| 13106 | 20.340 | 2.860 | 23.200 | 35.050 | 27.850 |
| 13107 | 18.640 | 4.700 | 23.340 | 35.970 | 28.240 |
| 13108 | 18.710 | 4.960 | 23.670 | 36.790 | 29.630 |
| 13109 | 19.870 | 3.770 | 23.640 | 36.250 | 28.700 |
| 13110 | 19.980 | 3.860 | 23.840 | 37.130 | 28.990 |
| Average | 19.625 | 3.841 | 23.466 | 35.466 | 28.821 |
| Session 3 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 13201 | 18.890 | 4.770 | 23.660 | 33.820 | 29.020 |
| 13202 | 20.320 | 5.010 | 25.330 | 39.430 | 31.680 |
| 13203 | 19.450 | 3.220 | 22.670 | 34.170 | 28.020 |
| 13204 | 18.570 | 4.230 | 22.800 | 33.310 | 28.830 |
| 13205 | 19.420 | 4.170 | 23.590 | 35.460 | 29.520 |
| 13206 | 19.000 | 4.900 | 23.900 | 35.620 | 28.980 |
| 13207 | 18.470 | 4.910 | 23.380 | 33.260 | 28.730 |
| 13208 | 18.140 | 5.300 | 23.440 | 33.780 | 28.350 |
| 13209 | 18.360 | 5.150 | 23.510 | 34.690 | 29.000 |
| 13210 | 17.730 | 5.870 | 23.600 | 34.890 | 29.310 |
| Average | 18.835 | 4.753 | 23.588 | 34.843 | 29.144 |
| Session 3 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 13301 | 15.990 | 5.820 | 21.810 | 30.530 | 27.610 |
| 13302 | 16.450 | 4.200 | 20.650 | 28.250 | 25.420 |
| 13303 | 15.970 | 6.090 | 22.060 | 31.610 | 27.440 |
| 13304 | 16.310 | 2.920 | 19.230 | 28.270 | 24.310 |
| 13305 | 19.390 | 4.380 | 23.770 | 32.730 | 27.390 |
| 13306 | 19.390 | 4.080 | 23.470 | 35.340 | 29.570 |
| 13307 | 18.040 | 4.490 | 22.530 | 32.670 | 27.200 |
| 13308 | 19.170 | 2.720 | 21.890 | 32.180 | 26.780 |
| 13309 | 17.580 | 2.540 | 20.120 | 28.780 | 25.050 |
| 13310 | 16.570 | 5.560 | 22.130 | 32.850 | 27.060 |
| Average | 17.486 | 4.280 | 21.766 | 31.321 | 26.783 |

CASE STUDY SUBJECT 2 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases All Test Sessions

| Session 1 | Baseline | | | Mic Cal | 61 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 21101 | 35.971 | 55.872 | 19.901 | 569.180 | 2887.338 |
| 21102 | 36.861 | 56.109 | 19.248 | 578.937 | 2902.779 |
| 21103 | 35.186 | 55.652 | 20.466 | 571.783 | 2916.835 |
| 21104 | 36.862 | 56.372 | 19.510 | 576.630 | 2935.100 |
| 21105 | 37.292 | 57.143 | 19.851 | 574.275 | 2921.405 |
| 21106 | 37.187 | 57.283 | 20.096 | 581.475 | 3781.459 |
| 21107 | 36.915 | 57.214 | 20.299 | 579.432 | 3795.191 |
| 21108 | 33.152 | 57.477 | 24.325 | 577.469 | 3800.536 |
| 21109 | 38.132 | 56.707 | 18.575 | 579.377 | 3796.886 |
| 21110 | 36.129 | 56.512 | 20.383 | 581.253 | 2914.961 |
| Average | 36.369 | 56.634 | 20.265 | 576.981 | 3265.249 |
| Session 1 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 21201 | 32.778 | 56.372 | 23.594 | 587.561 | 3803.066 |
| 21202 | 36.335 | 56.717 | 20.382 | 588.303 | 3831.860 |
| 21203 | 36.833 | 56.940 | 20.107 | 587.455 | 2942.112 |
| 21204 | 38.189 | 55.823 | 17.634 | 586.688 | 2946.762 |
| 21205 | 33.318 | 56.329 | 23.011 | 587.079 | 2940.548 |
| 21206 | 30.801 | 57.373 | 26.572 | 587.462 | 2935.204 |
| 21207 | 34.101 | 56.434 | 22.333 | 584.956 | 2921.834 |
| 21208 | 35.949 | 57.743 | 21.794 | 585.495 | 3799.097 |
| 21209 | 34.326 | 57.647 | 23.321 | 586.125 | 3793.396 |
| 21210 | 35.409 | 57.310 | 21.901 | 585.478 | 2656.663 |
| Average | 34.804 | 56.869 | 22.065 | 586.660 | 3257.054 |
| Session 1 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 21301 | 31.212 | 56.932 | 25.720 | 574.495 | 2914.980 |
| 21302 | 32.464 | 57.713 | 25.249 | 584.471 | 2936.313 |
| 21303 | 30.935 | 57.708 | 26.773 | 584.675 | 2932.833 |
| 21304 | 30.556 | 57.529 | 26.973 | 584.065 | 2920.263 |
| 21305 | 30.802 | 57.949 | 27.147 | 585.547 | 2938.352 |
| 21306 | 33.183 | 57.705 | 24.522 | 582.743 | 2940.130 |
| 21307 | 33.566 | 57.273 | 23.707 | 584.476 | 2931.425 |
| 21308 | 30.283 | 56.739 | 26.456 | 583.634 | 2922.522 |
| 21309 | 33.221 | 56.412 | 23.191 | 586.887 | 2931.100 |
| 21310 | 30.145 | 56.723 | 26.578 | 581.924 | 2934.863 |
| Average | 31.637 | 57.268 | 25.632 | 583.292 | 2930.278 |

CASE STUDY SUBJECT 2 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | Mic Cal | 94 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 21101 | 35.958 | 59.910 | 23.952 | 580.538 | 3786.705 |
| 21102 | 43.458 | 61.861 | 18.403 | 577.607 | 2927.793 |
| 21103 | 38.988 | 61.695 | 22.707 | 585.649 | 2922.076 |
| 21104 | 40.236 | 61.708 | 21.472 | 582.726 | 2921.336 |
| 21105 | 30.122 | 60.804 | 30.682 | 586.341 | 2924.814 |
| 21106 | 35.281 | 61.476 | 26.195 | 583.985 | 2922.053 |
| 21107 | 41.488 | 61.554 | 20.066 | 584.801 | 2926.635 |
| 21108 | 37.472 | 62.911 | 25.439 | 585.187 | 2922.217 |
| 21109 | 42.651 | 62.814 | 20.163 | 584.004 | 2941.351 |
| 21110 | 41.930 | 61.749 | 19.819 | 585.890 | 2930.233 |
| Average | 38.758 | 61.648 | 22.890 | 583.673 | 3012.521 |
| Session 1 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 21201 | 40.732 | 60.418 | 19.686 | 588.279 | 2949.048 |
| 21202 | 39.656 | 61.725 | 22.069 | 579.770 | 2926.840 |
| 21203 | 39.535 | 62.756 | 23.221 | 580.458 | 2929.248 |
| 21204 | 38.841 | 62.288 | 23.447 | 584.548 | 3550.532 |
| 21205 | 39.904 | 62.253 | 22.349 | 580.966 | 2930.231 |
| 21206 | 37.551 | 63.207 | 25.656 | 579.095 | 3537.665 |
| 21207 | 39.779 | 62.326 | 22.547 | 580.463 | 2627.759 |
| 21208 | 39.898 | 63.210 | 23.312 | 579.171 | 3508.111 |
| 21209 | 35.543 | 62.979 | 27.436 | 580.340 | 2917.977 |
| 21210 | 41.288 | 60.298 | 19.010 | 579.424 | 2906.663 |
| Average | 39.273 | 62.146 | 22.873 | 581.251 | 3078.407 |
| Session 1 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 21301 | 42.743 | 60.776 | 18.033 | 576.289 | 2906.949 |
| 21302 | 38.691 | 61.007 | 22.316 | 582.122 | 2630.975 |
| 21303 | 41.403 | 62.199 | 20.796 | 579.081 | 2630.240 |
| 21304 | 43.399 | 61.576 | 18.177 | 578.426 | 2645.519 |
| 21305 | 42.527 | 62.861 | 20.334 | 584.245 | 2662.360 |
| 21306 | 43.300 | 60.802 | 17.502 | 590.086 | 2672.344 |
| 21307 | 46.678 | 62.089 | 15.411 | 587.337 | 2661.512 |
| 21308 | 43.403 | 63.169 | 19.766 | 586.884 | 2932.730 |
| 21309 | 45.899 | 62.426 | 16.527 | 582.991 | 3817.805 |
| 21310 | 39.171 | 62.574 | 23.403 | 583.041 | 2949.743 |
| Average | 42.721 | 61.948 | 19.227 | 583.050 | 2851.018 |

CASE STUDY SUBJECT 2 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | Mic Cal | 94 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 22101 | 35.958 | 59.910 | 23.952 | 580.538 | 3786.705 |
| 22102 | 43.458 | 61.861 | 18.403 | 577.607 | 2927.793 |
| 22103 | 38.988 | 61.695 | 22.707 | 585.649 | 2922.076 |
| 22104 | 40.236 | 61.708 | 21.472 | 582.726 | 2921.336 |
| 22105 | 30.122 | 60.804 | 30.682 | 586.341 | 2924.814 |
| 22106 | 35.281 | 61.476 | 26.195 | 583.985 | 2922.053 |
| 22107 | 41.488 | 61.554 | 20.066 | 584.801 | 2926.635 |
| 22108 | 37.472 | 62.911 | 25.439 | 585.187 | 2922.217 |
| 22109 | 42.651 | 62.814 | 20.163 | 584.004 | 2941.351 |
| 22110 | 41.930 | 61.749 | 19.819 | 585.890 | 2930.233 |
| Average | 38.758 | 61.648 | 22.890 | 583.673 | 3012.521 |
| Session 2 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 22201 | 40.732 | 60.418 | 19.686 | 588.279 | 2949.048 |
| 22202 | 39.656 | 61.725 | 22.069 | 579.770 | 2926.840 |
| 22203 | 39.535 | 62.756 | 23.221 | 580.458 | 2929.248 |
| 22204 | 38.841 | 62.288 | 23.447 | 584.548 | 3550.532 |
| 22205 | 39.904 | 62.253 | 22.349 | 580.966 | 2930.231 |
| 22206 | 37.551 | 63.207 | 25.656 | 579.095 | 3537.665 |
| 22207 | 39.779 | 62.326 | 22.547 | 580.463 | 2627.759 |
| 22208 | 39.898 | 63.210 | 23.312 | 579.171 | 3508.111 |
| 22209 | 35.543 | 62.979 | 27.436 | 580.340 | 2917.977 |
| 22210 | 41.288 | 60.298 | 19.010 | 579.424 | 2906.663 |
| Average | 39.273 | 62.146 | 22.873 | 581.251 | 3078.407 |
| Session 2 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 22301 | 42.743 | 60.776 | 18.033 | 576.289 | 2906.949 |
| 22302 | 38.691 | 61.007 | 22.316 | 582.122 | 2630.975 |
| 22303 | 41.403 | 62.199 | 20.796 | 579.081 | 2630.240 |
| 22304 | 43.399 | 61.576 | 18.177 | 578.426 | 2645.519 |
| 22305 | 42.527 | 62.861 | 20.334 | 584.245 | 2662.360 |
| 22306 | 43.300 | 60.802 | 17.502 | 590.086 | 2672.344 |
| 22307 | 46.678 | 62.089 | 15.411 | 587.337 | 2661.512 |
| 22308 | 43.403 | 63.169 | 19.766 | 586.884 | 2932.730 |
| 22309 | 45.899 | 62.426 | 16.527 | 582.991 | 3817.805 |
| 22310 | 39.171 | 62.574 | 23.403 | 583.041 | 2949.743 |
| Average | 42.721 | 61.948 | 19.227 | 583.050 | 2851.018 |

CASE STUDY SUBJECT 2 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | Mic Cal | 94 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 22101 | 19.710 | 30.080 | 10.370 | 40.020 | 33.670 |
| 22102 | 20.450 | 29.700 | 9.250 | 38.750 | 31.600 |
| 22103 | 19.050 | 29.370 | 10.320 | 37.150 | 31.820 |
| 22104 | 19.990 | 29.910 | 9.920 | 39.210 | 32.070 |
| 22105 | 17.610 | 29.700 | 12.090 | 39.650 | 32.370 |
| 22106 | 18.830 | 29.550 | 10.720 | 38.420 | 30.980 |
| 22107 | 20.250 | 30.140 | 9.890 | 39.490 | 31.930 |
| 22108 | 20.030 | 30.620 | 10.590 | 39.860 | 32.640 |
| 22109 | 21.150 | 29.800 | 8.650 | 38.870 | 31.860 |
| 22110 | 21.580 | 30.260 | 8.680 | 39.740 | 32.460 |
| Average | 19.865 | 29.913 | 10.048 | 39.116 | 32.140 |
| Session 2 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 22201 | 20.910 | 30.560 | 9.650 | 38.760 | 32.760 |
| 22202 | 21.010 | 30.190 | 9.180 | 39.280 | 32.930 |
| 22203 | 18.260 | 29.750 | 11.490 | 37.690 | 31.020 |
| 22204 | 18.590 | 30.800 | 12.210 | 37.870 | 32.000 |
| 22205 | 18.950 | 29.950 | 11.000 | 40.090 | 30.870 |
| 22206 | 18.520 | 30.930 | 12.410 | 41.060 | 31.780 |
| 22207 | 17.760 | 30.240 | 12.480 | 36.940 | 30.420 |
| 22208 | 17.070 | 30.720 | 13.650 | 39.540 | 31.070 |
| 22209 | 14.340 | 30.000 | 15.660 | 37.300 | 30.630 |
| 22210 | 18.580 | 29.510 | 10.930 | 40.980 | 29.790 |
| Average | 18.399 | 30.265 | 11.866 | 38.951 | 31.327 |
| Session 2 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 22301 | 19.000 | 28.990 | 9.990 | 36.850 | 31.010 |
| 22302 | 18.690 | 29.700 | 11.010 | 36.410 | 31.620 |
| 22303 | 20.210 | 30.460 | 10.250 | 38.070 | 32.220 |
| 22304 | 21.740 | 30.680 | 8.940 | 42.980 | 32.390 |
| 22305 | 21.730 | 30.290 | 8.560 | 39.470 | 31.630 |
| 22306 | 22.370 | 29.460 | 7.090 | 38.930 | 31.660 |
| 22307 | 22.010 | 29.970 | 7.960 | 38.430 | 31.700 |
| 22308 | 20.490 | 31.330 | 10.840 | 42.070 | 33.100 |
| 22309 | 21.590 | 30.470 | 8.880 | 41.550 | 32.600 |
| 22310 | 19.840 | 29.010 | 9.170 | 36.460 | 30.060 |
| Average | 20.767 | 30.036 | 9.269 | 39.122 | 31.799 |

CASE STUDY SUBJECT 2 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | Mic Cal | 92 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 23101 | 42.088 | 60.428 | 18.34 | 561.696 | 3768.138 |
| 23102 | 48.038 | 60.400 | 12.362 | 577.754 | 2903.142 |
| 23103 | 42.458 | 60.556 | 18.098 | 585.567 | 2926.082 |
| 23104 | 45.715 | 60.437 | 14.722 | 586.151 | 2932.285 |
| 23105 | 41.063 | 60.287 | 19.224 | 583.615 | 2919.806 |
| 23106 | 41.856 | 60.337 | 18.481 | 569.207 | 2898.407 |
| 23107 | 40.912 | 61.092 | 20.18 | 579.572 | 2917.890 |
| 23108 | 39.685 | 62.310 | 22.625 | 579.278 | 2927.216 |
| 23109 | 44.274 | 60.278 | 16.004 | 584.278 | 2930.251 |
| 23110 | 47.890 | 60.630 | 12.74 | 584.987 | 2929.282 |
| Average | 43.398 | 60.676 | 17.2776 | 579.211 | 3005.250 |
| Session 3 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 23201 | 46.419 | 61.903 | 15.484 | 579.933 | 2915.398 |
| 23202 | 46.209 | 61.231 | 15.022 | 585.702 | 2947.539 |
| 23203 | 46.458 | 61.225 | 14.767 | 582.385 | 2928.749 |
| 23204 | 39.747 | 62.411 | 22.664 | 586.320 | 2927.019 |
| 23205 | 43.636 | 62.404 | 18.768 | 587.344 | 2687.607 |
| 23206 | 37.528 | 61.632 | 24.104 | 579.647 | 2913.596 |
| 23207 | 43.278 | 62.212 | 18.934 | 585.405 | 2923.760 |
| 23208 | 40.433 | 62.266 | 21.833 | 589.291 | 2956.004 |
| 23209 | 39.149 | 61.948 | 22.799 | 584.199 | 2931.435 |
| 23210 | 40.550 | 61.547 | 20.997 | 583.101 | 2925.099 |
| Average | 42.341 | 61.878 | 19.537 | 584.333 | 2905.621 |
| Session 3 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 23301 | 44.669 | 60.662 | 15.993 | 581.911 | 2913.243 |
| 23302 | 40.539 | 61.474 | 20.935 | 584.558 | 2934.489 |
| 23303 | 41.271 | 61.121 | 19.850 | 586.754 | 2951.131 |
| 23304 | 38.675 | 60.914 | 22.239 | 584.969 | 2947.227 |
| 23305 | 38.835 | 60.321 | 21.486 | 584.808 | 2944.296 |
| 23306 | 38.121 | 60.526 | 22.405 | 584.037 | 2944.340 |
| 23307 | 40.389 | 61.727 | 21.338 | 581.116 | 2952.841 |
| 23308 | 38.969 | 60.988 | 22.019 | 588.996 | 2957.624 |
| 23309 | 42.892 | 61.463 | 18.571 | 586.765 | 2934.627 |
| 23310 | 39.911 | 62.422 | 22.511 | 578.004 | 2913.639 |
| Average | 40.427 | 61.162 | 20.735 | 584.192 | 2939.346 |

CASE STUDY SUBJECT 2 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | Mic Cal | 92 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 23101 | 19.690 | 27.610 | 7.920 | 35.910 | 28.920 |
| 23102 | 20.150 | 28.430 | 8.280 | 36.950 | 30.070 |
| 23103 | 20.380 | 29.070 | 8.690 | 37.260 | 30.960 |
| 23104 | 22.090 | 30.050 | 7.960 | 40.320 | 32.700 |
| 23105 | 21.060 | 29.760 | 8.700 | 40.570 | 31.710 |
| 23106 | 19.420 | 27.710 | 8.290 | 35.390 | 28.720 |
| 23107 | 20.390 | 28.270 | 7.880 | 36.280 | 30.010 |
| 23108 | 19.750 | 30.110 | 10.360 | 38.790 | 32.400 |
| 23109 | 23.110 | 29.430 | 6.320 | 39.320 | 31.890 |
| 23110 | 24.130 | 31.010 | 6.880 | 41.080 | 34.530 |
| Average | 21.017 | 29.145 | 8.128 | 38.187 | 31.191 |
| Session 3 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 23201 | 22.410 | 30.420 | 8.010 | 38.550 | 32.550 |
| 23202 | 22.220 | 31.020 | 8.800 | 39.770 | 33.560 |
| 23203 | 22.990 | 30.000 | 7.010 | 37.980 | 32.660 |
| 23204 | 19.550 | 31.260 | 11.710 | 41.070 | 33.570 |
| 23205 | 20.140 | 32.450 | 12.310 | 41.960 | 35.250 |
| 23206 | 20.550 | 30.650 | 10.100 | 38.700 | 32.160 |
| 23207 | 22.680 | 31.550 | 8.870 | 40.710 | 34.110 |
| 23208 | 21.700 | 31.580 | 9.880 | 41.540 | 34.730 |
| 23209 | 21.660 | 32.090 | 10.430 | 42.670 | 34.290 |
| 23210 | 20.950 | 30.870 | 9.920 | 38.980 | 33.560 |
| Average | 21.485 | 31.189 | 9.704 | 40.193 | 33.644 |
| Session 3 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 23301 | 22.310 | 29.030 | 6.720 | 35.720 | 30.580 |
| 23302 | 22.720 | 29.540 | 6.820 | 37.280 | 31.580 |
| 23303 | 21.550 | 29.350 | 7.800 | 37.670 | 32.240 |
| 23304 | 21.880 | 29.990 | 8.110 | 38.200 | 32.340 |
| 23305 | 22.120 | 29.540 | 7.420 | 37.050 | 31.660 |
| 23306 | 22.790 | 31.300 | 8.510 | 40.640 | 34.280 |
| 23307 | 23.580 | 31.070 | 7.490 | 39.790 | 33.770 |
| 23308 | 22.400 | 30.130 | 7.730 | 38.070 | 32.800 |
| 23309 | 23.290 | 31.490 | 8.200 | 41.400 | 34.720 |
| 23310 | 21.040 | 30.400 | 9.360 | 41.180 | 32.800 |
| Average | 22.368 | 30.184 | 7.816 | 38.700 | 32.677 |

CASE STUDY SUBJECT 3 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases All Test Sessions

| Session 1 | Baseline | | | Mic Cal | 90 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 21101 | 39.919 | 52.181 | 12.262 | 1184.792 | 2975.381 |
| 21102 | 41.521 | 53.544 | 12.023 | 1182.317 | 2931.488 |
| 21103 | 35.554 | 53.717 | 18.163 | 1183.524 | 2955.475 |
| 21104 | 36.418 | 53.795 | 17.377 | 1189.761 | 2983.959 |
| 21105 | 36.929 | 53.640 | 16.711 | 1189.230 | 2983.082 |
| 21106 | 37.428 | 53.014 | 15.586 | 1191.683 | 2986.067 |
| 21107 | 34.047 | 53.245 | 19.198 | 1191.331 | 2989.238 |
| 21108 | 35.083 | 52.146 | 17.063 | 1190.653 | 2979.812 |
| 21109 | 32.869 | 52.713 | 19.844 | 1189.016 | 2971.573 |
| 21110 | 33.840 | 52.512 | 18.672 | 1186.196 | 2944.587 |
| Average | 36.361 | 53.051 | 16.690 | 1187.850 | 2970.066 |
| Session 1 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 21201 | 41.755 | 54.398 | 12.643 | 1183.378 | 2931.240 |
| 21202 | 42.909 | 53.202 | 10.293 | 1186.756 | 2941.619 |
| 21203 | 40.414 | 52.587 | 12.173 | 1188.331 | 2974.316 |
| 21204 | 38.736 | 52.665 | 13.929 | 1190.311 | 2971.254 |
| 21205 | 38.701 | 51.408 | 12.707 | 1195.243 | 2986.624 |
| 21206 | 38.651 | 52.457 | 13.806 | 1190.590 | 2975.236 |
| 21207 | 37.854 | 50.433 | 12.579 | 1197.589 | 3005.883 |
| 21208 | 36.676 | 49.865 | 13.189 | 1196.597 | 2983.427 |
| 21209 | 37.248 | 50.799 | 13.551 | 1195.935 | 2994.734 |
| 21210 | 37.390 | 51.252 | 13.862 | 1194.705 | 2977.940 |
| Average | 39.033 | 51.907 | 12.873 | 1191.944 | 2974.227 |
| Session 1 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 21301 | 37.341 | 50.145 | 12.804 | 1198.009 | 2982.698 |
| 21302 | 39.538 | 52.403 | 12.865 | 1190.679 | 2959.375 |
| 21303 | 38.319 | 51.621 | 13.302 | 1192.018 | 2977.410 |
| 21304 | 38.460 | 50.824 | 12.364 | 1193.136 | 2983.092 |
| 21305 | 34.128 | 50.009 | 15.881 | 1195.541 | 2985.786 |
| 21306 | 39.269 | 52.524 | 13.255 | 1188.468 | 2977.149 |
| 21307 | 38.004 | 51.007 | 13.003 | 1197.009 | 2994.191 |
| 21308 | 38.591 | 50.074 | 11.483 | 1197.143 | 2997.495 |
| 21309 | 38.057 | 50.768 | 12.711 | 1195.904 | 2989.617 |
| 21310 | 38.764 | 50.595 | 11.831 | 1196.792 | 2994.362 |
| Average | 38.047 | 50.997 | 12.950 | 1194.470 | 2984.118 |

CASE STUDY SUBJECT 3 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases All Test Sessions

| Session 1 | Baseline | | | Mic Cal | 90 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 21101 | 13.420 | 18.940 | 5.520 | 25.220 | 25.330 |
| 21102 | 15.620 | 21.030 | 5.410 | 25.840 | 26.500 |
| 21103 | 14.950 | 21.130 | 6.180 | 28.040 | 27.010 |
| 21104 | 15.960 | 25.180 | 9.220 | 31.040 | 29.500 |
| 21105 | 16.180 | 24.090 | 7.910 | 29.830 | 28.920 |
| 21106 | 15.090 | 22.040 | 6.950 | 29.280 | 28.160 |
| 21107 | 15.850 | 24.270 | 8.420 | 30.290 | 29.330 |
| 21108 | 14.220 | 22.570 | 8.350 | 29.400 | 28.360 |
| 21109 | 14.680 | 19.940 | 5.260 | 29.110 | 27.700 |
| 21110 | 15.500 | 23.150 | 7.650 | 29.520 | 27.990 |
| Average | 15.147 | 22.234 | 7.087 | 28.757 | 27.880 |
| Session 1 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 21201 | 15.780 | 22.430 | 6.650 | 28.020 | 27.860 |
| 21202 | 16.080 | 20.830 | 4.750 | 28.310 | 28.030 |
| 21203 | 16.830 | 21.030 | 4.200 | 28.130 | 27.410 |
| 21204 | 16.000 | 21.040 | 5.040 | 29.680 | 27.950 |
| 21205 | 17.450 | 22.030 | 4.580 | 30.150 | 27.910 |
| 21206 | 15.540 | 21.480 | 5.940 | 28.820 | 27.620 |
| 21207 | 16.670 | 21.690 | 5.020 | 31.190 | 28.100 |
| 21208 | 16.380 | 21.120 | 4.740 | 30.730 | 27.360 |
| 21209 | 17.270 | 22.950 | 5.680 | 31.910 | 28.320 |
| 21210 | 16.790 | 23.400 | 6.610 | 32.160 | 28.500 |
| Average | 16.479 | 21.800 | 5.321 | 29.910 | 27.906 |
| Session 1 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 21301 | 16.000 | 22.470 | 6.470 | 32.250 | 27.120 |
| 21302 | 15.240 | 21.560 | 6.320 | 29.640 | 27.610 |
| 21303 | 15.720 | 21.970 | 6.250 | 29.770 | 27.860 |
| 21304 | 17.910 | 19.890 | 1.980 | 29.050 | 27.110 |
| 21305 | 16.930 | 20.640 | 3.710 | 30.420 | 26.560 |
| 21306 | 15.790 | 19.880 | 4.090 | 28.110 | 26.750 |
| 21307 | 18.350 | 20.770 | 2.420 | 30.430 | 27.870 |
| 21308 | 17.090 | 19.780 | 2.690 | 30.530 | 26.930 |
| 21309 | 17.970 | 20.360 | 2.390 | 29.880 | 27.080 |
| 21310 | 16.380 | 20.650 | 4.270 | 30.580 | 27.240 |
| Average | 16.738 | 20.797 | 4.059 | 30.066 | 27.213 |

CASE STUDY SUBJECT 3 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | Mic Cal | 92 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 22101 | 39.961 | 55.934 | 15.973 | 1182.013 | 2925.768 |
| 22102 | 41.833 | 56.052 | 14.219 | 1181.884 | 2931.992 |
| 22103 | 44.975 | 54.495 | 9.520 | 1184.267 | 2948.654 |
| 22104 | 43.032 | 54.033 | 11.001 | 1186.067 | 2947.997 |
| 22105 | 44.765 | 54.256 | 9.491 | 1189.213 | 2929.355 |
| 22106 | 44.901 | 55.350 | 10.449 | 1187.842 | 2960.967 |
| 22107 | 38.305 | 55.068 | 16.763 | 1185.250 | 2951.610 |
| 22108 | 38.190 | 55.062 | 16.872 | 1186.514 | 2917.134 |
| 22109 | 38.221 | 55.067 | 16.846 | 1188.750 | 2952.808 |
| 22110 | 39.134 | 55.069 | 15.935 | 1190.859 | 2951.018 |
| Average | 41.332 | 55.039 | 13.707 | 1186.266 | 2941.730 |
| Session 2 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 22201 | 36.502 | 56.419 | 19.917 | 1186.677 | 2920.167 |
| 22202 | 40.279 | 55.692 | 15.413 | 1190.968 | 2955.200 |
| 22203 | 37.518 | 54.615 | 17.097 | 1193.461 | 2976.297 |
| 22204 | 40.884 | 54.143 | 13.259 | 1194.729 | 2981.625 |
| 22205 | 42.249 | 53.711 | 11.462 | 1195.130 | 2996.855 |
| 22206 | 41.566 | 52.288 | 10.722 | 1195.595 | 2995.564 |
| 22207 | 41.243 | 51.539 | 10.296 | 1197.191 | 2982.817 |
| 22208 | 40.031 | 51.394 | 11.363 | 1197.365 | 2981.043 |
| 22209 | 42.265 | 52.998 | 10.733 | 1196.776 | 2960.550 |
| 22210 | 40.715 | 52.138 | 11.423 | 1197.952 | 3564.291 |
| Average | 40.325 | 53.494 | 13.169 | 1194.584 | 3031.441 |
| Session 2 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 22301 | 39.097 | 53.380 | 14.283 | 1195.863 | 3567.887 |
| 22302 | 40.550 | 53.237 | 12.687 | 1195.007 | 2989.198 |
| 22303 | 41.043 | 52.651 | 11.608 | 1196.338 | 3000.150 |
| 22304 | 42.770 | 53.400 | 10.630 | 1199.058 | 3008.975 |
| 22305 | 40.830 | 52.932 | 12.102 | 1200.069 | 2998.112 |
| 22306 | 39.407 | 52.301 | 12.894 | 1198.138 | 3008.403 |
| 22307 | 40.919 | 52.379 | 11.460 | 602.297 | 2996.850 |
| 22308 | 41.998 | 52.612 | 10.614 | 1201.358 | 3003.370 |
| 22309 | 37.610 | 52.552 | 14.942 | 1200.823 | 3010.135 |
| 22310 | 37.482 | 52.729 | 15.247 | 1200.605 | 3011.442 |
| Average | 40.171 | 52.817 | 12.647 | 1138.956 | 3059.452 |

CASE STUDY SUBJECT 3 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | Mic Cal | 92 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 22101 | 16.520 | 19.650 | 3.130 | 26.030 | 27.010 |
| 22102 | 15.190 | 20.000 | 4.810 | 26.080 | 27.760 |
| 22103 | 16.820 | 19.540 | 2.720 | 27.100 | 27.280 |
| 22104 | 15.860 | 19.920 | 4.060 | 27.320 | 28.120 |
| 22105 | 17.380 | 20.750 | 3.370 | 30.490 | 29.050 |
| 22106 | 15.930 | 20.490 | 4.560 | 28.990 | 28.350 |
| 22107 | 13.690 | 19.080 | 5.390 | 26.650 | 26.490 |
| 22108 | 17.020 | 19.470 | 2.450 | 27.180 | 27.450 |
| 22109 | 15.290 | 20.610 | 5.320 | 27.420 | 28.250 |
| 22110 | 17.540 | 20.050 | 2.510 | 29.070 | 27.810 |
| Average | 16.124 | 19.956 | 3.832 | 27.633 | 27.757 |
| Session 2 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 22201 | 15.480 | 21.950 | 6.470 | 29.090 | 29.340 |
| 22202 | 16.940 | 20.840 | 3.900 | 29.470 | 29.060 |
| 22203 | 16.570 | 20.410 | 3.840 | 29.950 | 28.410 |
| 22204 | 17.380 | 20.890 | 3.510 | 29.530 | 28.770 |
| 22205 | 18.320 | 21.120 | 2.800 | 31.020 | 28.730 |
| 22206 | 17.850 | 21.150 | 3.300 | 30.030 | 28.910 |
| 22207 | 15.310 | 19.870 | 4.560 | 30.240 | 27.370 |
| 22208 | 15.940 | 20.050 | 4.110 | 29.470 | 27.270 |
| 22209 | 15.870 | 21.710 | 5.840 | 31.990 | 29.750 |
| 22210 | 18.180 | 21.730 | 3.550 | 31.180 | 28.900 |
| Average | 16.784 | 20.972 | 4.188 | 30.197 | 28.651 |
| Session 2 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 22301 | 18.030 | 21.040 | 3.010 | 30.920 | 28.180 |
| 22302 | 16.460 | 19.560 | 3.100 | 30.080 | 27.440 |
| 22303 | 14.870 | 20.330 | 5.460 | 30.060 | 28.040 |
| 22304 | 19.540 | 21.010 | 1.470 | 32.530 | 29.160 |
| 22305 | 18.940 | 21.290 | 2.350 | 32.670 | 28.620 |
| 22306 | 14.480 | 20.510 | 6.030 | 31.010 | 28.270 |
| 22307 | 18.580 | 21.820 | 3.240 | 31.890 | 29.710 |
| 22308 | 16.070 | 21.070 | 5.000 | 32.670 | 28.760 |
| 22309 | 15.590 | 20.570 | 4.980 | 31.350 | 27.960 |
| 22310 | 15.310 | 20.490 | 5.180 | 31.760 | 28.630 |
| Average | 16.787 | 20.769 | 3.982 | 31.494 | 28.477 |

CASE STUDY SUBJECT 3 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | Mic Cal | 90 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 23101 | 34.398 | 56.809 | 22.411 | 590.846 | 2983.523 |
| 23102 | 34.369 | 56.191 | 21.822 | 600.356 | 3001.121 |
| 23103 | 35.361 | 56.292 | 20.931 | 603.705 | 3028.605 |
| 23104 | 34.900 | 55.135 | 20.235 | 601.169 | 3010.407 |
| 23105 | 36.933 | 55.034 | 18.101 | 596.412 | 3003.009 |
| 23106 | 35.627 | 54.669 | 19.042 | 599.207 | 3006.398 |
| 23107 | 36.014 | 53.336 | 17.322 | 598.387 | 3004.685 |
| 23108 | 35.309 | 54.341 | 19.032 | 600.510 | 3020.255 |
| 23109 | 36.137 | 54.542 | 18.405 | 597.950 | 3009.023 |
| 23110 | 34.989 | 54.294 | 19.305 | 597.984 | 3007.636 |
| Average | 35.404 | 55.064 | 19.6606 | 598.653 | 3007.466 |
| Session 3 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 23201 | 36.475 | 56.503 | 20.028 | 597.032 | 3001.379 |
| 23202 | 38.659 | 56.252 | 17.593 | 1185.041 | 3501.171 |
| 23203 | 38.719 | 56.124 | 17.405 | 590.835 | 2998.052 |
| 23204 | 34.870 | 54.659 | 19.789 | 600.059 | 3009.257 |
| 23205 | 35.926 | 54.224 | 18.298 | 600.990 | 3018.065 |
| 23206 | 40.297 | 55.858 | 15.561 | 603.637 | 3013.939 |
| 23207 | 35.776 | 52.969 | 17.193 | 599.718 | 3008.308 |
| 23208 | 35.121 | 54.443 | 19.322 | 603.490 | 3011.773 |
| 23209 | 36.821 | 55.677 | 18.856 | 608.413 | 3024.592 |
| 23210 | 37.001 | 55.611 | 18.610 | 609.036 | 3036.255 |
| Average | 36.967 | 55.232 | 18.266 | 659.825 | 3062.279 |
| Session 3 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 23301 | 38.450 | 57.375 | 18.925 | 591.413 | 2989.950 |
| 23302 | 37.725 | 55.669 | 17.944 | 590.263 | 2949.510 |
| 23303 | 39.022 | 55.411 | 16.389 | 1195.933 | 2996.527 |
| 23304 | 38.522 | 53.225 | 14.703 | 599.392 | 2989.836 |
| 23305 | 38.619 | 55.795 | 17.176 | 604.361 | 3007.889 |
| 23306 | 37.828 | 53.751 | 15.923 | 1200.194 | 3587.479 |
| 23307 | 37.001 | 53.698 | 16.697 | 1197.167 | 3550.457 |
| 23308 | 38.530 | 53.595 | 15.065 | 603.269 | 3596.331 |
| 23309 | 38.697 | 54.103 | 15.406 | 603.550 | 3606.107 |
| 23310 | 35.600 | 52.903 | 17.303 | 602.140 | 3026.036 |
| Average | 37.999 | 54.553 | 16.553 | 778.768 | 3230.012 |

CASE STUDY SUBJECT 3 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | Mic Cal | 90 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 303101 | 15.400 | 22.590 | 7.190 | 33.880 | 30.340 |
| 303102 | 18.760 | 24.440 | 5.680 | 37.320 | 32.020 |
| 303103 | 17.830 | 22.940 | 5.110 | 37.310 | 31.160 |
| 303104 | 18.970 | 23.580 | 4.610 | 36.960 | 31.370 |
| 303105 | 17.750 | 23.040 | 5.290 | 35.300 | 31.260 |
| 303106 | 18.210 | 23.140 | 4.930 | 36.010 | 31.380 |
| 303107 | 17.490 | 21.740 | 4.250 | 34.320 | 29.710 |
| 303108 | 15.630 | 22.180 | 6.550 | 35.260 | 30.100 |
| 303109 | 18.430 | 22.100 | 3.670 | 34.990 | 30.570 |
| 303110 | 16.700 | 21.410 | 4.710 | 34.260 | 29.540 |
| Average | 17.517 | 22.716 | 5.199 | 35.561 | 30.745 |
| Session 3 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 303201 | 18.280 | 24.580 | 6.300 | 36.110 | 33.440 |
| 303202 | 17.190 | 21.340 | 4.150 | 30.670 | 28.430 |
| 303203 | 16.300 | 22.350 | 6.050 | 33.020 | 29.690 |
| 303204 | 18.180 | 22.090 | 3.910 | 35.430 | 30.100 |
| 303205 | 17.090 | 22.560 | 5.470 | 34.950 | 29.740 |
| 303206 | 18.570 | 23.400 | 4.830 | 36.480 | 31.270 |
| 303207 | 15.900 | 22.270 | 6.370 | 35.820 | 29.990 |
| 303208 | 16.440 | 22.880 | 6.440 | 36.410 | 31.770 |
| 303209 | 18.770 | 22.330 | 3.560 | 36.590 | 30.750 |
| 303210 | 17.590 | 23.330 | 5.740 | 37.780 | 32.270 |
| Average | 17.431 | 22.713 | 5.282 | 35.326 | 30.745 |
| Session 3 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 303301 | 16.800 | 22.030 | 5.230 | 33.860 | 29.820 |
| 303302 | 16.650 | 21.670 | 5.020 | 33.100 | 29.080 |
| 303303 | 18.730 | 22.100 | 3.370 | 34.870 | 30.530 |
| 303304 | 19.860 | 24.490 | 4.630 | 36.150 | 34.900 |
| 303305 | 17.650 | 22.680 | 5.030 | 36.260 | 30.040 |
| 303306 | 16.080 | 21.970 | 5.890 | 34.560 | 30.350 |
| 303307 | 18.250 | 23.210 | 4.960 | 34.250 | 31.940 |
| 303308 | 18.250 | 23.050 | 4.800 | 35.670 | 32.030 |
| 303309 | 16.190 | 22.450 | 6.260 | 35.320 | 31.630 |
| 303310 | 16.720 | 22.730 | 6.010 | 34.830 | 31.230 |
| Average | 17.518 | 22.638 | 5.120 | 34.887 | 31.155 |

CASE STUDY SUBJECT 4 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases All Test Sessions

| Session 1 | Baseline | | | Mic Cal | 93 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 41101 | 27.129 | 44.843 | 17.714 | 589.822 | 2686.350 |
| 41102 | 30.819 | 43.765 | 12.946 | 592.844 | 2661.732 |
| 41103 | 29.169 | 46.151 | 16.982 | 588.191 | 3250.773 |
| 41104 | 30.205 | 45.230 | 15.025 | 591.163 | 3288.368 |
| 41105 | 33.518 | 46.665 | 13.147 | 591.095 | 3572.663 |
| 41106 | 32.566 | 46.812 | 14.246 | 585.072 | 3530.338 |
| 41107 | 31.757 | 47.098 | 15.341 | 587.989 | 2060.791 |
| 41108 | 30.535 | 47.473 | 16.938 | 586.957 | 2664.159 |
| 41109 | 29.002 | 45.924 | 16.922 | 590.887 | 2957.641 |
| 41110 | 32.714 | 49.845 | 17.131 | 592.128 | 2082.683 |
| Average | 30.741 | 46.381 | 15.639 | 589.615 | 2875.550 |
| Session 1 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 41201 | 32.237 | 46.402 | 14.165 | 587.450 | 2673.077 |
| 41202 | 32.148 | 47.348 | 15.200 | 585.907 | 2675.109 |
| 41203 | 30.494 | 46.690 | 16.196 | 584.297 | 3256.637 |
| 41204 | 30.644 | 47.449 | 16.805 | 586.072 | 3247.566 |
| 41205 | 30.649 | 47.257 | 16.608 | 589.216 | 3257.253 |
| 41206 | 29.395 | 47.372 | 17.977 | 588.926 | 2958.543 |
| 41207 | 31.755 | 47.103 | 15.348 | 587.969 | 2061.054 |
| 41208 | 31.465 | 49.062 | 17.597 | 584.510 | 2049.824 |
| 41209 | 32.154 | 49.885 | 17.731 | 585.866 | 2060.276 |
| 41210 | 30.933 | 49.606 | 18.673 | 587.335 | 2063.461 |
| Average | 31.187 | 47.817 | 16.630 | 586.755 | 2630.280 |
| Session 1 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 41301 | 31.705 | 47.660 | 15.955 | 593.175 | 2079.856 |
| 41302 | 29.811 | 47.872 | 18.061 | 583.399 | 2052.981 |
| 41303 | 29.057 | 48.732 | 19.675 | 582.160 | 3542.317 |
| 41304 | 27.605 | 48.103 | 20.498 | 589.375 | 3562.115 |
| 41305 | 29.435 | 49.235 | 19.800 | 586.789 | 3552.844 |
| 41306 | 32.595 | 49.224 | 16.629 | 590.353 | 3553.756 |
| 41307 | 29.894 | 47.891 | 17.997 | 592.724 | 3570.795 |
| 41308 | 30.406 | 47.856 | 17.450 | 593.521 | 3280.342 |
| 41309 | 31.372 | 48.680 | 17.308 | 593.470 | 3277.465 |
| 41310 | 30.313 | 46.992 | 16.679 | 588.823 | 2951.080 |
| Average | 30.219 | 48.225 | 18.005 | 589.379 | 3142.355 |

CASE STUDY SUBJECT 4 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases All Test Sessions

| Session 1 | Baseline | | | Mic Cal | 93 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 41101 | 13.250 | 22.000 | 8.750 | 25.120 | 22.700 |
| 41102 | 14.790 | 21.410 | 6.620 | 23.860 | 21.470 |
| 41103 | 14.530 | 20.980 | 6.450 | 23.960 | 20.080 |
| 41104 | 13.630 | 21.600 | 7.970 | 22.570 | 21.560 |
| 41105 | 16.160 | 22.730 | 6.570 | 25.530 | 21.820 |
| 41106 | 14.450 | 21.590 | 7.140 | 23.010 | 20.900 |
| 41107 | 14.960 | 21.930 | 6.970 | 22.140 | 21.490 |
| 41108 | 13.310 | 21.720 | 8.410 | 23.830 | 21.530 |
| 41109 | 14.030 | 22.940 | 8.910 | 25.100 | 22.820 |
| 41110 | 16.240 | 23.700 | 7.460 | 28.400 | 23.430 |
| Average | 14.535 | 22.060 | 7.525 | 24.352 | 21.780 |
| Session 1 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 41201 | 14.870 | 21.830 | 6.960 | 25.820 | 21.270 |
| 41202 | 15.680 | 23.000 | 7.320 | 25.490 | 22.790 |
| 41203 | 15.080 | 22.300 | 7.220 | 24.470 | 20.890 |
| 41204 | 14.060 | 22.480 | 8.420 | 23.490 | 21.290 |
| 41205 | 14.100 | 22.160 | 8.060 | 25.510 | 22.520 |
| 41206 | 15.280 | 22.800 | 7.520 | 25.440 | 21.650 |
| 41207 | 14.970 | 21.930 | 6.960 | 23.140 | 21.490 |
| 41208 | 15.060 | 22.460 | 7.400 | 24.220 | 21.660 |
| 41209 | 15.660 | 22.130 | 6.470 | 25.280 | 21.660 |
| 41210 | 14.480 | 22.440 | 7.960 | 25.810 | 22.170 |
| Average | 14.924 | 22.353 | 7.429 | 24.867 | 21.739 |
| Session 1 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 41301 | 15.980 | 23.650 | 7.670 | 26.600 | 23.790 |
| 41302 | 15.100 | 21.930 | 6.830 | 21.850 | 21.740 |
| 41303 | 16.080 | 22.420 | 6.340 | 24.040 | 22.300 |
| 41304 | 14.800 | 23.300 | 8.500 | 24.780 | 23.830 |
| 41305 | 15.750 | 23.510 | 7.760 | 25.730 | 24.270 |
| 41306 | 15.580 | 23.680 | 8.100 | 26.630 | 24.390 |
| 41307 | 15.270 | 23.030 | 7.760 | 27.360 | 23.210 |
| 41308 | 15.140 | 22.770 | 7.630 | 26.470 | 23.440 |
| 41309 | 13.280 | 22.730 | 9.450 | 27.970 | 23.280 |
| 41310 | 13.300 | 21.950 | 8.650 | 23.680 | 21.860 |
| Average | 15.028 | 22.897 | 7.869 | 25.511 | 23.211 |

CASE STUDY SUBJECT 4 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | Mic Cal | 88 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 42101 | 24.515 | 45.517 | 21.002 | 589.762 | 2076.501 |
| 42102 | 25.725 | 47.201 | 21.476 | 572.865 | 2048.258 |
| 42103 | 25.191 | 47.727 | 22.536 | 580.236 | 2057.829 |
| 42104 | 25.497 | 47.513 | 22.016 | 586.358 | 2071.342 |
| 42105 | 24.608 | 46.997 | 22.389 | 581.525 | 2071.887 |
| 42106 | 26.694 | 48.686 | 21.992 | 584.967 | 2062.692 |
| 42107 | 26.151 | 47.516 | 21.365 | 584.524 | 2650.168 |
| 42108 | 23.761 | 47.930 | 24.169 | 584.536 | 2647.926 |
| 42109 | 25.741 | 47.971 | 22.230 | 582.609 | 2654.747 |
| 42110 | 25.740 | 48.132 | 22.392 | 585.943 | 2658.669 |
| Average | 25.362 | 47.519 | 22.157 | 583.333 | 2300.002 |
| Session 2 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 42201 | 21.966 | 48.368 | 26.402 | 584.879 | 2651.567 |
| 42202 | 24.815 | 47.342 | 22.527 | 584.449 | 2660.647 |
| 42203 | 21.967 | 48.370 | 26.403 | 584.878 | 2651.567 |
| 42204 | 24.727 | 47.646 | 22.919 | 590.431 | 2081.926 |
| 42205 | 24.673 | 48.585 | 23.912 | 586.488 | 2661.482 |
| 42206 | 25.754 | 49.460 | 23.706 | 588.725 | 2669.275 |
| 42207 | 24.130 | 48.118 | 23.988 | 590.762 | 2667.230 |
| 42208 | 25.829 | 48.465 | 22.636 | 587.147 | 3249.230 |
| 42209 | 23.662 | 48.333 | 24.671 | 587.968 | 3259.640 |
| 42210 | 25.037 | 49.553 | 24.516 | 585.785 | 2961.216 |
| Average | 24.256 | 48.424 | 24.168 | 587.151 | 2751.378 |
| Session 2 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 42301 | 22.665 | 47.506 | 24.841 | 583.779 | 3230.519 |
| 42302 | 23.048 | 47.859 | 24.811 | 586.077 | 3248.875 |
| 42303 | 24.062 | 47.384 | 23.322 | 586.093 | 3267.196 |
| 42304 | 24.031 | 47.464 | 23.433 | 586.479 | 3252.301 |
| 42305 | 27.428 | 48.447 | 21.019 | 580.483 | 3235.657 |
| 42306 | 24.989 | 49.229 | 24.240 | 587.490 | 3254.884 |
| 42307 | 23.817 | 49.926 | 26.109 | 588.168 | 3259.788 |
| 42308 | 27.989 | 50.303 | 22.314 | 589.342 | 3258.780 |
| 42309 | 24.892 | 49.368 | 24.476 | 592.868 | 3269.371 |
| 42310 | 26.309 | 49.090 | 22.781 | 585.935 | 3259.906 |
| Average | 24.923 | 48.658 | 23.735 | 586.671 | 3253.728 |

CASE STUDY SUBJECT 4 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | Mic Cal | 88 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 42101 | 11.740 | 22.300 | 10.560 | 27.010 | 21.390 |
| 42102 | 10.630 | 21.280 | 10.650 | 22.040 | 20.590 |
| 42103 | 10.780 | 21.960 | 11.180 | 24.280 | 20.800 |
| 42104 | 11.390 | 22.800 | 11.410 | 26.930 | 22.410 |
| 42105 | 10.560 | 22.560 | 12.000 | 24.800 | 21.890 |
| 42106 | 12.290 | 23.040 | 10.750 | 27.910 | 23.170 |
| 42107 | 10.870 | 21.780 | 10.910 | 25.480 | 21.140 |
| 42108 | 11.330 | 22.670 | 11.340 | 26.100 | 22.090 |
| 42109 | 11.000 | 22.190 | 11.190 | 25.980 | 22.240 |
| 42110 | 10.820 | 22.740 | 11.920 | 26.350 | 22.530 |
| Average | 11.141 | 22.332 | 11.191 | 25.688 | 21.825 |
| Session 2 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 42201 | 10.510 | 22.600 | 12.090 | 26.960 | 21.950 |
| 42202 | 11.200 | 21.280 | 10.080 | 25.470 | 20.600 |
| 42203 | 10.520 | 22.610 | 12.090 | 26.960 | 21.950 |
| 42204 | 10.260 | 21.860 | 11.600 | 27.440 | 21.250 |
| 42205 | 10.530 | 22.160 | 11.630 | 26.530 | 21.730 |
| 42206 | 10.120 | 22.400 | 12.280 | 27.930 | 22.650 |
| 42207 | 9.340 | 22.500 | 13.160 | 28.460 | 22.600 |
| 42208 | 9.970 | 22.760 | 12.790 | 27.870 | 23.120 |
| 42209 | 10.620 | 22.930 | 12.310 | 29.520 | 23.280 |
| 42210 | 9.490 | 22.910 | 13.420 | 28.390 | 23.160 |
| Average | 10.256 | 22.401 | 12.145 | 27.553 | 22.229 |
| Session 2 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 42301 | 11.120 | 22.620 | 11.500 | 26.140 | 22.490 |
| 42302 | 12.790 | 22.500 | 9.710 | 25.890 | 22.790 |
| 42303 | 12.970 | 22.070 | 9.100 | 27.140 | 22.000 |
| 42304 | 11.950 | 21.880 | 9.930 | 25.720 | 21.830 |
| 42305 | 13.370 | 22.290 | 8.920 | 25.650 | 22.170 |
| 42306 | 12.660 | 22.860 | 10.200 | 28.200 | 23.580 |
| 42307 | 10.960 | 22.920 | 11.960 | 27.710 | 23.660 |
| 42308 | 11.350 | 23.280 | 11.930 | 29.420 | 24.020 |
| 42309 | 10.960 | 24.270 | 13.310 | 29.960 | 24.730 |
| 42310 | 11.170 | 22.790 | 11.620 | 27.120 | 22.540 |
| Average | 11.930 | 22.748 | 10.818 | 27.295 | 22.981 |

CASE STUDY SUBJECT 4 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | Mic Cal | 94 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 43101 | 29.896 | 53.230 | 23.334 | 586.602 | 3252.774 |
| 43102 | 28.162 | 53.104 | 24.942 | 583.961 | 3268.405 |
| 43103 | 27.922 | 53.294 | 25.372 | 577.469 | 3512.885 |
| 43104 | 27.980 | 53.443 | 25.463 | 585.433 | 3251.650 |
| 43105 | 27.268 | 53.394 | 26.126 | 587.242 | 3239.620 |
| 43106 | 28.258 | 54.115 | 25.857 | 587.489 | 3533.216 |
| 43107 | 26.411 | 53.666 | 27.255 | 586.593 | 3259.850 |
| 43108 | 26.746 | 53.565 | 26.819 | 582.680 | 3526.413 |
| 43109 | 27.418 | 53.327 | 25.909 | 586.644 | 3533.658 |
| 43110 | 27.170 | 54.165 | 26.995 | 581.291 | 3250.190 |
| Average | 27.723 | 53.530 | 25.8072 | 584.540 | 3362.866 |
| Session 3 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 43201 | 25.620 | 54.577 | 28.957 | 590.576 | 3272.831 |
| 43202 | 26.096 | 54.630 | 28.534 | 586.794 | 3262.969 |
| 43203 | 25.987 | 55.190 | 29.203 | 582.487 | 3261.977 |
| 43204 | 25.343 | 55.578 | 30.235 | 589.450 | 3267.330 |
| 43205 | 25.417 | 55.159 | 29.742 | 589.335 | 3272.732 |
| 43206 | 27.115 | 55.114 | 27.999 | 589.825 | 3274.792 |
| 43207 | 24.064 | 55.224 | 31.160 | 585.928 | 3264.909 |
| 43208 | 26.001 | 55.339 | 29.338 | 584.392 | 3548.001 |
| 43209 | 26.600 | 55.303 | 28.703 | 586.917 | 3267.501 |
| 43210 | 28.057 | 55.387 | 27.330 | 588.084 | 3270.923 |
| Average | 26.030 | 55.150 | 29.120 | 587.379 | 3296.397 |
| Session 3 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 43301 | 23.936 | 54.301 | 30.365 | 586.640 | 3232.736 |
| 43302 | 24.698 | 54.869 | 30.171 | 582.716 | 3509.025 |
| 43303 | 23.588 | 55.227 | 31.639 | 583.075 | 3229.517 |
| 43304 | 24.301 | 54.906 | 30.605 | 584.731 | 3536.984 |
| 43305 | 24.201 | 54.832 | 30.631 | 581.604 | 3238.100 |
| 43306 | 22.859 | 54.579 | 31.720 | 583.713 | 3527.491 |
| 43307 | 25.504 | 55.281 | 29.777 | 572.610 | 3526.780 |
| 43308 | 24.714 | 54.787 | 30.073 | 583.439 | 3217.528 |
| 43309 | 25.420 | 54.884 | 29.464 | 580.503 | 3233.746 |
| 43310 | 22.514 | 54.535 | 32.021 | 581.677 | 3225.512 |
| Average | 24.174 | 54.820 | 30.647 | 582.071 | 3347.742 |

CASE STUDY SUBJECT 4 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | Mic Cal | 94 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 43101 | 13.940 | 26.620 | 12.680 | 29.940 | 27.890 |
| 43102 | 13.800 | 25.260 | 11.460 | 28.770 | 25.460 |
| 43103 | 14.560 | 24.230 | 9.670 | 26.600 | 23.660 |
| 43104 | 15.680 | 26.400 | 10.720 | 29.940 | 27.990 |
| 43105 | 14.350 | 26.680 | 12.330 | 29.480 | 27.840 |
| 43106 | 14.340 | 27.330 | 12.990 | 31.600 | 29.440 |
| 43107 | 14.850 | 26.140 | 11.290 | 29.580 | 27.380 |
| 43108 | 14.550 | 26.190 | 11.640 | 28.120 | 26.920 |
| 43109 | 14.610 | 26.230 | 11.620 | 29.220 | 27.990 |
| 43110 | 15.200 | 25.540 | 10.340 | 28.900 | 27.290 |
| Average | 14.588 | 26.062 | 11.474 | 29.215 | 27.186 |
| Session 3 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 43201 | 13.540 | 26.810 | 13.270 | 32.180 | 28.010 |
| 43202 | 15.240 | 26.980 | 11.740 | 31.420 | 28.950 |
| 43203 | 15.700 | 27.950 | 12.250 | 32.850 | 29.720 |
| 43204 | 13.770 | 28.470 | 14.700 | 32.660 | 30.180 |
| 43205 | 14.950 | 28.200 | 13.250 | 31.680 | 30.060 |
| 43206 | 15.230 | 28.730 | 13.500 | 33.100 | 30.530 |
| 43207 | 13.960 | 27.750 | 13.790 | 31.240 | 29.400 |
| 43208 | 14.440 | 27.690 | 13.250 | 31.010 | 29.020 |
| 43209 | 14.470 | 28.160 | 13.690 | 31.100 | 30.140 |
| 43210 | 16.060 | 28.200 | 12.140 | 31.910 | 29.940 |
| Average | 14.736 | 27.894 | 13.158 | 31.915 | 29.595 |
| Session 3 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 43301 | 13.120 | 26.430 | 13.310 | 31.020 | 28.640 |
| 43302 | 12.810 | 26.330 | 13.520 | 29.400 | 28.120 |
| 43303 | 13.470 | 26.630 | 13.160 | 29.930 | 28.480 |
| 43304 | 13.900 | 26.690 | 12.790 | 30.670 | 29.200 |
| 43305 | 13.550 | 26.820 | 13.270 | 29.440 | 29.160 |
| 43306 | 13.780 | 26.740 | 12.960 | 30.850 | 29.410 |
| 43307 | 14.610 | 25.900 | 11.290 | 28.590 | 27.890 |
| 43308 | 12.760 | 26.700 | 13.940 | 29.580 | 29.070 |
| 43309 | 14.010 | 26.720 | 12.710 | 29.220 | 28.780 |
| 43310 | 14.340 | 26.770 | 12.430 | 29.710 | 29.200 |
| Average | 13.635 | 26.573 | 12.938 | 29.841 | 28.795 |

CASE STUDY SUBJECT 5 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases All Test Sessions

| Session 1 | Baseline | | | Mic Cal | 90 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 51101 | 38.430 | 53.885 | 15.455 | 1162.378 | 2946.757 |
| 51102 | 35.736 | 54.568 | 18.832 | 1163.561 | 2941.894 |
| 51103 | 39.482 | 54.068 | 14.586 | 1177.008 | 2954.639 |
| 51104 | 40.379 | 54.065 | 13.686 | 1167.175 | 2948.443 |
| 51105 | 40.225 | 53.800 | 13.575 | 1156.150 | 3474.671 |
| 51106 | 39.145 | 53.753 | 14.608 | 1160.626 | 3548.652 |
| 51107 | 36.989 | 52.873 | 15.884 | 1175.184 | 3561.442 |
| 51108 | 53.343 | 61.154 | 7.811 | 1154.440 | 3552.494 |
| 51109 | 36.241 | 53.408 | 17.167 | 1180.806 | 3562.185 |
| 51110 | 38.997 | 54.521 | 15.524 | 1160.130 | 3557.531 |
| Average | 39.897 | 54.610 | 14.713 | 1165.746 | 3304.871 |
| Session 1 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 51201 | 33.856 | 53.693 | 19.837 | 1175.454 | 3539.616 |
| 51202 | 38.100 | 52.982 | 14.882 | 1160.783 | 3522.896 |
| 51203 | 37.968 | 53.502 | 15.534 | 1164.228 | 3493.568 |
| 51204 | 39.977 | 53.934 | 13.957 | 1151.758 | 3496.696 |
| 51205 | 40.319 | 53.687 | 13.368 | 1165.994 | 3550.620 |
| 51206 | 38.206 | 53.193 | 14.987 | 1181.070 | 3542.379 |
| 51207 | 39.144 | 53.783 | 14.639 | 1165.475 | 3504.356 |
| 51208 | 39.276 | 53.083 | 13.807 | 1159.250 | 3519.879 |
| 51209 | 35.905 | 53.171 | 17.266 | 1159.983 | 3530.857 |
| 51210 | 35.426 | 52.990 | 17.564 | 1178.326 | 3550.624 |
| Average | 37.818 | 53.402 | 15.584 | 1166.232 | 3525.149 |
| Session 1 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 51301 | 36.675 | 53.116 | 16.441 | 1170.743 | 2964.870 |
| 51302 | 37.241 | 53.248 | 16.007 | 1176.702 | 2959.067 |
| 51303 | 41.075 | 52.606 | 11.531 | 1173.777 | 2946.344 |
| 51304 | 41.323 | 52.889 | 11.566 | 1164.983 | 3567.640 |
| 51305 | 40.037 | 53.992 | 13.955 | 1162.181 | 3537.598 |
| 51306 | 40.679 | 53.140 | 12.461 | 1160.716 | 3530.696 |
| 51307 | 38.314 | 53.587 | 15.273 | 1163.422 | 3552.246 |
| 51308 | 39.276 | 53.083 | 13.807 | 1159.250 | 3519.879 |
| 51309 | 39.957 | 53.859 | 13.902 | 1173.417 | 3558.055 |
| 51310 | 39.980 | 53.072 | 13.092 | 1173.863 | 3558.241 |
| Average | 39.456 | 53.259 | 13.804 | 1167.905 | 3369.464 |

CASE STUDY SUBJECT 5 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases All Test Sessions

| Session 1 | Baseline | | | Mic Cal | 90 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 51101 | 13.960 | 21.720 | 7.760 | 23.280 | 25.880 |
| 51102 | 10.660 | 21.040 | 10.380 | 23.880 | 26.390 |
| 51103 | 15.910 | 20.540 | 4.630 | 25.050 | 27.060 |
| 51104 | 11.960 | 18.620 | 6.660 | 22.470 | 25.380 |
| 51105 | 13.870 | 18.020 | 4.150 | 20.560 | 24.140 |
| 51106 | 15.610 | 18.600 | 2.990 | 20.840 | 23.640 |
| 51107 | 15.250 | 18.510 | 3.260 | 22.140 | 24.940 |
| 51108 | 19.720 | 21.230 | 1.510 | 22.940 | 20.610 |
| 51109 | 16.080 | 19.990 | 3.910 | 24.660 | 26.470 |
| 51110 | 13.930 | 18.640 | 4.710 | 20.920 | 24.670 |
| Average | 14.695 | 19.691 | 4.996 | 22.674 | 24.918 |
| Session 1 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 51201 | 15.340 | 18.680 | 3.340 | 24.940 | 25.390 |
| 51202 | 11.840 | 18.170 | 6.330 | 21.500 | 24.290 |
| 51203 | 13.090 | 18.640 | 5.550 | 20.950 | 24.550 |
| 51204 | 12.090 | 17.540 | 5.450 | 20.660 | 23.760 |
| 51205 | 16.050 | 17.620 | 1.570 | 21.610 | 23.440 |
| 51206 | 17.760 | 19.450 | 1.690 | 25.890 | 25.950 |
| 51207 | 11.760 | 18.150 | 6.390 | 22.050 | 24.060 |
| 51208 | 12.450 | 18.000 | 5.550 | 21.320 | 23.130 |
| 51209 | 13.610 | 18.920 | 5.310 | 23.310 | 24.280 |
| 51210 | 14.760 | 19.460 | 4.700 | 24.980 | 25.330 |
| Average | 13.875 | 18.463 | 4.588 | 22.721 | 24.418 |
| Session 1 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 51301 | 15.040 | 20.920 | 5.880 | 26.060 | 30.380 |
| 51302 | 14.000 | 19.220 | 5.220 | 25.630 | 25.880 |
| 51303 | 13.610 | 18.150 | 4.540 | 23.040 | 24.590 |
| 51304 | 13.180 | 17.910 | 4.730 | 21.810 | 23.540 |
| 51305 | 11.780 | 18.180 | 6.400 | 21.860 | 24.050 |
| 51306 | 12.620 | 17.090 | 4.470 | 22.560 | 23.410 |
| 51307 | 14.300 | 17.790 | 3.490 | 20.430 | 23.760 |
| 51308 | 12.450 | 18.000 | 5.550 | 21.320 | 23.130 |
| 51309 | 18.020 | 19.070 | 1.050 | 25.670 | 25.360 |
| 51310 | 15.790 | 18.740 | 2.950 | 23.240 | 25.050 |
| Average | 14.079 | 18.507 | 4.428 | 23.162 | 24.915 |

CASE STUDY SUBJECT 5 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | Mic Cal | 92 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 52101 | 33.977 | 50.711 | 16.734 | 577.794 | 3542.543 |
| 52102 | 33.603 | 50.344 | 16.741 | 1176.346 | 3541.407 |
| 52103 | 36.236 | 50.037 | 13.801 | 1177.263 | 3562.656 |
| 52104 | 37.432 | 50.293 | 12.861 | 1172.123 | 2959.748 |
| 52105 | 36.216 | 49.562 | 13.346 | 1178.418 | 3555.666 |
| 52106 | 37.245 | 49.836 | 12.591 | 1164.684 | 3547.808 |
| 52107 | 36.024 | 49.805 | 13.781 | 1177.717 | 3551.817 |
| 52108 | 33.500 | 49.305 | 15.805 | 1169.848 | 3545.781 |
| 52109 | 31.094 | 49.366 | 18.272 | 1175.292 | 3549.893 |
| 52110 | 29.166 | 49.782 | 20.616 | 1174.769 | 3535.801 |
| Average | 34.449 | 49.904 | 15.455 | 1114.425 | 3489.312 |
| Session 2 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 52201 | 37.432 | 56.234 | 18.802 | 572.746 | 3522.193 |
| 52202 | 39.991 | 55.044 | 15.053 | 1176.426 | 3533.238 |
| 52203 | 38.997 | 56.231 | 17.234 | 1172.299 | 3537.554 |
| 52204 | 36.100 | 55.594 | 19.494 | 1171.425 | 3541.526 |
| 52205 | 38.739 | 52.858 | 14.119 | 1170.390 | 3516.069 |
| 52206 | 37.534 | 55.911 | 18.377 | 1161.224 | 3531.246 |
| 52207 | 39.906 | 55.171 | 15.265 | 1164.190 | 3529.802 |
| 52208 | 40.198 | 55.137 | 14.939 | 1174.659 | 3545.199 |
| 52209 | 39.096 | 55.131 | 16.035 | 1182.198 | 3551.049 |
| 52210 | 41.435 | 55.243 | 13.808 | 1183.645 | 3544.532 |
| Average | 38.943 | 55.255 | 16.313 | 1112.920 | 3535.241 |
| Session 2 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 52301 | 38.739 | 52.858 | 14.119 | 1170.390 | 3516.069 |
| 52302 | 38.681 | 52.191 | 13.510 | 1175.386 | 3555.816 |
| 52303 | 37.212 | 51.403 | 14.191 | 1169.518 | 3554.228 |
| 52304 | 37.725 | 52.304 | 14.579 | 1172.284 | 3545.568 |
| 52305 | 36.301 | 52.392 | 16.091 | 1161.140 | 3543.919 |
| 52306 | 38.938 | 51.840 | 12.902 | 1174.883 | 3539.465 |
| 52307 | 36.097 | 51.401 | 15.304 | 1163.613 | 3529.154 |
| 52308 | 37.511 | 50.642 | 13.131 | 1166.319 | 3549.032 |
| 52309 | 35.850 | 51.610 | 15.760 | 1168.962 | 3553.343 |
| 52310 | 37.982 | 51.326 | 13.344 | 1171.291 | 3545.882 |
| Average | 37.504 | 51.797 | 14.293 | 1169.379 | 3543.248 |

CASE STUDY SUBJECT 5 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 2 | Baseline | | | Mic Cal | 92 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 52101 | 13.640 | 19.790 | 6.150 | 23.660 | 27.340 |
| 52102 | 12.540 | 16.950 | 4.410 | 23.190 | 22.540 |
| 52103 | 13.810 | 17.610 | 3.800 | 22.010 | 23.120 |
| 52104 | 12.980 | 17.440 | 4.460 | 20.350 | 22.810 |
| 52105 | 11.200 | 16.070 | 4.870 | 21.310 | 21.670 |
| 52106 | 9.640 | 15.770 | 6.130 | 19.200 | 20.170 |
| 52107 | 12.410 | 16.830 | 4.420 | 22.180 | 22.630 |
| 52108 | 12.960 | 16.880 | 3.920 | 19.910 | 21.730 |
| 52109 | 12.580 | 16.960 | 4.380 | 21.000 | 21.620 |
| 52110 | 12.580 | 16.970 | 4.390 | 21.230 | 22.080 |
| Average | 12.434 | 17.127 | 4.693 | 21.404 | 22.571 |
| Session 2 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 52201 | 15.670 | 20.690 | 5.020 | 26.830 | 28.250 |
| 52202 | 16.910 | 20.800 | 3.890 | 27.700 | 27.390 |
| 52203 | 15.050 | 20.380 | 5.330 | 26.850 | 27.600 |
| 52204 | 15.640 | 19.110 | 3.470 | 26.710 | 26.590 |
| 52205 | 11.270 | 17.620 | 6.350 | 24.000 | 23.680 |
| 52206 | 15.770 | 18.750 | 2.980 | 25.920 | 25.720 |
| 52207 | 14.580 | 18.930 | 4.350 | 25.030 | 25.780 |
| 52208 | 15.540 | 18.780 | 3.240 | 27.140 | 26.690 |
| 52209 | 16.640 | 19.650 | 3.010 | 28.990 | 27.550 |
| 52210 | 15.410 | 20.400 | 4.990 | 30.190 | 28.300 |
| Average | 15.248 | 19.511 | 4.263 | 26.936 | 26.755 |
| Session 2 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 52301 | 11.270 | 17.620 | 6.350 | 24.000 | 23.680 |
| 52302 | 14.290 | 18.150 | 3.860 | 25.380 | 24.390 |
| 52303 | 13.080 | 17.070 | 3.990 | 23.100 | 23.320 |
| 52304 | 13.790 | 18.150 | 4.360 | 23.720 | 24.130 |
| 52305 | 11.830 | 17.960 | 6.130 | 23.720 | 24.150 |
| 52306 | 13.200 | 18.340 | 5.140 | 24.930 | 24.590 |
| 52307 | 11.550 | 16.360 | 4.810 | 21.680 | 21.630 |
| 52308 | 13.210 | 17.500 | 4.290 | 21.790 | 22.990 |
| 52309 | 13.670 | 17.530 | 3.860 | 22.530 | 22.960 |
| 52310 | 12.890 | 17.250 | 4.360 | 22.230 | 23.650 |
| Average | 12.878 | 17.593 | 4.715 | 23.308 | 23.549 |

CASE STUDY SUBJECT 5 ACOUSTIC DATA

Singing Power Ratio (SPR), Maximum Intensity 0-2 kHz (Max 0-2kHz), Maximum Intensity 2-4 kHz (Max 2-4kHz), Peak Frequency 0-2 kHz (Peak 0-2kHz), Peak Frequency 2-4kHz (Peak 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | Mic Cal | 94 |
|-----------|---------------|-------------------|----------------------|--------------------|--------------------|
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 53101 | 34.036 | 49.535 | 15.499 | 1167.945 | 3551.198 |
| 53102 | 36.963 | 50.962 | 13.999 | 1172.372 | 3545.247 |
| 53103 | 33.376 | 50.055 | 16.679 | 1179.016 | 3551.653 |
| 53104 | 34.881 | 49.876 | 14.995 | 1165.597 | 3529.224 |
| 53105 | 38.264 | 49.052 | 10.788 | 1160.389 | 3548.300 |
| 53106 | 36.101 | 48.381 | 12.28 | 1180.189 | 3557.671 |
| 53107 | 34.122 | 49.695 | 15.573 | 1170.211 | 3551.215 |
| 53108 | 30.245 | 50.281 | 20.036 | 1167.733 | 3540.028 |
| 53109 | 29.894 | 49.805 | 19.911 | 1170.793 | 3545.259 |
| 53110 | 36.204 | 49.391 | 13.187 | 1174.973 | 3558.922 |
| Average | 34.409 | 49.703 | 15.2947 | 1170.922 | 3547.872 |
| Session 3 | Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 53201 | 31.263 | 46.886 | 15.623 | 1183.331 | 3558.992 |
| 53202 | 33.634 | 48.580 | 14.946 | 1174.030 | 3552.292 |
| 53203 | 34.956 | 49.135 | 14.179 | 1161.341 | 3555.417 |
| 53204 | 34.246 | 49.571 | 15.325 | 1174.574 | 3554.230 |
| 53205 | 32.971 | 48.856 | 15.885 | 1179.581 | 3556.602 |
| 53206 | 33.336 | 49.263 | 15.927 | 1181.594 | 3549.344 |
| 53207 | 33.182 | 48.902 | 15.720 | 1169.902 | 3552.949 |
| 53208 | 31.936 | 48.788 | 16.852 | 1170.594 | 3551.707 |
| 53209 | 33.233 | 49.419 | 16.186 | 1171.250 | 3536.034 |
| 53210 | 33.659 | 49.337 | 15.678 | 1169.070 | 3544.091 |
| Average | 33.242 | 48.874 | 15.632 | 1173.527 | 3551.166 |
| Session 3 | Post-Training | | | | |
| | SPR | Max 0-2kHz | Max 2kHz-4kHz | Peak 0-2kHz | Peak 2-4kHz |
| 53301 | 30.956 | 48.935 | 17.979 | 1179.868 | 3530.309 |
| 53302 | 32.868 | 48.248 | 15.380 | 1171.275 | 3547.143 |
| 53303 | 33.453 | 48.346 | 14.893 | 1176.851 | 3537.958 |
| 53304 | 33.165 | 47.700 | 14.535 | 1169.021 | 3545.292 |
| 53305 | 34.128 | 48.391 | 14.263 | 1163.497 | 3533.241 |
| 53306 | 33.723 | 49.277 | 15.554 | 1176.067 | 3536.300 |
| 53307 | 31.128 | 48.651 | 17.523 | 1172.028 | 3543.097 |
| 53308 | 33.021 | 49.199 | 16.178 | 1168.014 | 3546.160 |
| 53309 | 31.733 | 47.961 | 16.228 | 1183.007 | 3555.997 |
| 53310 | 33.784 | 49.268 | 15.484 | 1177.389 | 3535.269 |
| Average | 32.796 | 48.598 | 15.802 | 1173.702 | 3541.077 |

CASE STUDY SUBJECT 5 ACOUSTIC DATA

Energy Ratio (ER), Average Intensity 600-800 Hz (AI 600-800), Average Intensity 900-1400 Hz (AI 900-1400), Average Intensity 0-2 kHz (AI 0-2kHz), Average Intensity 2-4 kHz (AI 2-4kHz) Test Results for All Phases in All Test Sessions

| Session 3 | Baseline | | | Mic Cal | 94 |
|-----------|---------------|------------------|--------------------|-------------------|--------------------|
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 53101 | 15.000 | 17.990 | 2.990 | 23.420 | 22.100 |
| 53102 | 11.090 | 16.710 | 5.620 | 22.350 | 22.180 |
| 53103 | 11.980 | 17.560 | 5.580 | 24.800 | 22.940 |
| 53104 | 13.240 | 16.760 | 3.520 | 20.780 | 21.790 |
| 53105 | 10.700 | 15.610 | 4.910 | 19.980 | 20.310 |
| 53106 | 14.700 | 17.680 | 2.980 | 23.690 | 22.970 |
| 53107 | 14.340 | 17.070 | 2.730 | 20.990 | 22.170 |
| 53108 | 13.800 | 16.860 | 3.060 | 20.210 | 21.320 |
| 53109 | 14.350 | 16.380 | 2.030 | 21.300 | 21.060 |
| 53110 | 14.090 | 17.230 | 3.140 | 21.250 | 22.510 |
| Average | 13.329 | 16.985 | 3.656 | 21.877 | 21.935 |
| Session 3 | Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 53201 | 14.770 | 17.690 | 2.920 | 23.450 | 22.710 |
| 53202 | 13.440 | 18.410 | 4.970 | 22.310 | 23.640 |
| 53203 | 16.060 | 18.000 | 1.940 | 21.180 | 23.320 |
| 53204 | 15.610 | 18.050 | 2.440 | 24.020 | 22.950 |
| 53205 | 11.600 | 17.570 | 5.970 | 23.420 | 22.980 |
| 53206 | 17.000 | 19.610 | 2.610 | 25.590 | 23.940 |
| 53207 | 12.730 | 17.250 | 4.520 | 22.520 | 21.870 |
| 53208 | 13.720 | 15.870 | 2.150 | 21.230 | 21.210 |
| 53209 | 12.100 | 16.590 | 4.490 | 21.710 | 21.810 |
| 53210 | 13.600 | 16.940 | 3.340 | 21.940 | 21.780 |
| Average | 14.063 | 17.598 | 3.535 | 22.737 | 22.621 |
| Session 3 | Post-Training | | | | |
| | ER | AI 0-2kHz | AI2kHz-4kHz | AI 600-800 | AI 900-1400 |
| 53301 | 1.480 | 9.750 | 8.270 | 20.050 | 20.460 |
| 53302 | 14.580 | 17.530 | 2.950 | 20.690 | 23.080 |
| 53303 | 14.070 | 16.200 | 2.130 | 22.030 | 21.880 |
| 53304 | 14.240 | 16.110 | 1.870 | 18.600 | 20.640 |
| 53305 | 10.950 | 15.350 | 4.400 | 17.940 | 19.600 |
| 53306 | 11.370 | 16.940 | 5.570 | 21.330 | 22.500 |
| 53307 | 14.460 | 16.620 | 2.160 | 19.650 | 21.690 |
| 53308 | 10.660 | 16.050 | 5.390 | 18.680 | 21.590 |
| 53309 | 14.570 | 17.160 | 2.590 | 21.710 | 22.530 |
| 53310 | 14.620 | 17.460 | 2.840 | 22.340 | 22.630 |
| Average | 12.100 | 15.917 | 3.817 | 20.302 | 21.660 |