University of Nevada, Reno

The Exploration of a Combination Therapy on Voice Feminization for Male-to-Female Transgender Individuals

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Speech Pathology and Audiology

by

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ABSTRACT

The Exploration of Combination Therapy on Voice Feminization for Male-to-Female Transgender Individuals

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Purpose: The purpose of this case series pilot study was two-fold. First, to add to the results from this experimental case series to the dearth of research on vocal therapy interventions provided by speech-language pathologists to transgender clients. Second, it piloted the Combination Voice and Communication (CVC) therapy to better understand the components of this therapy related to the feminization of the voice and communication for male to female (MTF) trans individuals.

Method: Two MTF participants were randomly selected from a pool of 4 participants and were randomly assigned to a team of clinicians. CVC therapy was delivered once a week for 50 minutes for seven weeks. It targeted pitch, breathiness, oral resonance, verbal communication, and nonverbal communication. Naïve listeners, clinicians, and participants judged vocal femininity and gender.

Results: Naïve listeners, clinicians, and the participants perceived both participants as sounding more feminine after participating in CVC therapy. The perceived increase in femininity after therapy by naïve listeners was found to be statistically significant with a large effect size. Nearly half of naïve listeners perceived Participant 1's gender as

"female" after therapy, however, Participant 2 was still perceived by the majority of naïve listeners as "male". Additionally, both participants reported dramatically better vocal quality of life scores after therapy.

Conclusion: CVC therapy is a successful model for voice and communication feminization for MTF transgender individuals. Results suggested that a number of targets could be trained in a particular set of therapy sessions and minutes with the implementation of a home program. Findings from this study have the potential to guide future voice therapy intervention models with lasting effects on the feminization of the voice.

Key Words: *transgender, male-to-female, voice therapy, communication therapy, combination therapy, voice and communication, CVC therapy.*

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Selah Sullivan

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CHAPTER I

INTRODUCTION

The abbreviation LGBT stands for *Lesbian*, *Gay*, *Bisexual*, and *Transgender*. This acronym has been used since the 1990's to describe people who have sexual and gender identities other than heteronormative. Other variations of the LGBT acronym have arisen since, and include additional letters of *Q (*Queer/Questioning), *I (Intersex),* and A (*Asexual/Ally*). An estimated 700,000 transgender individuals live in the United States today (Gates, 2011).

The Gay & Lesbian Alliance Against Defamation (GLAAD; GLAAD, 2014), define *Transgender* as "an umbrella term for people whose gender identity differs from what is typically associated with the sex they were assigned at birth." In other words, a transgender individual's internal identity of being a man or a woman does not line up with the gender they were given at birth. This is in comparison to "cisgender" individuals, whose gender does match the sex they were assigned at birth (Schilt & Westbrook, 2009). Furthermore, gender identity is distinct from sexual orientation. Gender identity simply refers to a person's internal sense of being a man or a woman, whereas sexual orientation refers to a person's attraction to another person. A transgender individual may be straight, gay, lesbian, bisexual, or asexual.

The transgender population faces many challenges every day. Individuals who are transgender represent the least accepted populations of the LGBT community. According to a report by the National Center for Transgender Equality and The Task Force (Grant, Mottet & Tanis, 2011), the "T" of the LGBT community is the most likely to be

unemployed and to live in poverty. Ninety-percent have reported being harassed, mistreated or discriminated against at their place of employment. Additionally, forty-one percent of those surveyed reported attempting suicide. Although a transgender individual encounters many hardships, the act of transitioning and outwardly projecting their internal gender can often lead to higher quality of life (Gorin-Lazard et. al., 2012). For this reason, transitioning to the gender with which they identify can lead to beneficial and positive changes in a transgender individual's life.

Transitioning to the gender with which one identifies can be a long and complicated process with many health and social complications (GLAAD, 2014). One of the greatest obstacles that a male-to-female (MTF) transgender individual faces is having her voice perceived as female. Androgen supplements successfully change the voice of female-to-male (FTM) transgender men by bulking up or "thickening" the vocal folds, which to a great extent helps them achieve the voice of a typical biological male or "cis male". Conversely, estrogen therapy has no effect on the vocal folds or larynx, so MTF transgender women must seek other options in order to change their voice to match the gender with which they identify (McNeill, Wilson, Clark, & Deakin, 2008). While some surgeries, such as cricothriodplexy, exist and show potential for changing the voice of MTF individuals in the future, current results still vary. Moreover, surgery is an expensive and invasive option (Neumann & Welzel, 2004). Therefore, transgender MTF individuals will often seek out voice therapy from a speech-language pathologist.

Raising the overall fundamental frequency (pitch) of MTF transgender individuals is one of the most common targets in voice feminization (Gelfer, 1999). This is because vocal pitch is one of the primary features that distinguishes the voice of a male from the

voice of a female (Borsel, Janssens, & De Bodt, 2009). This perceptual difference in vocal pitch is due to a vast variance between the average fundamental frequencies of men in comparison to women. The fundamental frequency of a typical male is around 118 Hz, whereas the average fundamental frequency of a typical female is around 205 Hz (Gelfer & Bennett, 2012).

While raising fundamental frequency has been found to significantly raise the perception of a more feminine voice, it is still distinguishable from the voice of a biologically female or "cis female" speaker and lacks other feminine qualities (Bralley, Bull, Gore, & Edgerton, 1978). Thus, it is important that speech-language pathologists look into additional aspects of vocal quality and communication for their transgendered MTF clients that can be used in combination with raising fundamental frequency.

Since changes in pitch alone have not lead to the perception of a female voice, there needs to be empirical evidence on an intervention that will lead to an increased feminine perception of the voice. The purpose of this study was to pilot CVC therapy and better understand the components of this therapy related to the feminization of the voice and communication for MTF trans individuals.

CHAPTER II

LITERATURE REVIEW

U.S. Demographics

Current projections of transgender individuals living in the United States today is .3% of the adult population totaling nearly 700,000 transgender individuals (Gates & Scholar, 2011). However, this is a conservative number and is likely underestimated. Discrepant transgender estimates range from .3% to 3.2% of the adult population. For example, the more liberal estimate comes from the California LGBT Tobacco Survey in 2003, which estimated that 3.2% of adults identified as transgender. The Massachusetts Behavioral Risk Factor Surveillance Survey conducted a survey with a more conservative estimate in 2007 and 2009, which estimated 0.5% of adults who identified as transgender (Conron, 2011). It is easily understood how challenging it may be to acquire accurate numbers. One factor that obscures accurate number estimates is how surveys may have defined the term "transgender". Another complication is that some people may in fact be transgender, but have not yet taken steps toward transitioning and identifying publically as a transgender (Gates & Scholar, 2011).

Demographics

Transgender individuals live in every state in the United States, and many organizations have evolved over time to protect the rights of these individuals. The American Civil Liberties Union has defended the rights of the LGBT community since 1936 (ACLU, 2014). The participants of the current study were recruited from transgender women living in Northern Nevada. The Office of Public Health Informatics and Epidemiology Nevada Division of Public and Behavioral Health Department of

Health and Human Services conducted a survey in 2014 titled "Hope Grows for Nevada Trans Health". Those surveyed were 18-65(+) with the majority of individual's ages falling between 18-34 (31%). This survey reported that 25% of the Nevada transgender population resides in the Washoe County area.

Findings from this survey of Nevada indicated that the transgender population is heterogeneous in both race and education. Seventy-three percent of the Nevada trans population identified as White, 10% identified as Latino/a, 4% identified as Black, and 4% identified as Asian. Most Nevada trans individuals had "some college" (43%) and only 7% had "less than high school" as their educational status. The Nevada trans community contributes economically to society. Seventy-two percent of the population is employed part or full-time with the majority reporting an average annual income between $10,000 and $24,999 (26%). Additionally, ninety-five percent reported stable living arrangements.

This survey also reported specific information regarding gender identity. As stated previously, sexual identity is separate from gender identity. For example, a female transitioning to male (FTM) who is exclusively attracted to women would usually identify himself as a straight man, and a male transitioning to a female (MTF) who is exclusively attracted to women would typically identify as a lesbian woman. In the Nevada survey, 25% of transgender individuals identified as gay/lesbian, 23% identified as heterosexual, 17% identified as bisexual, 13% identified as pansexual, 11% identified as queer, 8% were questioning, and 4% were asexual.

The demographics of transgender individuals are similar in nature to the cis

gender population. However, living a transgender life is often accompanied by social adversities. The Nevada Survey also examined hardships that transgender individuals encounter. According to the survey, 66% of transgender Nevada residents have been the victims of verbal abuse and 37% have experienced physical abuse. Fifty percent have reported problems getting a job and 27% have reported losing a job. Eighteen percent reported experiencing problems with the police or justice system, which they attributed to their "gender identity expression".

Quality of Life

The effects of hormones, gender reassignment, and facial surgery are indicators of quality of life for transgender individuals. Most existing studies have also found that taking steps in transitioning is associated with higher quality of life (QoL) scores. Recent studies demonstrated improved quality of life for trans individuals who undergo hormone therapy (Gorin-Lazard et al., 2011), gender reassignment surgery (Wierckx et al., 2011), and facial feminization surgery (Ainsworth & Spiegel, 2010). These studies found that taking these steps in transitioning have an overall positive effect on QoL.

Gorin-Lazard and colleagues (2011) examined the effect of hormonal therapy on self-reported quality of life (QoL) for 61 adults with an average age of 34.7 years. Participants were categorized into a hormonal therapy group or a nonhormonal therapy group. Participants in the hormonal therapy group were assigned hormonal therapy in addition to sexual reassignment procedure, equaling 72.1% (44) of the participants. The nonhormonal group participants received the sex reassignment procedure before hormonal therapy. Participants' QoL was assessed using the Short Form 36. Higher

scores indicated higher levels of QoL. Results indicated the transgender individuals who received hormone therapy experienced significantly higher QoL than those who did not.

Other research examined the effect of sexual reassignment procedure on QoL. Wiertckx et al. (2011) examined the effect of gender reassignment surgery (GRS) on quality of life in 49 transgender men with an average age of 37 years. Participants included in the study received GRS at least 1 year before the study. The average years post GRS was 8 years (ranged from 2 years to 22 years). QoL was measured using a Dutch version of the Short Form 36 Health Survey. Questions addressed self-perceived physical, social, and mental health areas. Findings suggested that transgender men were living a satisfactory life after GRS.

Another way for transgender females to transition is to undergo a facial feminization procedure. Ainsworth and Spiegel (2010) examined the QoL of 247 transgender MTFs who did or did not undergo facial feminization surgery or GRS in comparison to the general female population. Participants completed surveys online. QoL was measured using the San Francisco short 36-question health questionnaire form. Findings revealed a significant difference between transgender MTF who received facial feminization therapy in comparison to those who did not favoring the group who had the procedure. Transgender women who did not receive surgical intervention performed significantly lower than the general female population on mental QoL measures. Those who received one or both surgical procedures did not score significantly different than the general female population.

Overall, hormones and surgical procedures have been used in the transgender process. Research has measured the effect of these surgeries on the QoL of transgender

individuals. It appears that hormones and surgical procedures can enhance the QoL for transgender individuals.

Hormones

Many transgender individuals seek hormone therapy to help them appear as the gender with which they identify. It is important to note that the effects of hormonal therapy for FTM and MTF are different, and that both benefits and risks exist for hormone therapy.

FTM individuals seeking hormone therapy are administered testosterone. Typical results are an increase in body and facial hair, increased musculature, increased libido, and a change of the voice (Ettner, 2012). Testosterone has a "bulking up" effect on the vocal folds, which causes the voice to sound deeper and more masculine. These effects are seen as benefits because they allow for more masculine physical and emotional characteristics. Similar to hormone therapy for MTFs, physicians should also monitor hormone therapy for FTM transgender because of health risks. The testosterone hormone can cause liver and gall bladder issues (Adler, Hirsch, & Mordaunt, 2012).

Typical results from hormonal therapy for MTF individuals include softening of the skin, decreased muscle mass, fat redistribution, development of breasts, atrophy of genitals, and a reduction of body hair. While these benefits can greatly help an individual as being perceived as having a more feminine appearance, feminization hormones have no effect on the vocal folds and, therefore, do not change an individual's voice. Generally, hormone treatments may include antiandrogenic compounds, conjugated estrogen, transdermal estradiol patches, or intramuscular injections of ethinyl estradiol (Ettner, 2012). These hormones may be recommended individually or in some

combination. Hormone therapy can cause possible health issues involving the vascular system and liver. Due to possible complications when receiving hormone therapy, it is highly recommended that the physician administering the hormones closely monitor individuals.

Vocal and Communication Therapy.

It is believed the first research article on transgender voice appeared in 1978 by Bralley and colleagues. Also, very few additional articles were published between 1978 and the early 2000's. Therefore, since 1978, there is still only limited evidence on the efficacy of treatment options regarding the feminization of the voice. Of those articles, there is a lack of consensus on which therapy interventions to use and the effectiveness of those interventions. For example, some researchers emphasize raising average speaking fundamental frequency (SFF) to feminize the MTF voice (Davies & Goldberg, 2006). In contrast, a study done by Colton, Casper, and Leonard (2006) stated that raising fundamental frequency is often ineffective. Additionally, there are some discrepancies on *how* and *when* to begin therapy. As demonstrated, selecting the best therapy approach strongly involves both professional expertise and patient goals.

The literature on voice and communication therapy includes a variety of treatment targets including vocal quality aspects, verbal communication, and nonverbal communication. The current study's intervention program combines a specific set of these interventions as a combination of voice and communication therapy. Specifically, behaviors targeted included pitch, resonance, breathiness, verbal communication, and non-verbal communication. These behaviors were selected to comprehensively address several of the key difference between male and female voice and language aspects.

Outcomes that measured these variables through perceptual difference were successful in increasing the perception of a more feminine voice when utilized (Adler, Hirsch, & Mordaunt, 2012). A review of transgender voice and communication therapy studies that include pitch, resonance, breathiness, verbal communication, and non-verbal communication are described below.

Pitch

By far, the most common and well-known therapy variable utilized to feminize the voice of MTF individuals is the raising of SFF or pitch. Trans women often come to a speech-language pathologist with the singular goal of raising the pitch of their voice. The most common frequency that individuals use during connected speech is referred to as the habitual speaking fundamental frequency. Habitual SFF is typically a product of both the laryngeal anatomical structure (biological) and learned speaking behaviors (environmental). Habitual pitch may differ from an individual's physiologically normal pitch, which is the pitch produced if phonological physiology is within normal limits. For therapy, it is best that habitual and physiological pitch have a similar SFF because a large difference between the two can lead to issues with vocal quality, therefore pitch should only be raised a few semitones (Stemple, Glaze, & Klaben, 2010).

Gelfer and Bennett (2012) examined the effect of vowel formant frequencies on the perception of vocal gender and age for 15 biologically male and 15 biologically female speakers. Participants were asked to produce i/, /a/, and /u/ vowel sounds a speech sample using a "carrier" phrases to elicit the /i/, /a/, and /u/ vowel sounds at the phrase level. The researchers sliced the carrier phrases to isolated vowels. The carrier phrases

and sliced isolated vowels were then randomized and presented to 10 male and 10 female listeners who were asked to identify the age and gender of the speakers.

Findings revealed that all three vowel formant frequencies differentiated the perception of male and female voices. Correlations were conducted to determine if the perceived gender was in fact related to the formant frequency. Findings revealed statistically significant correlation between the perception of gender and each vowel formant ($p = 0.0038$). In other words, the higher the percentage of "perceived female", the higher the average vowel formant frequency. Also, the correlation coefficient fell between $r = - 0.569$ and $r = -0.836$, which is a large effect size. These findings revealed that vowel formant frequencies are an indicator of gender.

Despite the popularity and benefits in raising pitch as a therapy technique, clients and therapists should recognize that a female voice is not merely a higher version of a man's voice. In fact, there are many other vocal, verbal, and nonverbal contributors to the female communication. Therefore, raising fundamental frequency alone will not result in an accurate female voice (Becklund-Freidenberg, 2002; Bralley et. al., 1978; Gelfer & Schofield, 2000; Kent & Read, 2002). When setting goals to raise SFF, it is important to only raise pitch to a sustainable frequency. Without a sustainable frequency, the speaker would not be able to use vocal range, intonation, or practice good vocal hygiene (comfortably maintain the voice while speaking) (Stemple, Glaze, & Klaben, 2010).

Resonance

Resonance is responsible for what we hear when an individual speaks after the sound has been filtered through the vocal tract and amplified (Boone, McFarlane, Von

Berg, & Zraick, 2014). Resonance is the "tone" of the voice, which marks another feature that contributes to how "male" or "female" a voice sounds. The resonance of the male voice typically sounds very "chesty" like it is coming from deep within the vocal tract, whereas, female resonance tends to sound more "heady" coming more from the oral cavity (Pickering & Baker, 2012). For this reason, forward oral resonance is often a recommended therapy approach.

Carew, Dacakis, and Oates (2007) examined the effectiveness of oral resonance therapy on increasing the femininity of the voice of 10 MTF transgender participants who had not undergone sexual reassignment surgery or had any prior voice therapy for voice feminization. Participants received five sessions of oral resonance voice therapy, which targeted lip spreading and forward tongue carriage. These techniques were practiced in tasks that increased in linguistic difficulty starting with isolated vowels and moving toward conversational speech.

Speech samples of the "Rainbow" passage were taken from each of participants both pre- and post-treatment. These samples were then randomized and presented to 12 speech pathology students in their 4th year of study to listen to and judge the samples based on how feminine they perceived the voice. Listeners were asked to mark where they felt the voice fell on a 10-cm horizontal line with the very left side representing very masculine and the far right side representing very feminine. Formant frequency values of the vowel sounds /a/, /i/, and /ʊ/ were taken from two different words in the passage and a mean formant frequency score was calculated.

Findings revealed that all participants demonstrated significant gains in vowel formant frequencies post-treatment (F1: $p = .02$, F2: $p = 0.01$, FF: $p = 0.01$) and there

was an upward trend in the perception of femininity in the participants' voices. Patient self-ratings revealed that patients considered their voice as more feminine post-treatment. Another benefit, which was unexpected, was that fundamental frequency was raised spontaneously during the course of treatment without specifically being targeted.

Breathiness

Breathiness is another vocal quality associated with the perception of a female voice. Breathiness can be defined as an airy or soft vocal quality of the voice. Breathiness was included as the therapy approach because of studies that found that voices, which are slightly more breathy, are perceived as more feminine (Pickering & Baker, 2012).

Borsel, Janssens, and De Bodt (2009) investigated the effect of breathiness on the perception of a feminine voice in transgender MTF as compared to raising fundamental frequency alone. Twelve biologically female speech pathology graduate students between the age of 21 and 60 (with a mean age of 27.7) were chosen as participants. The use of all female participants was meant to simulate a situation in which a trans MTF individual might be able to make her voice more feminine after already achieving a high fundamental frequency. Participants were asked to produce two normal /a/ sounds and two breathy /a/ sounds totaling forty-eight samples, which were then analyzed and rated on breathiness by three speech-language pathologists. Any normal sample judged as being within the "breathy" range and any breathy samples judge as being within in the "normal" range were thrown out. This process left 14 samples from seven of the 12 initial participants to be used in two listener experiments.

The female speech samples were used in two experiments. The purpose of both Experiment 1 and Experiment 2 was to determine the effect of breathiness on the voice,

but differed in procedures. There were 40 (20 male and 20 female) naïve listeners who were selected to evaluate the 14 speech samples. Males and females were randomly assigned to be the listeners for Experiments 1 and 2, totaling 10 males, 10 females in each experiment. All listeners were blinded to the purpose of the study.

In Experiment 1, the 14 samples were presented at random to listeners as if they were from different speakers. Judges rated femininity on a five-point scale with 1 being "little feminine" and 5 being "very feminine". In Experiment 2, the normal and breathy samples were presented to listeners side-by-side in seven pairs and listeners were required to indicate which of the two samples sounded the most feminine.

Results of both Experiment 1 and Experiment 2 indicated that the breathy samples were perceived as more feminine than the normal samples. In Experiment 1, the normal sample always received a lower femininity score than the breathy sample. Statistical analysis using Wilcoxon signed rank test showed that the difference was significant ($z = -2.37$; $p = 0.02$). In Experiment 2, significantly more listeners marked the breathy sample as being the more feminine counterpart of the two samples presented ($p = 0.02$). These results are consistent with the findings of Gorham and Morris (2006) that breathiness is associated with a more feminine voice in MTF transgender individuals.

Verbal Communication. There are also differences between male and female speakers not just in the way their voices sounds, but in *how* they communicate. For example, differences exist in the rate of speech, the types of words used, and intonation. Speaking rate is the number of words used in a set amount of time. Typically women have a slower rate of speech, which has more pauses in it and short bursts. Men tend to speak faster and in a more monotonous rhythm (Fitzsimmons, Sheahan & Staunton,

2001; Gunzberger, 1995). The syntax and semantics utilized by men and women are often very different, with one of the main differences being that women elaborate more, use more adverbs, use more adjectives, and use more words when speaking (Andrews, 1999). Lastly, intonation is how emphasis is put on a word or utterance. Women appear to use more rising intonation, which makes utterance sound less direct and more open (similar to a question).

A recent study by Hancock, Colton, and Douglas (2013) was conducted to determine the effect of intonation on the gender perception of transgender speakers in connected speech for 12 biological and gender identified males, 12 biological and gender identified females, six FTM transgendered men, and fourteen MTF transgender women. A spontaneous speech sample was obtained for all participants, totaling 44 speech samples. These speech samples were then randomly presented to 14 listeners who rated the samples on a two-anchor scale. The left side represented "masculine male" and the right side of the scale represented "feminine female".

The results of the study revealed significant differences between the four gender groups, [$\chi 2$ (4, n = 44) = 34.21, p = 0.00]. The highest median score was received by the female group (Md = 870), followed by male-to-female group (Md = 446), FTM (Md = 225), and lastly the biologically male and FTM groups (Md = 59). The femininity rating of biologically female participants was found significantly higher than both male groups (males: $u = 0.00$, $z = -4.16$, $p = 0.00$; FTMs: $u = 0.00$, $z = -3.37$, $p = 0.00$), and the transgender male-to-female group ($u = 5.5$, $z = -4.04$, $p = 0.00$) based on the Mann-Whitney U post hoc tests with Bonferroni adjustment. The transgender MTF individuals were found to have significantly higher differences from the males ($u = 5$, $z = -4.06$, $p =$

0.00). The biologically male and the FTM groups did not score significantly different from one another ($u = 15$, $z = -1.97$, $p = 0.049$), however the scores of the FTM and the MTF groups also did not differ significantly ($u = 19$, $z = -1.90$, $p = 0.06$).

Hancock et. al. (2013) found that intonation *may* be useful in transgender communication therapy because it appears to influence the perception of a feminine voice in some instances. Intonation is not a clear indicator of a MTF transgender woman passing as female or not. However, maintaining a high percentage of utterances with downward intonation might distinguish a speaker as male. It is likely that intonation's role in gender perception is minor, but results in this study indicate that intonation is not completely irrelevant for transgender voice therapy.

Nonverbal Communication

In addition to perceptual differences of the voice between male and female speakers, there are also differences in nonverbal communication, specifically, the type of body language and the use of gestures. Nelson and Gloant (2004) found that women use their head during communication more often than men, and that their head movements often reflect the movements of the person with whom they are speaking. Movement of the trunk also differs between the sexes. According to Tidwell (2011), the posture of men is more of a back lean away from their communication partner, whereas women tend to "lean in" towards their communication partner. Arm and hand gestures in women appear more "compact" and closer to the body compared to men who use their wingspan more (Hirsch & Van Borsel, 2012). The movements of women have also been observed to appear more curved and fluid in their motion (Adler, Hirsch, & Mordaunt, 2012). Nonverbal communication can also be perceived as more feminine or more masculine.

Summary of Literature Review

To conclude, external evidence demonstrated that breathiness, average formant frequency (pitch), resonance, and verbal communication modalities all successfully helped to raise the perception of a more feminine voice. Although studies demonstrated an increase in the perception of feminine voice, the MTF transgender voice is usually still distinguishable from the biologically female voice (Bralley et. al., 1978). The application of a combination approach for MTF individuals should yield better results than working on fundamental frequency (pitch), resonance, breathiness, verbal communication, or nonverbal communication alone. In other words, a combination therapy approach to voice therapy for MTF transgender individuals may be more effective in achieving a more feminine voice than any one therapy type alone. However, there is a need for more therapy techniques to be developed, as no one therapy approach or combination of approaches has been found to successfully achieve the perception of a female voice at this point in time.

Purpose and Research Aims

There currently exists very little research on transgender voice therapy and these gaps lead to some confusion as to which treatment options would be the most successful and the most beneficial to the client. One such gap that exists is the effectiveness of targeting multiple areas of communication with a multi-therapy approach. According to Oates (2012, p. 60) "There are no reports of studies that compare the effectiveness of two or more specific treatment methods, and few reports that provide evidence as to

whether targeting a particular voice characteristic or combination of voice characteristics leads to superior outcomes."

The purpose of this case series pilot study was two-fold. First, to add to the results from this experimental case series to the dearth of research on vocal therapy interventions provided by speech-language pathologists to transgender clients. Second, the purpose of this case series was to better understand the components and delivery of CVC therapy and the vocal feminine quality perceptions of CVC therapy from transgender individuals, naïve listeners, and clinicians' perspectives. Our CVC therapy targeted pitch, breathiness, oral resonance, as well as, feminine verbal and nonverbal communication skills. Specific research aims regarding the implementation of CVC therapy for transgender MTF speakers were as follows:

1. Explore CVC therapy's components of pitch, breath support, oral resonance, and breathiness on vocal feminine qualities.
2. Explore CVC therapy's components of speech rate and mean length of utterance on feminine verbal communication.
3. Explore CVC therapy's component of gestures on nonverbal communication.
4. Describe the perceptions of a transgender individual's self-perception of her voice after CVC therapy.
5. Describe naïve listeners' vocal femininity and gender perceptions of transgender individuals after CVC therapy.
6. Describe clinicians' femininity and gender perceptions of transgender individuals after CVC therapy.

CHAPTER III

METHODOLOGY

Participant Recruitment

This study was conducted under the supervision of the University of Nevada, Reno, Institutional Review Board (#617963-1). Participants were recruited from the summer 2014 pilot Transgender Voice and Communication Clinic at the University of Nevada, Reno. Participants were required to meet four criteria: 1) an adult (18+), 2) transgender male-to-female individual who is seeking to feminize her voice, 3) a native speaker of English, and 4) a non-smoker. Of the nine transgender women who attended the Transgender Voice and Communication Clinic's "Meet and Greet", four volunteered and consented to participate in this pilot study. An online random number generator (http://www.randomizer.org/form.htm) was used to randomly select two of the four qualifying participants.

Participants

Participant 1 was a 63 year-old who was living 100% of the time as a female. She began transitioning two years prior in 2012, and began presenting as female in public in June of 2013. She began taking estrogen and other hormones in May of 2012 and planned to undergo gender reassignment surgery, but had not undergone the procedure at the time she was enrolled in voice therapy. Participant 1 graduated from high school, took some higher education courses, and was retired. Her support system included her wife, a cousin, and a close friend who was also a trans woman. Participant 1 received no voice therapy prior to her participation in this study, but reported that she had tried to raise her pitch on her own by watching YouTube videos.

Participant 2 was a 54 year-old who was only presenting as female 2% of the time at the time of treatment but planned to transition into living 100% of the time as female within the following year. She began transitioning 12 years prior and was taking estrogen and other hormones but was not currently presenting as female in public. Participant 2 was still considering if she wanted gender reassignment surgery, but felt she would likely get it in the future. She was self-employed and held a master's degree. She was divorced but stated that her friends and family were very supportive. Participant 2 had also received no voice therapy prior to her participation in this study.

Clinician Training

All four of the graduate student clinicians attended two trainings related to transgender issues and speech therapy prior to the initiation of therapy. The first training was 4 hours in length and addressed topics related to service delivery and sensitivity to transgender issues. Two transgender individuals delivered this training. The second training was 3 hours in length and addressed specific therapy information and techniques related to verbal and nonverbal communication for transgender individuals. A doctoral level speech-language pathologist who specializes in transgender voice therapy and who is the director of a transgender voice clinic at a university in northern California delivered the second training. One graduate student clinician in each pair attended a semester-long course in voice therapy. This clinician was appointed as the lead therapist addressing vocal content during therapy. The other clinician lead the verbal and nonverbal communication strategies not related to voice.

Client-Clinician Pairing

An online random number generator (http://www.randomizer.org/form.htm) was used to randomly select two of the four qualifying participants. Each participant was matched with a team consisting of two speech-language pathology graduate students, named Team One and Team Two. The first participant was assigned to Team One and the second participant was assigned to Team Two. The other two participants continued to receive therapy in the summer clinic but their data was not used for this study.

Procedures

CVC therapy was implemented for 50-60 minutes on Fridays from 4 – 5pm from June 13th through August 1st with no therapy on Friday, July 4th at the University of Nevada, Reno's (UNR) Speech and Hearing Center's Transgender Voice and Communication Clinic. The teams stated above administered therapy, which consisted of two, second-year speech-language pathology graduate student clinicians. A certified speech-language pathologist supervised all sessions at the UNR Transgender Voice Clinic. Both teams delivered therapy in the same size room and had the same environmental set up with similar placement of tables, chairs, participants, and clinicians. Each session was recorded digitally using a SONY ICD PX333 digital audio recorder and a SONY HDR-CX240 digital video recorder. Digital and audio recordings were immediately uploaded to a password protected server following each session. All data was immediately erased from the recording devices. Recording were used at a later time to ensure treatment fidelity and to score outcome measures.

Independent Variables

The term CVC therapy was used to differentiate this therapy program from other programs for MTF transgender individuals. In contrast to other therapy programs that focused on only the voice, this CVC therapy included vocal, verbal communication, and nonverbal communication training. The CVC therapy was divided into eight sections: 1) vocal hygiene and relaxation, 2) breath support, 3) pitch, 4) resonance, 5) breathiness, 6) verbal communication, 7) nonverbal communication, and 8) homework. Vocal hygiene and relaxation lasted an average of 3 minutes. Activities included laryngeal massage and yawn-sigh. Breath support was delivered for an average of 3 minutes. Activities included yoga breathing and snuff-hiss. Pitch was delivered for an average of 9 minutes. Activities included matching pitch to a keyboard, scaling up and down from fundamental frequency, and pitch shift up. Resonance was delivered for an average of 9 minutes. Activities included forward focus, specifically the Lessac-Madsen Resonant Voice Therapy (LRVT) (Verdolini, 2000). Breathiness was delivered for an average of 3 minutes. Activities included contrasting normal and breath voice in isolation, syllables, words, and sentences. Verbal communication was delivered for an average of 8 minutes. Activities included adjusting speaking rate during oral conversation and reading, as well as using elaborations during conversational speech. Nonverbal communication was delivered for an average of 8 minutes. Activities included head movement, smiling, body posture, and arm movement. Homework was given the last two minutes of the session on specific tasks discussed during the session. See Figure 1 and 2 for a percentage of time participants spent on each area.

Dependent Variables

Five main areas were assessed for the presence of the femininity and included vocal qualities, verbal communication, nonverbal communication, participant's self-perceptions of femininity, and listeners' perception of femininity. Feminine communication skills contained both subjective and objective measures. The participants, clinician, and naïve listeners judged subjective areas, and the clinician obtained objective measures. Vocal feminine quality was measured objectively for pitch (and breath support to sustain pitch), and subjectively by clinicians for oral resonance, and breathiness. Verbal Communication was measured objectively using mean length of utterance (MLU) and speech rate calculated by words per minute (WPM). Nonverbal communication was measured subjectively by clinicians base on the frequency and quality of gestures. Self-perception of femininity was completed by the participants and were subsequently evaluated by clinicians to obtain a vocal quality of life (VQoL) score. Last, listener perception included ratings of femininity of participants' voices by naïve listeners and clinicians.

Vocal Qualities.

Pitch. Pitch is the perception of fundamental frequency. Fundamental frequency is the average vibration of the vocal folds. Fundamental frequency was measured in hertz using a KayPENTAX Visi-Pitch IV program (Carew, Dackais, & Oates, 2007). Participants were asked to say two different stimulus sentences: "Joe lives in Reno" and "The boys won the game". Habitual pitch was calculated by averaging the hertz of the two stimulus sentences. The fundamental frequency of a typical male is around 118 Hz and the average fundamental frequency of a typical female is around 205 Hz (Gelfer &

Bennett, 2012). Clinicians objectively measured pitch using the KayPENTAX Visi-Pitch IV before therapy, after therapy, and one month post therapy (maintenance).

Breath Support. Breath support refers to the vital capacity in the lungs and is important for maintaining pitch, increasing pitch range, and sustaining phonation. To support an increase in vocal pitch participants were provided with a vocal hygiene routine to follow (see Appendix H), vocal relaxation techniques, as well as, techniques to increase breath support. Breath support is important because sustaining and maintaining a higher pitch puts a strain on the voice, which can lead to hyperfunctional voice problems (Stemple, Glaze, & Klaben, 2010).The participants were asked to sustain an /a/ so breath support could be objectively measured using the Phonatory Aerodynamic System (PAS) for sustained phonations. To measure sustained phonation, participants were asked to go for the "Olympic" breathing record and take the deepest breath they could, then phonate /a/ for as long as possible until they ran out of breath. Clinicians recorded the time /a/ was sustained and the expiratory volume (measured by liters expelled). Breath support was measured before therapy, after therapy, and one month post therapy (maintenance).

Oral Resonance. Oral resonance is one of the vocal components which contributes to distinctions in the sound of male and female speakers and was therefore one of the vocal qualities targeted in therapy (Adler, Hirsch & Mordaunt,, 2012). Oral resonance is defined as the sound of the voice during speech, specifically in regards to the quality of the voice's vibration during speech in the oral, nasal, and pharyngeal cavities (Kummer, 2006). Oral resonance was judged by the location of resonance (chest vs. oral) on a 3-point Likert scale of "Deep Chest", "In Between Deep Chest and Forward Oral", and "Forward Oral". Clinicians subjectively measured oral resonance before

therapy, after therapy, and at maintenance one month after therapy from a speech sample task and an oral reading of the Grandfather Passage.

Breathiness. Breathiness is a hallmark vocal quality of females (Dacakis, 2002). In addition, an increase in breathiness has been positively correlated to the perception of a more feminine voice (Borsel et. al., 2009). It is defined as the amount of audible perception of air during expiration due to the lack of complete vocal fold closure. It is typically measured by listener perception. Many female voices vary on the breathiness continuum. Although a very breathy voice is perceived as feminine, an excess of breathiness can be perceived as too quiet. Therefore, it was suggested that participants use a moderate amount of breathiness. This study measured breathiness using a slightly modified Consensus Auditory-Perceptual Evaluation of Voice (CAPE-V) system. The American Speech Language Hearing Association Special Interest Division 3, Voice and Voice Disorders recommended using the CAPE-V as a tool for clinicians to measure auditory-perceptual vocal qualities. Instead of describing the quality as "deviant", we described the quality as "Mild", "Mild/Moderate", "Moderate", "Moderate/Excessive", or "Excessive". The CAPE-V question: "Tell me about when your voice problem began, what were you noticing and what you have done about it" was be replaced with: "Tell me about what you would like to change about your voice, how you and others perceive it." Furthermore, instead of measuring overall severity, roughness, strain, pitch, loudness, and breathiness, only breathiness was measured. The participants were asked to produce a sustained (3-5 seconds) production of /a/ and /i/, read six standard sentences aloud, read a standard passage and answer a predetermined question to obtain a spontaneous speech sample. The clinicians judged breathiness based on all of the speech samples and rated

an overall breathiness average before therapy, after therapy, and one month after therapy to determine maintenance. See Appendix F for specific CAPE-V procedures.

Verbal Communication.

Speech Rate. Speaking rate was targeted because some studies have shown that women have a slightly slower speaking rate than men, most noticeably during oral readings (Fitzsimmons, Sheahan & Staunton, 2001). This difference is mainly due to women using longer and more frequent pauses (Gunzberger, 1995). Speech rate is the number of words used per minute. Participants were asked to provide an oral spontaneous speech sample and read the Grandfather Passage aloud. Clinicians calculated the average words per minute for each task separately. Speech rate was measured before therapy, after therapy, and one month after therapy for maintenance.

Mean Length of Utterance. Mean length of utterance is a representation of the complexity of a sentence (Blake, Quartaro, & Onorati, 1993). Participants provided a spontaneous speech sample that was segmented into communication units (Loban, 1976). The number of morphemes was calculated for each utterance. A morpheme is the smallest unit of speech. Mean length of utterance was calculated by dividing the total number of morphemes by the number of total utterances. Clinicians measured mean length utterance before therapy, after therapy, and one month post therapy (maintenance).

Nonverbal Communication.

Gestures. As stated earlier, nonverbal communication may include a many number of things including body posture, head movements, and gestures. All of these areas were addressed briefly in the course of therapy, however the majority of time in CVC therapy was spent on gestures. Therefore, gestures were the only nonverbal

communication area that were formally assessed and recorded. Men and women carry themselves and use gestures differently. Some research has suggested that women gesture slightly more frequently, but one of the greatest differences observed is that women tend to use gestures in a more fluid motion than men and make movements closer to the body (Eckes, 2000 & Glass, 1992). Gestures were subjectively measured during the spontaneous speech sample task. The quantity of gestures was judged on a 3-point Likert scale with "None", "Few", and "Many". If gestures were present, then the quality of gestures were judged on the scale of "Abrupt", "Between Abrupt and Fluid", and "Fluid". Clinicians measured gestures before therapy, after therapy, and one month post-therapy to determine maintenance.

Self-Perception of Femininity and Vocal Quality of Life. Vocal quality of life is a measure of how happy each participant was with her voice and how well her voice matched her identity. The participants completed the Transgender Voice Questionnaire (TVQ) by Shelagh Davies (www.shelaghdavies.com) related to vocal self-perceptions and voice related quality of life. The TVQ includes 30 questions on a 4-point Likert scale ("1" = Never or Rarely, "2" = Sometimes, "3" = Often, "4" = Usually or Always) and 2 overall voice ratings on a 5-point Likert scale ("Very Female", "Somewhat Female", "Gender Neutral", "Somewhat Male", "Very Male"). On the 4-point scale, scores of "1" were the best score possible in relation to quality of life and higher scores (e.g., "3" or "4") were related to lower voice related quality of life. Potential total scores were between 30 and 120, with 30 being the best possible VQoL score and 120 being the worst possible VQoL score. The 5 point-Likert scale included a rating of participants' current voice and a rating of the participants' ideal voice. See Appendix A for a sample

of the TVQ. The TVQ was administered before therapy, after therapy, and one month post therapy for maintenance.

Naïve Listener Perceptions of Femininity and Gender

Naïve Listeners. Similar to the Van Borsell, Janssens, and De Bodt (2009) study, naïve listeners in this study were used to judge perceptual measures of vocal femininity and gender based on recorded speech samples. We anticipated that gender might have obscured perceptions of femininity and gender; therefore, both females and males were recruited as naïve listeners. Ten female and five male individuals between the ages of 19 and 39 (mean age 27 years old) agreed to participate as naïve listeners. All of the naïve listeners recruited were blinded to the purpose of the study.

Naïve Listener Procedures. Naïve listeners were asked to judge the speech samples of the participants and the ten decoy speakers. Five males and five females between the ages of 31 and 73 (mean age of 50 years old) were recruited as "decoy" speakers to provide the same type of speech samples collected from participants. This is similar to the model by Hancock et. al. (2013), which used male and female speakers in comparison to trans speakers. Similar to the participants in that study, these decoys were all native English speakers and non-smokers. Four different speech samples were collected from each of the participants and the decoy speakers, namely: sustained vowel /a/, sustained vowel /i/, 5-6 standard sentences, and a standard reading passage. Eight randomized playlists were compiled, two for each speech sample task and were labeled either Playlist A or Playlist B. Each playlist included 16 speech samples, one for each of the decoy speakers, and three for each of the participants (before therapy, after therapy,

and maintenance). All speech samples were collected with a SONY ICD PX333 Digital Voice Recorder in a quiet environment.

The speech samples of the participants and decoy speakers were randomized across each task, and randomized again between Playlist A and Playlist B. Each playlist was presented to the naïve listeners in the same order: sustained vowel /a/, sustained vowel /i/, 5-6 standard sentences, and the Grandfather Passage. Naïve listeners judged the first four playlists on a 5-point Likert scale (Very Female, Somewhat Female, Gender Neutral, Somewhat Male, Very Male), and then judged the next four samples on a dichotomous scale for gender perception of the voice (Male, Female). "Femininity" and "Masculinity" was not defined for the listeners and they were instructed to judge according to their personal perception of femininity. This listening trial was then repeated at least one week after the initial presentation for intrarater reliability purposes and to obtain an average perceptual score. One female participant was unable to return for the second presentation, leaving 14 naïve listeners as judges. Similar to calculations in the Van Borsell, Janssens, and De Bodt (2009) study, a mean ''femininity score'' and "gender" was calculated for each of the participants (before therapy, after therapy, maintenance) and male and female decoy speech samples from individual scores assigned by the naïve listeners.

Clinician Perceptions of Femininity

Clinicians rated vocal femininity based on the Grandfather Passage and a spontaneous speech sample using the same 5-point Likert scale (Very Female, Somewhat Female, Gender Neutral, Somewhat Male, Very Male) used by naïve listeners. However the clinicians' judgements were made in real time, rather than from voice recordings.

Clinicians measured vocal femininity before therapy, after therapy, and one month post therapy (maintenance).

Treatment Fidelity

All treatment sessions were digitally recorded for later viewing by two independent raters who were blinded to the purpose of the study. Each rater independently reviewed videos of each therapy session while simultaneously checking off a session fidelity sheet. Each session's fidelity sheet included a list of all of the components that were intended to be covered during that specific therapy session by the clinicians as well as the completion of the tasks of the participants. See Appendix G for a sample of a treatment fidelity checklist. Team 1 and Team 2 implemented the therapy program with 97% or better accuracy. Participant 1 and Participant 2 participated in therapy tasks with 98% or better accuracy.

One hundred percent of the 7 treatment sessions were viewed from digital recordings by two independent raters who were blinded to the purpose of the study. Two methods of interrater reliability were conducted: point-by-point (PBP) and Cohen's *kappa*. A PBP interrater reliability of 90% or above was deemed acceptable. A *kappa* of .6 or better was deemed as substantial agreement (Vierra & Garrett, 2005). Interrater reliability for implementation of the therapy program was calculated point-by-point on 141 points and was 100% for Team 1 and 100% for Team 2. Kappa for implementation of the therapy program was significant with a Cohen's *kappa* = 1.0. Interrater reliability for participant task completion was calculated PBP on 118 points and was 100% for Participant 1 and 100% for Participant 2. *Kappa* for participant task completion was significant with a Cohen's *kappa* = 1.0 for Participant 1 and Participant 2.

Data Analysis and Hypotheses

No formal statistical analyses were conducted for questions one through four and six because this study only included two participants.

Research Aim One. To answer research aim one, four different measures were reported. An average pitch was calculated using the output from the Visi-Pitch's real-time pitch program. Maximum phonation time and liters of air expelled were collected from the Phonatory Aerodynamic System (PAS) as a measure of breath support. The average score on a 3-point Likert scale from two clinicians was calculated as a measure of oral resonance. The average score on a 5-point Likert scale from two clinicians was calculated as a measure of breathiness.

Research demonstrates that an individual's voice will lack feminine qualities if pitch is the only area of voice targeted (Bralley, Bull, Gore, & Edgerton, 1978). We hypothesized that CVC therapy would increase feminine vocal qualities of pitch, breath support, oral resonance, and breathiness. Additional research has shown that raising pitch can lead to certain voice disorders (Stemple, Glaze, & Klaben, 2010). We hypothesized that vocal relaxation and breath support activities would allow participants to better sustain a higher pitch.

Research Aim Two. To answer aim two, words per minute (WPM) was calculated to achieve a speaking rate and the mean length of utterance (MLU) was calculated to achieve a mean length utterance score. Evidence has shown that verbal communication of men and of women is very different (Fitzsimmons, Sheahan & Staunton, 2001; Gunzberger, 1995). We hypothesized that participants would demonstrate more feminine verbal communication skills. Specifically, we hypothesized

that participants would decrease their words per minute because we anticipated that they would add longer pauses between words. We also hypothesized that MLU would be reflective of a western female speaker and participants would increase their MLU by adding additional descriptor words such as adjectives and adverbs (Andrews, 1999).

Research Aim Three. To answer aim three, an average from a 3-point Likert scale for frequency and a 3-point Likert scale for quality from two clinicians was calculated to determine a nonverbal communication measure. Evidence shows that the type of gestures used by women are more fluid than those used by men (Eckes, 2000 & Glass, 1992). We hypothesized that participants would demonstrate more fluid gestures demonstrating more feminine qualities after CVC therapy.

Research Aim Four. To answer aim four, the total TVQ score was calculated. We anticipated that the participants' total score on the TVQ would be lower after therapy showing a higher vocal quality of life score. A study by Gorin-Lazard et. al. (2012) found that taking steps to transition has a positive effect on quality of life of trans individuals. We hypothesized that MTF transgender individuals who received CVC therapy would positively affect the quality of life for the participants.

Research Aim Five. To answer aim five, an average score of naïve listeners was calculated for femininity and gender. Naïve listeners have been used in several studies to rate femininity including Hancock et. al. (2011) and Borsel et. al. (2009). Nonparametric Wilcoxon Signed Rank analyses were also conducted to compare naïve listener's perception of femininity before and after therapy. A Cohen's *d* effect size was calculated as well. We hypothesized that naïve listeners would rate speech samples after CVC

therapy as more feminine on the Likert scale and that they would categorize the gender of the speech samples as female.

Research Aim Six. To answer aim six, an average on a 5-point Likert scale for femininity from two clinicians was reported to determine a femininity measure. We hypothesized that clinicians would perceive the participants voice as more feminine following CVC therapy.

CHAPTER IV

RESULTS

Vocal Feminine Qualities

To answer research aim one, four vocal quality components of the CVC therapy were explored to observe the feminine qualities of the voice. Qualities included pitch, breath support, resonance, and breathiness. As you may recall, vocal qualities were measured both objectively and subjectively.

Pitch. Pitch was objectively measured using the VisiPitch's Real Time Pitch Program. After participating in CVC therapy, Participant 1 increased the pitch of her voice. Prior to the CVC therapy, Participant 1 reported that she had independently been working on increasing her pitch using YouTube videos. Before therapy, Participants 1's average pitch was 173 Hz with a difference of 30 Hz between the two stimulus sentences ("Joe lives in Reno" and "The boys won the game"). However, clinicians perceived her voice as sounding hoarse and raspy. Moreover, Participant 1 exhibited difficulty maintaining a higher pitch. After therapy, her pitch was an average of 211 Hz with a difference in the two stimulus sentences of 25 Hz. This average pitch is slightly higher than the average female voice of 205 Hz. One month later, her average pitch was 205 Hz, with only a 10 Hz difference between the two productions. The reduction in the difference in pitch across speech samples at maintenance indicates that her pitch was much more consistent after CVC therapy.

After participating in CVC therapy, Participant 2 also increased the pitch of her voice. Prior to therapy, Participant 2's pitch was measured at an average of 111 Hz with

a difference of 10 Hz between the stimulus sentences. After therapy, her average pitch was 124 Hz with a difference in her two productions of 12 Hz. One month later, her average pitch was 130 Hz with a difference in her two productions of 7 Hz. See Table 1 and Figures 3 - 4 for pitch results. These results are consistent with our hypothesis that participants would increase their pitch to resemble a feminine pitch after receiving CVC therapy.

Breath Support. Breath support is important for maintaining pitch, increasing pitch range, and sustaining phonation. Breath support was objectively measured using the Phonatory Aerodynamic System (PAS). After receiving CVC therapy, Participant 1 increased her breath support as demonstrated as her expiratory volume and phonation time increased. Prior to therapy, Participant 1's sustained expiratory volume was .04 liters. During the sustained phonation task she was able to sustain /a/ for 4.7 seconds on her first attempt. Since this time was incredibly shor, she was asked to repeat the task. She produced /a/ for 15.7 seconds on her second attempt for an average of 10.2 seconds. After therapy, sustained expiratory volume was .11 liters. Her sustained phonation time was 19.4 seconds. At maintenance, her sustained expiratory volume was .11 liters and she sustained /a/ for 23.12 seconds.

After receiving CVC therapy, Participant 2 did not increase her breath support as measured by her expiratory volume and phonation time increased. Prior to therapy Participant 2's sustained expiratory volume was 4.01 liters. During the sustained phonation task she sustained /a/ for 29.39 seconds. After therapy, Participant 2's sustained expiratory volume was 3.87 liters. Her sustained phonation time was 9.42 seconds. At maintenance her sustained expiratory volume was 3.42 liters and she

sustained /a/ for 12.96 seconds. See Table 2 for breath support results. Participant 1's results support our hypothesis that vocal relaxation and breath support activities would allow participants to better sustain a higher pitch, but Participant 2's results do not. The decrease seen in Participant 2's expiratory volume is most likely due to the strain from the increase in pitch despite the attempt to offset these problems with vocal hygiene, vocal relaxation, and breath support exercises.

Resonance. Clinicians subjectively judged resonance on a 3-point Likert scale. After receiving CVC therapy, Participant 1 changed her resonance to be more characteristic of a feminine resonance. Participant 1 began with a "Forward Oral" but unnatural oral resonance during spontaneous speech and "Between Deep Chest and Forward Oral" resonance during a reading passage. Over the course of the therapy program, her oral resonance was consistently "Forward Oral" and became more natural. Additionally, she was able to maintain this resonance one month later.

After receiving CVC therapy, Participant 2 changed her resonance to be more characteristic of a feminine resonance. Participant 2 began with "Deep Chest" resonance during spontaneous speech and the reading passages. Her resonance during therapy progressively became more "Forward Oral", however, at the maintenance stage her oral resonance fell to "Between Deep Chest and Forward Oral". See Table 3 for oral resonance results. These results are in support of our hypothesis that CVC therapy would increase feminine vocal qualities of resonance in participants by producing a more forward oral resonance after receiving therapy, which as stated before, is similar to the resonance of biologically female speakers. Although a decrease was observed in the use of oral resonance for Participant 2 at the maintenance stage, she admitted that she had not

continued to practice techniques at home after the conclusion of therapy.

Breathiness. Breathiness was measured using the modified CAPE-V, with a more "moderate" rating considered to be of feminine quality. After receiving CVC therapy, Participant 1 and Participant 2 changed their breathiness to be more feminine. The clinicians rated Participant 1's breathiness as "Mild/Moderate" before therapy, "Moderate" at the conclusion of therapy, and "Moderate" at maintenance. The clinicians rated Participant 2's breathiness as "Mild" before therapy, "Moderate" at the conclusion of therapy, and "Mild" at maintenance. See Table 4 for breathiness results. These results support the hypothesis that CVC therapy would increase feminine vocal qualities of breathiness.

Verbal Communication

To answer research aim two, three aspects of CVC's verbal communication were explored to observe feminine verbal communication features. As you may recall, verbal communication was measured by speech rate during spontaneous conversation, and mean length utterance (MLU) during spontaneous conversation and a standard reading passage.

Speech Rate. After receiving CVC therapy, Participant 1 decreased her words per minute to be more reflective of a female speech rate. Typically, speaking rate should fall between 130-190 WPM depending on the speaker and the topic (Glenn, Glenn, & Forman, 1998). Participant 1's speaking rate during spontaneous speech was 180 WPM before therapy, 166 WPM at the end of therapy, and 128 WPM one month post therapy. Participant 1's oral reading rate of the Grandfather Passage was 126 WPM before therapy, 121 WPM after therapy, and 113 WPM one month post therapy. Similar to her spontaneous speech sample, she used pauses that were longer in duration and frequency.

After receiving CVC therapy, Participant 2 actually increased her words per minute to be more fluent and consistent with a female speech rate. Participant 2's speaking rate during spontaneous speech was 60 WPM before therapy, 58 WPM after therapy, and 111 WPM one month post therapy. It was observed that during the data collection, Participant 2 took an extended time to collect her thoughts and provide an answer. Thus, the sample was not representative of her average words per minute during oral speech. Participant 2's oral reading rate of a standard passage was 152 WPM before therapy, 123 WPM after therapy, 141 WPM one month post therapy. Similar to Participant 1, Participant 2 used more pauses that were longer in duration to reduce speaking rate. See Table 5 for speech rate results. These results are consistent with our hypothesis that we would observe longer speaking rates due to frequent and longer pause times between words.

Mean Length Utterance. After receiving CVC therapy, Participant 1 and Participant 2 increased their mean length of utterance. Participant 1's MLU from her spontaneous speech sample was 5.8 before therapy, 11.6 after therapy, and 13.2 one month post therapy. This demonstrated that Participant 1 increased her MLU. She did so by adding more elaboration and descriptive words. Participant 2's MLU from her spontaneous speech sample was 8.5 before therapy, 13 after therapy, and 16.3 one month after therapy. Like Participant 1, Participant 2 also saw an increase in MLU by adding more elaboration and descriptive words. See Table 6 for mean length of utterance results. These results are consistent with our hypothesis that MLU would increase.

Nonverbal Communication

To answer research aim three, one aspect of CVC's nonverbal communication (gesture) was explored to observe the use of feminine gestures.

After receiving CVC therapy, Participant 1 changed her frequency and quality of her gestures to be more feminine. Prior to therapy, Participant 1's quantity of gestures was subjectively marked by clinicians as "2-Few", with a quality of "2-Abrupt and Fluid". At the conclusion of training Participant 1's quantity of marked as "3-Many", with a quality of "3- Fluid". When Participant 1 returned one month later for maintenance testing quantity of gestures were marked by clinicians as "3-Many", with a quality of "3-Fluid".

After receiving CVC therapy, Participant 2 increased her frequency of her gestures but did not change her quality to be more feminine. Before therapy, clinician's subjectively judged Participant 2's quantity of gestures as "1-None", therefore the quality could not be judged. At the conclusion of training Participant 2's quantity of marked as "2-Few", with a quality of "2- Abrupt and Fluid". When Participant 2 returned one month later for maintenance testing quantity of gestures were marked by clinicians as "2-Few", with a quality of "2-Abrupt and Fluid". See Table 7 for gesture results. Participant 1's results are consistent with our hypothesis that participants would demonstrate more fluid gestures demonstrating more feminine qualities. However, since Participant 2 did not use any gestures before therapy, there was no baseline to compare her gestures with after therapy.

Self-Perception and Vocal Quality of Life

To answer research aim four, three aspects of self-perception were observed in relation to the participants' vocal quality of life (VQoL). Self-perception and vocal quality of life were measured by the total VQoL score, the average score of each item, and the self-rating of voice femininity.

After completing CVC therapy, both participants perceived their own voice as more feminine and demonstrated better VQoL scores. Before therapy, Participant 1's VQoL score was 69 with the average rating falling at 2.3. On the Likert scale, she marked that she perceived her own voice as "3-Gender Neutral" and stated that her goal was for her voice to sound "1-Very Female". At the conclusion of training her VQoL score was 61 with the average rating falling at 2.1. This post therapy score was based on an average of only 29 questions because Participant 1 accidently skipped one of the TVQ questions. Post therapy, Participant 1 perceived her voice as sounding "2-Somewhat Female". When Participant 1 returned one month post trainings she marked her VQoL as a 41, with her average rating falling at 1.3. This is a 28 point higher VQoL score and only 11 points away from the best QoL score (30). At that time, she felt that her voice had been maintained as "2-Somewhat Female".

Before therapy, Participant 2's QoL score was 90 with the average rating falling at 3. On the Likert scale she marked that she perceived her own voice as "5-Very Male" and stated that her goal was for her voice to sound "2-Somewhat Female". At the conclusion of training her VQoL score was 48 with her average score falling at 1.6.

Additionally, she perceived her voice as sounding "3-Gender Neutral". When Participant 2 returned one month post training she marked her VQoL as a 54, with her average rating falling at 1.8. At this time, she felt that her voice had been maintained and that she perceived it as "3-Gender Neutral". See Appendix A for sample TVQ, see Table 8 for self-perception results, and see Table 9 for vocal quality of life results. These results support our hypothesis that CVC therapy would positively affect the quality of life for the participants.

Perception of Femininity and Gender by Naïve Listeners

To answer research aim five, naïve listeners judged speech samples from participants as well as male and female "decoy" speakers. Samples were judged twice, once for gender and once on a 5-point Likert for masculinity and femininity.

Femininity and Masculinity. Average femininity and gender ratings were calculated from Naïve listeners' individual scores. After participants completed CVC therapy, naïve listeners judged Participant 1 and 2's vocal femininity significantly different from before therapy with large effect sizes for /a/, Sentences, and the Grandfather Passage. Participant 1's samples leaned more towards feminine and Participant 2's leaned more towards masculine. This indicates that both Participants significantly changed the femininity of their voices so that a naïve listener was able to detect a difference after receiving CVC therapy. For results see Table 10 for /a/, Table 11 for /i/, Table 12 for sentences, and Table 13 for the Grandfather Passage. See Figure 5 and 6 for a representation of all scores. Naïve listeners judged decoy females as more feminine, decoy males as more masculine, and the participants in between feminine and

masculine. These findings support our hypothesis that naïve listeners would rate speech samples after therapy as more feminine on the Likert scale.

Gender. An average gender rating was calculated from naive listeners' individual scores. After Participant 1 completed the CVC therapy, naive listeners judged her voice as female. Before therapy, most naïve listeners perceived Participant 1's voice as male. However, after therapy, around half of naive listeners perceived Participant 1's voice as female.

After Participant 2 completed the CVC therapy, naive listeners did not judge Participant 2's voice to be female. Before therapy, most naive listeners perceived Participant 2's voice as male, and after therapy Participant 2's voice was still perceived by almost all of naive listeners as male. At maintenance Participant 2's voice continued to be perceived by naïve listeners as male. Naïve listeners judged females as female, males as male, and the participants inconsistently with some perceiving the participant as male and some as female. See Tables 14 - 17 for /a/, /i/, sentences, and Grandfather Passage averages for female speakers, male speakers, and participants before therapy, after therapy, and at maintenance. These results are partially consistent with our hypothesis that naïve listeners would categorize the gender of the speech samples as female. Naïve listeners judged Participant 1's voice to be female and Participant 2's to be male.

Naïve Listener Intrarater Reliability. Average point-by-point intrarater reliability for participants was 92% (range 80% to 95%). Intrarater reliability for female speakers was 97% (range 93%-100%). Raters were found the most reliable for male speakers with an average intrarater reliability of 100% (range 99%-100%).

Perception of Femininity by Clinicians

To answer research aim six, an average femininity rating was calculated from clinicians' taken from participants' spontaneous speech sample and an oral reading passage. After participants completed CVC therapy, clinicians judged Participant 1 and Participant 2's voices to be more feminine. Before therapy, clinicians perceived Participant 1's voice as sounding "4- Somewhat Male" during the spontaneous sample and the Grandfather Passage. After therapy, clinicians perceived her voice as sounding "2- Somewhat Female" during both tasks and these results were maintained one month later with the voice still being perceived as "2- Somewhat Female".

Before therapy, clinicians perceived Participant 2's voice as sounding "4- Somewhat Male" during the spontaneous sample and "5-Very Male" during the Grandfather Passage. After therapy, clinicians perceived her voice as sounding "3- Gender Neutral" during both tasks. Clinicians perceived that femininity overall was preserved one month later at maintenance with the voice still being perceived as "3- Gender Neutral" during the spontaneous speech sample and as "2- Somewhat Female" during the oral reading of the Grandfather Passage. See Table 18 for clinician perception of participants' voices. These results support our hypothesis that clinicians would perceive the participants' voices as more feminine following CVC therapy.

Clinician Interrater Reliability. Two clinicians scored vocal femininity and gender independently for 100% of speech samples before therapy, after therapy, and maintenance. Average point-by-point interrater reliability for participants was judged

within a one scale value on 12 points. Interrater reliability for clinician judgment was 100% reliable in judging Participant 1 and Participant 2's speech samples for vocal femininity and gender.

CHAPTER V

DISCUSSION

The major purpose of this study was provide more information on vocal therapy interventions provided by speech language pathologists to MTF transgender voice clients and to better understand the components and delivery of CVC therapy and the vocal feminine quality perceptions of CVC therapy from transgender individuals, naïve listeners, and clinicians' perspectives. The CVC therapy program created for this study addressed vocal qualities, verbal communication, and nonverbal communication. Additionally, participants were asked to rate their vocal quality of life as well as their perception of their voice. Naïve listeners were asked to perceptually judge the femininity and masculinity of the participants' speech samples, as well as male and female speakers. This therapy program was delivered to two male-to-female transgender individuals.

Vocal Feminine Qualities

Pitch. The first part of the CVC therapy program focused on increasing feminine qualities of the voice, specifically on pitch (breath support), resonance, and breathiness. As mentioned previously, pitch has been a focus of voice therapy in the past to achieve a more feminine voice, since the average pitch of a woman is dramatically higher than that of a man. Participant 1's average pitch in the beginning would be considered in between an average pitch for males and females leaning towards female. After therapy, Participant 1 was able to increase her pitch to 211 Hz, which is considered in the female range. Furthermore, at maintenance, Participant 1's pitch equaled the average female range (205 Hz). Interestingly, the variation in her pitch between the two sentences decreased from 30 Hz difference before therapy to 10 Hz difference at maintenance. This

demonstrates that she was able to sustain a higher pitch more consistently. These findings indicate that participation in the CVC therapy program increased Participant 1's average pitch.

Participant 2 also experienced a substantial increase in her pitch after participating in the CVC therapy. Her average pitch increased from 111 Hz before therapy to 124 Hz post therapy, and 130 Hz at maintenance. Unlike Participant 1, Participant 2's increase in pitch was more challenging. Her variation in her pitch between sentences increased from 10 Hz before therapy to 15 Hz range at maintenance. Though less stability of pitch was observed, it was relatively minor and did not represent a considerably important difference. Findings suggest that participation in CVC therapy improved Participant 2's average pitch.

Breath Support. Breath support was also targeted to supplement pitch exercises because it can be difficult to maintain and sustain a pitch that is higher than an individual is accustomed to without sufficient breath support. Prior to therapy, Participant 1 had attempted to raise her pitch on her own by watching YouTube videos. Her voice quality was hoarse and she would consistently have breaks in pitch when she spoke. After receiving CVC therapy, the quality of her voice and her sustained breath support markedly better in conjunction with raising her average pitch. She improved her expiratory volume by .07 liters and increased her ability to sustain a vowel by over 12 seconds after therapy at maintenance. These findings are in contrast to current literature that warns of the implications of raising pitch. As stated by Gelfer (1999) "As the client raises pitch toward the target level, quality may initially be poor and intensity weak. The clinician must be prepared to address a variety of vocal parameters that temporarily

become problematic as a result of raising pitch." Exercises to help increase breath support were targeted concurrently with vocal hygiene and vocal relaxation techniques to help the participants achieve and preserve a health voice. Adding supports such as breath support, vocal hygiene, and vocal relaxation in CVC therapy therefore has the potential to offset the prospective harmful effects of raising pitch.

However, in contrast to Participant 1, Participant 2 did experience some of the expected harmful effects associated with pitch increase. She demonstrated a decrease in breath support and phonation time in accordance with raising her pitch. She decreased her breath support by .59 liters and her phonation of a vowel by 16.43 seconds. Although, Participant 2 did experience an increase in pitch, she also exhibited some of the potentially harmful consequences of doing so. However, it is likely that the harmful effects would have been much more dramatic had she not been using vocal hygiene, vocal relaxation, and breath support techniques in therapy.

In summary, CVC therapy, which included pitch with the assistance of breath support, was successful in raising overall pitch and counteracting some of the potentially harmful results which are often seen concomitantly (Stemple, Glaze, & Klaben, 2010). These results are consistent with other studies on the perception of increased pitch like that of Gelfer and Bennett (2012). What is especially interesting in our case series, is that pitch was only addressed each session for an average of 8-10 minutes, meaning across all 6 sessions only about 1 total hour was spent on pitch per-participant. Despite this relatively short time, both participants raised their pitch about two whole semitones. This indicates that a whole session does not, and should not be spent on pitch alone since such a dramatic change can be seen quickly by addressing pitch as only one part of the whole.

Resonance. A more forward oral resonance was targeted during therapy as it is perceived as a female characteristic. Participant 1 demonstrated a mixture of "Between Deep Chest and Forward Oral" and "Forward Oral". However, the Forward Oral resonance during the spontaneous sample was also marked as forced and unnatural sounding. She had less room to change than Participant 2 who demonstrated "Deep Chest" consistently before therapy. After receiving therapy, both participants were judged as having a more forward oral resonance. Furthermore, Participant 1's oral resonance was perceived as sounding much more natural, suggesting a successful change in the perception of resonance.

Participant 2's resonance at maintenance decreased slightly to "Between Deep Chest and Forward Oral". This drop might have been due to a lack of "practice" and participation in the at home program clinicians introduced at the conclusion of therapy. Participant 1 reported that she practiced all areas introduced in therapy every day, whereas Participant 2 reported that she "rarely' practiced the techniques at home after therapy concluded. This indicates the importance of an at home practice for maintaining results.

Findings suggest that CVC therapy does change oral resonance placement to a more Oral Forward position. Vocal resonance can create a major transformation in the perception of the voice, male resonance tends to sounds more "chesty" compared to the more "oral" resonance produced by women (Pickering & Baker, 2012). These findings are similar to studies/therapy that focused solely on oral resonance. For example, our study found similar results to Carew, Dacakis, and Oates' (2007) study on resonance voice therapy. It should be noted that there were some inconsistencies between

participants' performances, which could be due to the length of therapy, the amount of practice after therapy, or individual differences. Further inquiry in this area is warranted.

Breathiness. Breathiness was the last of the vocal qualities addressed. Participants were asked to target using a "moderate" amount of breathiness during speech. Both Participant 1 and Participant 2 experienced an increase in breathiness post therapy. Participant 1 increased breathiness form "Mild/Moderate" to "Moderate" and had maintained this level one month later. Participant 2 also increased breathiness, from "Mild" before therapy to "Moderate" after therapy, however this level of breathiness was not maintained. At the maintenance stage Participant 2 was again perceived as using a "Mild" amount of breathiness. Findings revealed that CVC therapy successfully increased the amount of breathiness. Current research exists which has shown that increased breathiness is associated to higher perceptions of femininity (Borsel, Janssens, and De Bodt, 2009), however, little research has included breathiness as a therapy technique. Therefore, this study is one of the first to indicate the effectiveness of incorporating breathiness in combination therapy.

The decrease in Participant 2's breathiness at maintenance raises similar questions as resonance. Although it appears that increased length of therapy or individual differences could explain the decrease of breathiness at maintenance, Participant 1 continued to practice after therapy, while Participant 2 did not. This implies that breathiness is a skill that could be learned in a seven week program and then practiced for maintenance of these skills.

Verbal Communication

Speaking Rate. Increasing the number of pauses and the length of pauses was

targeted during therapy for both participants. The anticipated result would be that participants reduced their number of words per minute, demonstrating their ability to add pauses and increase the length of pauses. Both participants experienced a reduction in the number of WPM, which was influenced by an increase in the number and duration of pauses. Participant 1 reduced her oral speaking rate from the high end of the spectrum (180 wpm) to the lower end of the spectrum 128 wpm) by adding pauses that were longer in duration and frequency. This reduction in oral speaking rate falls slightly below Glenn, Glenn, and Forman's (1998) normative speaking rate values. Participant 1's results from the oral reading passage were slightly influenced by her literacy skills; during reading activities she exhibited some difficulty reading the samples she was provided.

Participant 2's oral reading rate decreased slightly from before therapy to after therapy due to using more and longer pauses. Participant 2's WPM was in a *very* slow compared to Glenn, Glenn, and Forman's (1998) normative speaking rate values before therapy, after therapy, and maintenance for her spontaneous speech sample. However, this was not a sign of disordered speech, rather it represented the extended time it took Participant 2 to collect her thoughts when providing an answer. Therefore, the samples taken were not representative of her average words per minute during oral speech. Also of note, both Participants were observed as using more prosody and upward inflection during spontaneous speech and reading samples.

Mean Length of Utterance. Both participants increased their MLU during spontaneous speech samples after therapy, indicating that CVC therapy raised MLU. The importance of MLU is still being observed, and some studies have even suggested that

the MLU of men is longer than that of women (Todd & Hill, 2007). However, other research demonstrates that the length of utterance has been found to increase when female speakers are speaking to other women, than when they are speaking to men or in in the presence of men (Bilous & Krauss, 1988). Additional research also exists that indicates that MLU is longer in women of western cultures (Andrews, 1999). In addition, women have also been found to use more descriptive terms, which was one of the targets in verbal communication therapy (Mulac, Wienmann, Widenmann, & Gibson, 1988). All clinicians were female, so participants were addressing "same-sex" communication partners and participants were "western women". Therefore, it was expected that participants would increase MLU.

Nonverbal Communication

Nonverbal communication targeted gestures, posture, head position, and hand shape. Participants were observed using these feminine characteristics, and clinicians reported improvement in all of these areas but formal observations were only made for gestures. There has been some research that supports that women use more gestures than men. However, this area is still in need of further inquiry, since there is some debate as to if the difference in frequency of gestures is meaningfully different (Hanna & Wilson, 1988; Tidwell, 2011). What is clear, however, is that the gestures of women appear to be more fluid in nature than those of men (Glass, 1992). Both participants were observed using more gestures after therapy. Also, the gestures of Participant 1 appeared to be more fluid after therapy. Participant 2 was not observed using any gestures before therapy so she had no baseline to compare her after therapy results. However, she was observed using gestures that had some fluidity after therapy.

These results imply that CVC therapy is successful in targeting nonverbal female characteristics of body language and gestures.

Naïve Listeners Perception

Naïve listeners who were blinded to the purpose of the study were used as an outside party to judge the speech samples of participants similar to Hancock et. al., 2011. Listeners were told that they would be marking samples based on how masculine or how feminine they perceived the voice speaking as, in addition to what they perceived the gender of the speaker to be. They were not aware, however, that some of the speech samples belonged to members of the trans community.

Naïve listeners' perceptions of Participant 1 and Participant 2's speech samples were significantly different from before therapy to after therapy with large effect sizes. Significant perceptual differences were noted for Participants 1's vocal femininity on /a/, sentences, and the Grandfather Passage. Furthermore, during the gender perception task, all of Participant 1's sentence and Grandfather samples were marked as "Male" before therapy (Male = 2). However after therapy, nearly half of naïve listeners perceived her voice as being "Female" (Sentences = 1.54, Grandfather Passage = 1.68). Also of note, the majority of Participant 1's speech samples were perceived as being maintained after therapy and in some cases were even perceived as slightly more feminine at maintenance, though not significantly different.

Similar to Participant 1, significant perceptual differences were noted for Participant 2's vocal femininity on /a/, /i/, sentence, and the Grandfather Passage. However, during the gender perception task, participants still consistently perceived her gender as being "Male". This indicates that while she made great strides in the

feminization of her voice, it still did not "pass" as female. Unlike Participant 1, Participant 2's femininity scores at maintenance were slightly inconsistent. The Grandfather Passage indicates that Participant 2's voice was maintained (4.00 to 3.96), but the sentences actually showed a decreased perception of femininity (3.75 to 4.14).

While the increase in femininity scores seen in any of the samples is encouraging, perhaps the most reassuring is the significant difference seen in scores for sentences and the Grandfather Passage. These longer samples included more vocal and linguistic information than vowels alone, which makes the longer samples a better representation of the participants' voices (Gelfer and Bennett, 2012). The differences in maintenance results between Participant 1 and Participant 2 also indicate that continuing to practice therapy techniques at home may lead to better maintenance. However, although Participant 1's voice was maintained, the change does not appear to be as large as that achieved during therapy suggesting a longer therapy period may be warranted for participants to achieve their "best possible" voice.

These results indicate that CVC therapy was successful at significantly increasing the perception of femininity of participants' voices as judged by naïve listeners. However, CVC therapy was not successful in changing the perception of gender, despite gains made in this area. Since gender perception of Participant 1's voice after therapy and at maintenance were split between male and female, it is likely that 6 sessions of CVC therapy was not enough time to change gender perception. Therefore, gender results also suggest that a longer therapy period way be warranted for participants to achieve maximal results.

Clinician Perception

Clinicians judged participants' voices from a spontaneous speech sample and the Grandfather Passage. Similar to naïve listeners, clinicians perceived both participants as sounding more feminine after therapy. In addition, clinicians also deemed that femininity was maintained after therapy. However, clinicians judged the voice of participants as slightly more feminine than naïve listeners. For example, naïve listeners judged Participant 1's Grandfather Passage speech sample after therapy as "3- Gender Neutral", whereas clinicians rated her voice as "2- Somewhat Female" on that same speech sample. Participant 2's results mirrored this pattern with naïve listeners judging her voice post therapy as "4- Somewhat Male", whereas clinicians had judge this same sample as "3- Gender Neutral". The discrepancy in these results may be in part due to some bias on the clinician's part, influenced by wanting the participants to do well. It may also be influenced by other factors that are present in person but not in voice recording, such as the physical presentation and use of nonverbal communication modalities. In fact, participants' self-perception of their voices paralleled that the clinicians' perceptions of their voices perfectly, indicating the influence of additional elements not present on the voice recordings. This is consistent with literature which states that physical appearance and non-verbal communication are important elements in "passing" for transgender individuals (Kayajian, 2005). An additional factor may also be that clinicians had more expertise to judge samples than the naïve listeners. In Hancock et. al's 2011 study, naïve listeners marked samples similar to clinicians, however they were not as reliable in their observations. These results indicate that CVC therapy successfully increased feminine

characteristics of voice and communication in participants as judged by clinicians.

Self-Perception and Vocal Quality of Life

Arguably, the perception that matters most is that of the participants themselves. Participants reported that being a part of the University of Nevada, Reno's Transgender Voice and Communication Clinic had been a positive and even "empowering" experience. Both participants perceived their voices as being more feminine after therapy, with Participant 1's self-perception score moving 1 whole scale point, and Participant 2's self-perception score moving 2 whole scale points. Participants also believed that they had maintained these results one month later. In addition, both participants also reported better vocal quality of life (VQoL) scores afterwards, and this change was statistically significant. These results are in agreement with a study done by McNeil et. al. (2008) which found that a trans MTF individual's happiness with their voice is related to how feminine their voice is perceived. At maintenance, Participant 1 reported an even better VQoL score than she had after therapy indicating that she had continued to experience positive changes in her voice after therapy. In contrast, Participant 2 reported a slightly lower vocal quality of life score at maintenance, indicating that not continuing to practice at home may have negatively affected her VQoL. It is also possible that Participant 2 may have needed more treatment sessions to establish stronger skills to give her the confidence to continue at home. These results also imply that CVC therapy has a positive effect on transgender individual's quality of life, similar to the other studies which found steps in transitioning have a positively in quality of life (Gorin-Lazard et. al., 2012).

Limitations

This experiment was a case series that examined the potential components of a

combination therapy approach for transgender MTF individuals. Research in transgender voice is still relatively limited, so at this time it is incredibly important to continue to investigate areas related to transgender voice. Limitations of this studied included the small sample size, the limited statistical evidence available, the short duration of therapy, and the reliance on subjective measures, since no objective measures exist for certain areas of communication.

This case series only included two participants, which is an incredibly small sample size. So while the data indicates support for CVC therapy, more research of a higher research design is needed to further establish the efficacy of the program. Due to the small sample of transgender MTF speakers, it is also difficult to conduct more robust parametric statistical analyses. In addition, the participants only received 6 total hours of therapy time. Potential for gains might be higher if participants received more therapy time. It is also worth noting that objective measures do not exist for many areas and types of communication, so subjective measures must be used which can be influenced by clinician bias.

Clinical Implications

Findings from this study have clinical implications to advise future clinicians on appropriate therapy targets for MTF trans individuals, as well as the efficacy of using CVC therapy. It also sets up a guide for future research on CVC therapy, as well as, how much treatment time is need to achieve a perceptual change. This is incredibly important because research related to transgender voice is still relatively small, with many gaps in how services should be implemented. As stated by Pickering and Baker in 2012, "There is limited evidence on the appropriate length of time or number of sessions needed for

maximum success in voice and communication therapy".

We learned that combination therapy that includes pitch, resonance, breathiness, verbal communication targets, non-verbal communication, and practice to support a healthy voice (breath support, vocal relaxation, and vocal hygiene) may effectively change the voice of a trans woman. Furthermore, CVC therapy is successful in creating a voice that sounds more "female" based on the perception of naïve listeners, speech pathology clinicians, and the participants themselves. With just six, one-hour sessions, over the course of seven weeks (in combination with weekly homework strategies) participants' voices became significantly more feminine.

Moreover, change in the voice was not just seen in perceptual differences, it was also seen in objective measures and on a vocal quality of life measure. A steady increase in pitch was observed in both participants' average speaking fundamental frequency. Participant 1 also experienced an increase in breath support. Additionally, both participants reported a significantly better vocal quality of life after receiving CVC therapy.

Results also indicated the importance of continued practice at home for maintenance, and possibly even for generalization of the skills learned in therapy. This can be seen in the discrepancy in maintenance scores of Participant 1, who did continue to practice at home, and Participant 2, who did not. Other contributing factors may also include how many steps an individual has taken toward transitioning. At the time of maintenance, Participant 2 was not yet living full-time as a woman, whereas Participant 1 was. It is likely that a lack of consistency in using her new voice was detrimental to Participant 2's progress. This suggests that, while change in voice is possible for

individuals in any point in transitioning, trans individuals who are living 100% as the gender with which they identify will be more successful in sustaining their vocal and communication changes.

In summary, this case series has informed both clinicians and researchers on the effectiveness of CVC therapy and as a guide on changes that may be expected within six sessions of CVC therapy. This is particularly important because research related to transgender voice issues is still lacking, and it is therefore imperative that clinicians have empirically supported treatment programs when implementing voice and communication therapy to trans individuals.

Future Research

This case series was one of the first studies to examine the effect of a combination therapy on many different aspects of vocal quality, verbal communication, non-verbal communication, self-perception, and clinician perception with a sample size of 2. Since results suggest that CVC therapy has the potential to be effective, future research could focus on increasing the sample size and conducting a higher level of research design. Furthermore, the dosage of the CVC therapy could be explored to determine which aspects of vocal quality, verbal communication, and nonverbal communication need more explicit instruction from those aspects that can be quickly trained and practiced independently for generalization.

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APPENDICES

Appendix A

Transgender Voice Questionnaire (TVQ)

TVQ MtF

Rating Scale
1 = never or rarely
2 = sometimes
3 = often
4 = usually or always

Name: _____

Date: _____

Based on your actual experience of living as a female, please tick the response that fits you best.

		1	2	3	4
1.	People have difficulty hearing me in a noisy room.	☐	☐	☐	☐
2.	I feel anxious when I know I have to use my voice.	☐	☐	☐	☐
3.	My voice makes me feel less feminine than I would like.	☐	☐	☐	☐
4.	The pitch of my speaking voice is too low.	☐	☐	☐	☐
5.	The pitch of my voice is unreliable.	☐	☐	☐	☐
6.	My voice gets in the way of me living as a woman.	☐	☐	☐	☐
7.	I avoid using the phone because of my voice.	☐	☐	☐	☐
8.	I'm tense when talking with others because of my voice.	☐	☐	☐	☐
9	My voice gets croaky, hoarse or husky when I try to speak in a female voice.	☐	☐	☐	☐
10.	My voice makes it hard for me to be identified as a woman.	☐	☐	☐	☐
11.	When I speak the pitch of my voice does not vary enough.	☐	☐	☐	☐
12.	I feel uncomfortable talking to friends, neighbours and relatives because of my voice.	☐	☐	☐	☐
13.	I avoid speaking in public because of my voice.	☐	☐	☐	☐
14.	My voice sounds artificial.	☐	☐	☐	☐
15.	I have to concentrate to make my voice sound the way I want it to sound.	☐	☐	☐	☐
16.	I feel frustrated with trying to change my voice.	☐	☐	☐	☐
17.	My voice difficulties restrict my social life.	☐	☐	☐	☐
18.	When I am not paying attention my pitch goes down.	☐	☐	☐	☐
19.	When I laugh I sound like a man.	☐	☐	☐	☐
20.	My voice doesn't match my physical appearance.	☐	☐	☐	☐
21.	I use a great deal of effort to produce my voice.	☐	☐	☐	☐
22.	My voice gets tired quickly.	☐	☐	☐	☐
23.	My voice restricts the sort of work I do.	☐	☐	☐	☐
24.	I feel my voice does not reflect the 'true me'.	☐	☐	☐	☐
25.	I am less outgoing because of my voice.	☐	☐	☐	☐
26.	I feel self-conscious about how strangers perceive my voice.	☐	☐	☐	☐
27.	My voice 'gives out' in the middle of speaking.	☐	☐	☐	☐
28.	It distresses me when I'm perceived as a man because of my voice.	☐	☐	☐	☐
29.	The pitch range of my speaking voice is restricted.	☐	☐	☐	☐
30.	I feel discriminated against because of my voice.	☐	☐	☐	☐

Please provide an overall rating of your voice:

Currently, my voice is:	☐ Very female	☐ Somewhat female	☐ Gender neutral	☐ Somewhat male	☐ Very male
My ideal voice would sound:	☐ Very female	☐ Somewhat female	☐ Gender neutral	☐ Somewhat male	☐ Very male

Appendix B

Sustained Vowel Procedures for /a/ and /i/

/a/:

1. Ask participant to sustain **/a/** for 3-5 seconds duration.

2. Provide example.

3. Select “Record”.

4. Record /a/.

5. Select “Stop” to stop recording.

/i/

1. Ask participant to sustain **/i/** for 3-5 seconds duration.

2. Provide example.

3. Select “Record”.

4. Record /a/.

5. Select “Stop” to stop recording.

Appendix C

Sentences

Ask participant to read the following sentences:

a. The blue spot is on the key again.

b. How hard did he hit him?

c. We were away a year ago.

d. We eat eggs every Easter.

e. My mama makes lemon muffins.

f. Peter will keep at the peak.

Appendix D

Grandfather Passage Speech Sample

Grandfather Passage Speech Sample

University of Nevada, Reno

Participant #_____

Date: _____

Voice Femininity:

Check (X) the box that best applies:

Very female	Somewhat female	Gender neutral	Somewhat male	Very male

Gestures: Describe the **frequency** of gestures.

_____

Scale: _____

None Few Many

Gestures: Describe the **type/appearance** of gestures (i.e. constantly moving, fluid, arms above/below the waist etc.)

_____

_____

Oral Resonance:

a. Does resonance appear to be more deep/chest or more forward/oral? Explain.

_____

_____

b. Does resonance appear to be Hypernasal, Hyponasal, or Normal? Explain.

_____

_____

c. Other:

_____

_____

STOP: Item 5 and 6 may be completed later.

Speech Rate:

Calculate the Words Per Minute

Words Per Minute (WPM) = (# of words in passage ÷ reading time (in seconds)) x 60

*There are 132 words in the Grandfather passage

Mean Length of Utterance:

Calculate MLU_____

Count the number of morphemes in each sentence and note the total of words, syllables, and morphemes under each sentence. Once you have the total of morphemes for each utterance average the totals with the number of utterances (total of morphemes divided by # of utterances) to find the MLU.

For example:
1. My ugly bothers picked on me this morning

8 words; 11 syllables; **10 morphemes**
(the word endings "s" and "ed" count as separate morphemes)

2. I go bye bye

4 words; 4 syllables; **3 morphemes**
(*bye bye* has one meaning)

He looks unhappy

3 words; 5 syllables; **5 morphemes**
("s" ending and "un" prefix have their own endings)

Using the utterances above, the MLU is **(10+3+5)÷3=9**

ADDITIONAL NOTES:

Clinician: _____

Appendix E

Spontaneous Speech Form

Spontaneous Speech Sample

University of Nevada, Reno

Participant #_____

Date: _____

Voice Femininity:

Check (X) the box that best applies:

Very female	Somewhat female	Gender neutral	Somewhat male	Very male

Gestures: Describe the **frequency** of gestures.

Scale: _____

None Few Many

Gestures: Describe the **type/appearance** of gestures (i.e. constantly moving, fluid, arms above/below the waist etc.)

Oral Resonance:

Does resonance appear to be more deep/chest or more forward/oral? Explain.

b. Does resonance appear to be Hypernasal, Hyponasal, or Normal? Explain.

c. Other:

STOP: Item 5 and 6 may be completed later.

Speech Rate:

Calculate the Words Per Minute

Words Per Minute (WPM) = (# of words in passage ÷ reading time (in seconds)) x 60

*There are 132 words in the Grandfather passage

Mean Length of Utterance:

Calculate MLU_____

Count the number of morphemes in each sentence and note the total of words, syllables, and morphemes under each sentence. Once you have the total of morphemes for each utterance average the totals with the number of utterances (total of morphemes divided by # of utterances) to find the MLU.

For example:
My ugly bothers picked on me this morning

8 words; 11 syllables; **10 morphemes**
(the word endings "s" and "ed" count as separate morphemes)

2. I go bye bye

4 words; 4 syllables; **3 morphemes**
(*bye bye* has one meaning)

He looks unhappy

3 words; 5 syllables; **5 morphemes**
("s" ending and "un" prefix have their own endings)

Using the utterances above, the MLU is **(10+3+5)÷3=9**

ADDITIONAL NOTES:

Clinician: _____

Appendix F

Modified CAPE

Modified CAPE-V Parameters

University of Nevada, Reno

Participant #_____

Date: _____

This form is used in conjunction with FORM C. Elicit a spontaneous speech sample using the prompt: "Tell me about what you would like to change about your voice, how do you and others perceive it." Then rate the following vocal quality characteristics below.

Legend: C =Consistent I = Intermittent
MI = Mildly
MO = Moderate
SE = Severely

Roughness: _____ C I
M M S

Breathiness: _____ C I
M M S

Strain: _____ C I
M M S

Pitch: _____ C I
M M S

Loudness: _____ C I
M M S

Additional Features: (For example, diplophonia, fry, falsetto, asthenia, aphonia, pitch instability, tremor, wet/gurgly, or other relevant terms)_____

Clinician_____

Appendix G

Sample Fidelity Checklist

	Clinician		Participant	Time
__/2	Clinician walks participant through laryngeal massage. Clinician walks participant through Yawn-sigh. (5xs)	__/2	Participant does laryngeal massage. Participant does yawn-sigh 5xs.	Start Time: End Time: Total:
__/2	Clinician walks participant through yoga breathing. (5xs) Clinician walks participant through snuff-hiss. (5xs)	__/2	Participant does yoga breathing (5xs). Participant does snuff-hiss (5xs).	Start Time: End Time: Total:
__/1	Pitch Exercises: Match Pitch (habitual) Match Pitch (lower/starting note) notes 1-2-3 notes 1-2-3-4-5 notes 1-2-3-4-5, then 5-4-3-2-1 notes 1-2-3-4-5-4-3-2-1 ALL repeated 5xs	__/1	Participant follows clinicians directions for pitch.	Start Time: End Time: Total:
__/3	Clinician instructs participant to stretch neck. Clinician instructs participant to do lip trills Clinician instructs participant to produce oral resonance: Hum, mi, mimi, mitmi, meet me peter, meet me peter, meet me	__/3	Participant stretches neck. Participant attempts lip trills. Participant attempts oral resonance: Hum, mi, mimi, mitmi, meet me peter, meet me peter, meet me	Start Time: End Time: Total:
__/1	Breathiness: Clinician instructs participant to produce /h/, /ha/ (5xs), /hu/ (5xs)	__/1	Participant produces produce /h/, /ha/ (5xs), /hu/ (5xs)	Start Time: End Time: Total:

__/2	Speaking Rate: Clinician will give participant a passage to read (cowboy passage) and times the reading. Clinician will instruct participant to re-read the passage but to attempt to read slower.	__/2	Participant will read passage. Participant will re-read passage.	Start Time: End Time: Total:
__/2	Conversation Elaboration: Clinician asks participant "What did you have for lunch today?" and "What is the first things you would buy if you won the lottery?" Clinician will instruct participant to re-answer questions but elaborate more (adjectives, adverbs).	__/2	Participant answers the questions. Participant will re-answer questions.	Start Time: End Time: Total:
__/3	Clinician tell participant about the following: Head Movement - nodding/mirror conversational partner Trunk - movement (more but near body) lean in Arms - Closer to body, move from the elbow vs. shoulder. Clinician will give participant homework and go over it.			Start Time: End Time: Total:

Appendix H

Vocal Hygiene

VOCAL HYGIENE SUGGESTIONS

1. Identify and eliminate all instances of vocal abuse and/or misuse.
2. Use an appropriate, comfortable speaking pitch.
3. Speaking should be done without effort or pushing.
4. Use easy, relaxed breathing patterns. You don't have to take deep breaths to support your voice.
5. Avoid speaking in excessively loud environments where you have to strain to be heard above background noise.
6. Avoid loud environments which require speaking.
7. Generally reduce the amount you use your voice when voice quality becomes husky, hoarse, effortful.
8. Avoid smoking, alcohol and caffeine which are irritants.
9. Avoid gargling with over-the-counter mouthwash preparations.
10. Avoid any type of milk products as they increase amount of secretions in your throat.
11. Avoid clearing your throat habitually. Try swallowing your own saliva or sip on a non-caffeinated beverage.
12. Keep yourself well-hydrated--eight glasses/day of a non-caffeinated beverage, preferrably water, unless otherwise indicated by your physician.
13. Avoid clenching or grinding your teeth. Keep your teeth apart and your jaw in a relaxed position.
14. Avoid whispering. You are not saving your voice.
15. Certain environmental conditions may produce some negative voice affects: dryness; dampness; cold; dust; smoke; noise. Ideal humidity 40-50%.
16. If indigestion symptoms are a problem, gastric reflux may be contributing to your voice symptoms. Consult your physician, who may prescribe a reflux regimen.

TABLES

Table 1

Pitch Calculated on VisiPitch

	Pre	Post	Maintenance
Average Pitch			
Participant 1	173 Hz	211 Hz	205 Hz
Participant 2	111 Hz	124 Hz	130 Hz
Pitch Range			
Participant 1	30 Hz	25 Hz	10 Hz
Participant 2	10 Hz	12 Hz	15 Hz

Note. Pitch was objectively measured using the Real Time Pitch program of the KayPentax VisiPitch; Hz = Hertz; Average male pitch 118, Average female pitch 205.

Table 2

Breath Support Calculated on Phonatory Aerodynamic System

	Pre	Post	Maintenance
Expiratory Volume			
Participant 1	.04	.11	.11
Participant 2	4.01	3.87	3.42
Phonation Time			
Participant 1	10.2	19.41	23.12
Participant 2	29.39	9.42	12.96

Note. Breath support was objectively measured from sustained phonation using the Phonatory Aerodynamic System; Expiratory volume was measured in liters; Phonation time was measured in seconds.

Table 3

Vocal Resonance Rated by Clinicians

	Pre	Post	Maintenance
Spontaneous			
Participant 1	Forward Oral	Forward Oral	Forward Oral
Participant 2	Deep Chest	Forward Oral	Between Deep Chest and Forward Oral
Grandfather			
Participant 1	Between Deep Chest and Forward Oral	Forward Oral	Forward Oral
Participant 2	Deep Chest	Forward Oral	Between Deep Chest and Forward Oral

Note. Benchmark for vocal resonance: deep chest, between deep chest and forward oral, and forward oral.

Table 4

Breathiness Rated by Clinicians

	Pre	Post	Maintenance
Spontaneous			
Participant 1	Mild/ Moderate	Moderate	Moderate
Participant 2	Mild	Moderate	Mild

Note. Breathiness was subjectively measured by clinicians using the modified CAPE-V = Consensus Auditory-Perceptual Evaluation of Voice; Breathiness benchmark: mild, mild/moderate, moderate, moderate/excessive, and excessive.

Table 5

Speech Rate Calculated Words Per Minute

	Pre	Post	Maintenance
Spontaneous			
Participant 1	180 WPM	166 WPM	128 WPM
Participant 2	60 WPM	58 WPM	111 WPM
Grandfather			
Participant 1	126 WPM	121 WPM	113 WPM
Participant 2	152 WPM	123 WPM	141 WPM

Note. Spontaneous = spontaneous speech sample; Grandfather = Grandfather Passage; WPM = Words Per Minute.

Table 6

Verbal Communication Results Calculated by MLU

	Pre	Post	Maintenance
Spontaneous			
Participant 1	5.8	11.6	13.2
Participant 2	8.5	13	16.3

Note. Spontaneous = spontaneous speech sample; MLU=Mean Length of Utterance.

Table 7

Gestures Results Rated by Clinicians

	Pre	Post	Maintenance
Frequency			
Participant 1	Few	Many	Many
Participant 2	None	Few	Few
Quality			
Participant 1	Abrupt and Fluid	Fluid	Fluid
Participant 2	None	Abrupt and Fluid	Abrupt and Fluid

Note. Frequency of gestures benchmark: "1" = No gestures present; "2" = Few gestures present, "3" = Many gestures present; Quality of gestures benchmark: "1" = Abrupt; "2" = Abrupt and Fluid; "3" = Fluid.

Table 8

Self-Perception of Femininity Results Rated by Participants

	Pre	Post	Maintenance
Ideal Voice			
Participant 1		1 Very Female	
Participant 2		2 Somewhat Female	
Perception of Voice			
Participant 1	3 Gender Neutral	2 Somewhat Female	2 Somewhat Female
Participant 2	5 Very Male	3 Gender Neutral	3 Gender Neutral

Note. "1" = Very Female; "2" = Somewhat Female, "3" = Gender Neutral; "4" = Somewhat Male; "5"= Very Male.

Table 9
Self-Perception of Vocal Quality of Life Rated by Participants

	Pre	Post	Maintenance
Total Score			
Participant 1	69	61	41
Participant 2	90	48	54
Average Score			
Participant 1	2.3	2.1	1.3
Participant 2	3	1.6	1.8

Note: Total Score: All potential scores fell between 30-120; with 30 representing the best possible quality of life score and 120 representing the worst possible quality of life score; Average Scores: Potential rating of voice issues feel between 1-4; With 1 representing the best vocal option and 4 representing the worst vocal option; "1"= Never or Rarely, "2" = Sometimes, "3" = Often, "4" = Usually or Always; See Appendix A for sample questions.

Table 10

Voice Femininity /a/ Judged by Naïve Listeners

	Mean	SD	Range
Decoy Speakers			
Male	4.72	0.36	3-5
Female	1.81	0.51	1-4
Participant 1			
Pre	3.00	0.62	2-4
Post	1.68	0.61	1-2.5
Pre to Post	*p=.01*, d= 2.14*[a]		
Maintenance	1.68	0.50	1-3
Participant 2			
Pre	4.89	0.21	4.5-5
Post	3.64	0.50	2.5-4.5
Pre to Post	*p=.02*, d= .42*		
Maintenance	4.64	0.36	4-5

Note: *Statistically significant difference: p-value <0.05; Effect size (d) classification: [a]Small (0.20 to 0.50), [b]Medium (0.50 to 0.80) and [c]Large (0.80 and higher); SD= Standard deviation. "1" = Very Female; "2" = Somewhat Female, "3" = Gender Neutral; "4" = Somewhat Male; "5"= Very Male.

Table 11

Voice Femininity /i/ Judged by Naïve Listeners

	Mean	SD	Range
Decoy Speakers			
Male	4.84	0.29	4-5
Female	1.43	0.35	1-3
Participant 1			
Pre	2.79	0.54	2-3.5
Post	2.57	0.47	1.5-3.5
Pre to Post	*p=.17, d= .42*		
Maintenance	2.86	0.57	1.5-3.5
Participant 2			
Pre	4.46	0.46	4-5
Post	4.00	0.62	3-5
Pre to Post	*p=.02*, d= .85*[a]		
Maintenance	3.68	0.42	3-4.5

Note: *Statistically significant difference: p-value <0.05; Effect size (d) classification: [a]Small (0.20 to 0.50), [b]Medium (0.50 to 0.80) and [c]Large (0.80 and higher); SD= Standard deviation. "1" = Very Female; "2" = Somewhat Female, "3" = Gender Neutral; "4" = Somewhat Male; "5"= Very Male.

Table 12

Voice Femininity Sentences Judged by Naïve Listeners

	Mean	SD	Range
Decoy Speakers			
Male	4.97	0.11	4-5
Female	1.21	0.29	1-2
Participant 1			
Pre	4.14	0.53	3.5-5
Post	3.07	0.68	2-4
Pre to Post	*p=.00*, d= 1.76*[a]		
Maintenance	3.04	0.82	1.5-4
Participant 2			
Pre	4.71	0.38	4-5
Post	3.75	0.51	2.5-4.5
Pre to Post	*p=.00*, d= 2.14*[a]		
Maintenance	4.14	0.46	3.5-5

Note: *Statistically significant difference: p-value <0.05; Effect size (d) classification: [a]Small (0.20 to 0.50), [b]Medium (0.50 to 0.80) and [c]Large (0.80 and higher); SD= Standard deviation. "1" = Very Female; "2" = Somewhat Female, "3" = Gender Neutral; "4" = Somewhat Male; "5"= Very Male.

Table 13

Voice Femininity Grandfather Passage Judged by Naïve Listeners

	Mean	SD	Range
Decoy Speakers			
Male	4.92	0.14	4-5
Female	1.24	0.33	1-2
Participant 1			
Pre	3.86	0.50	3-5
Post	3.07	0.83	1.5-4.5
Pre to Post	*p=.01*, d= 1.15*[a]		
Maintenance	3.04	0.80	1.5-4
Participant 2			
Pre	4.50	0.44	4-5
Post	4.00	0.52	3-5
Pre to Post	*p=.01*, d= 1.04*[a]		
Maintenance	3.96	0.46	3-5

Note: *Statistically significant difference: p-value <0.05; Effect size (d) classification: [a]Small (0.20 to 0.50), [b]Medium (0.50 to 0.80) and [c]Large (0.80 and higher); SD= Standard deviation. "1" = Very Female; "2" = Somewhat Female, "3" = Gender Neutral; "4" = Somewhat Male; "5"= Very Male.

Table 14

Gender Perception /a/ Judged by Naïve Listeners

	Mean	SD	Range
Decoy Speakers			
Male	1.99	0.03	1.5-2
Female	1.07	0.13	1-2
Participant 1			
Pre	1.64	0.41	1-2
Post	1.14	0.23	1-1.5
Maintenance	1.18	0.32	1-2
Participant 2			
Pre	2.00	0.00	2-2
Post	1.96	0.13	1.5-2
Maintenance	2.00	0.00	2-2

Note: "1" = Female; "2" = Male.

Table 15

Gender Perception /i/ Judged by Naïve Listeners

	Mean	SD	Range
Decoy Speakers			
Male	2.00	0.00	2-2
Female	1.04	0.10	1-1.5
Participant 1			
Pre	1.57	0.39	1-2
Post	1.46	0.41	1-2
Maintenance	1.61	0.40	1-2
Participant 2			
Pre	2.00	0.00	2-2
Post	1.96	0.13	1.5-2
Maintenance	1.96	0.13	1.5-2

Note: "1" = Female; "2" = Male.

Table 16

Gender Perception Sentences Judged by Naïve Listeners

	Mean	SD	Range
Decoy Speakers			
Male	2.00	0.00	2-2
Female	1.01	0.03	1-1.5
Participant 1			
Pre	2.00	0.00	2-2
Post	1.54	0.46	1-2
Maintenance	1.61	0.45	1-2
Participant 2			
Pre	2.00	0.00	2-2
Post	2.00	0.00	2-2
Maintenance	2.00	0.00	2-2

Note: "1" = Female; "2" = Male.

Table 17

Gender Perception Grandfather Passage Judged by Naïve Listeners

	Mean	SD	Range
Decoy Speakers			
Male	1.99	0.05	1-2
Female	1.01	0.05	1-1.5
Participant 1			
Pre	2.00	0.00	2-2
Post	1.68	0.42	1-2
Maintenance	1.64	0.46	1-2
Participant 2			
Pre	2.00	0.00	2-2
Post	2.00	0.00	2-2
Maintenance	2.00	0.00	2-2

Note: "1" = Female; "2" = Male.

Table 18

Perception of Femininity Results Rated by Clinicians

	Pre	Post	Maintenance
Perception of Spontaneous Speech			
Participant 1	4 Somewhat Male	2 Somewhat Female	2 Somewhat Female
Participant 2	4 Somewhat Male	3 Gender Neutral	3 Gender Neutral

FIGURES

Figure 1
Percentage of Treatment Time for Therapy Targets: Participant1

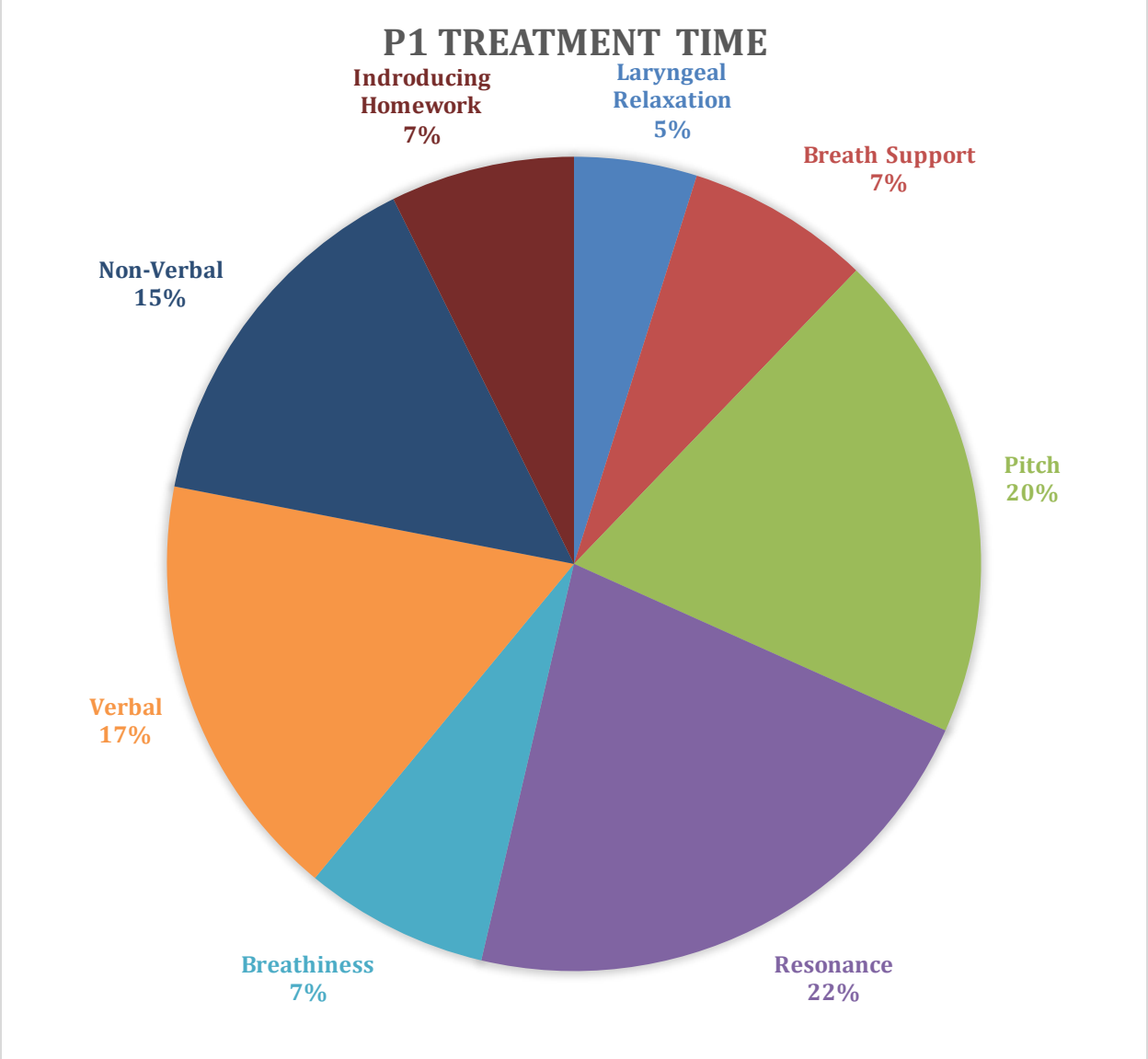

Figure 1. Team 1's implementation of CVC therapy for Participant 1. This figure represents the percentage of time spent on each component of CVC therapy per session. Total session time totaled 50 minutes.

Figure 2
Percentage of Treatment Time for Therapy Targets: Participant 2

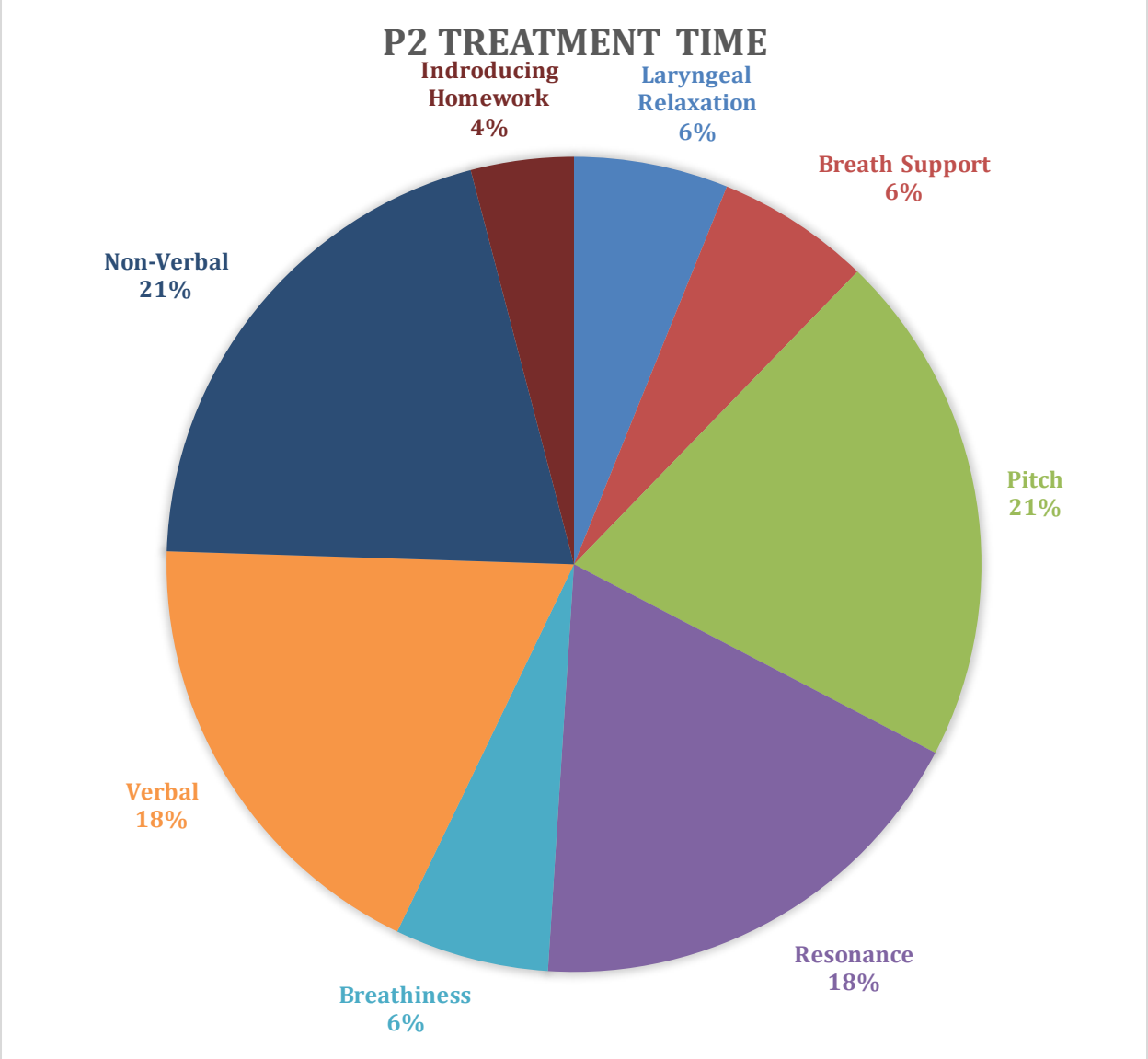

Figure 2. Team 2's implementation of CVC therapy for Participant 2. This figure represents the percentage of time spent on each component of CVC therapy per session. Total session time totaled 50 minutes.

Figure 3
Change in Pitch: Participant 1

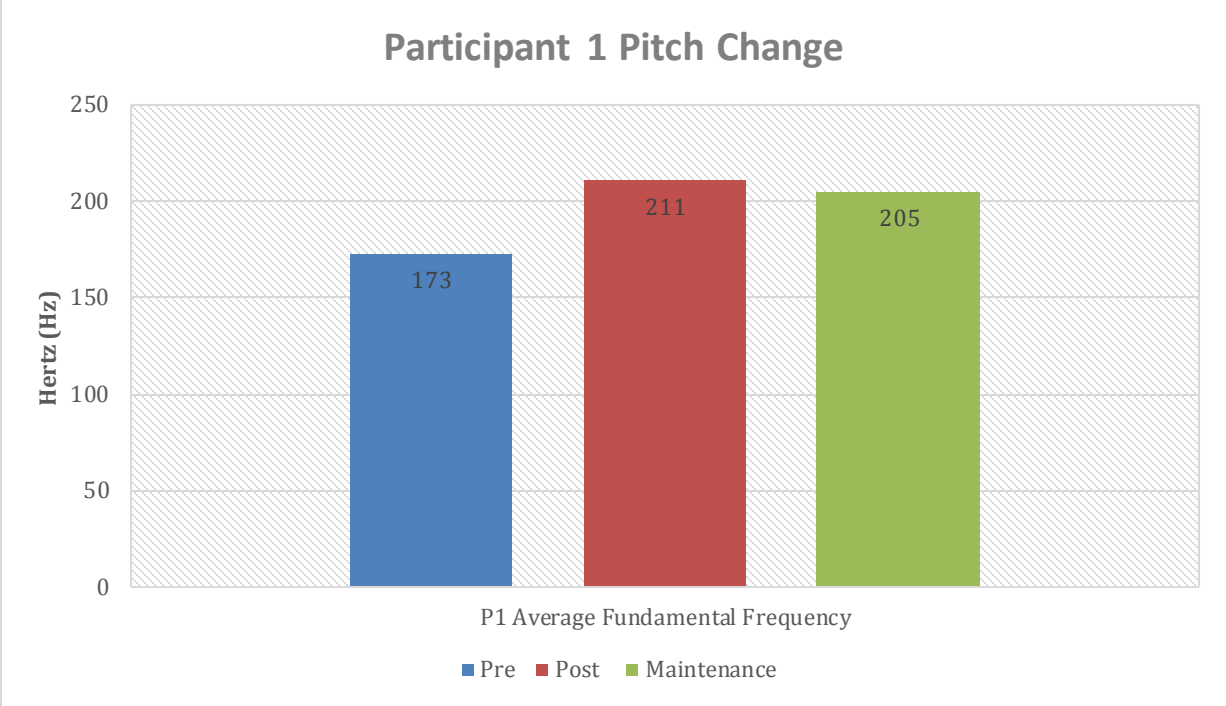

Figure 3. Pitch was objectively measured using the Real Time Pitch program of the KayPentax VisiPitch; Hz = Hertz; Average male pitch 118 Hz, Average female pitch 205 Hz.

Figure 4
Change in Pitch: Participant 2

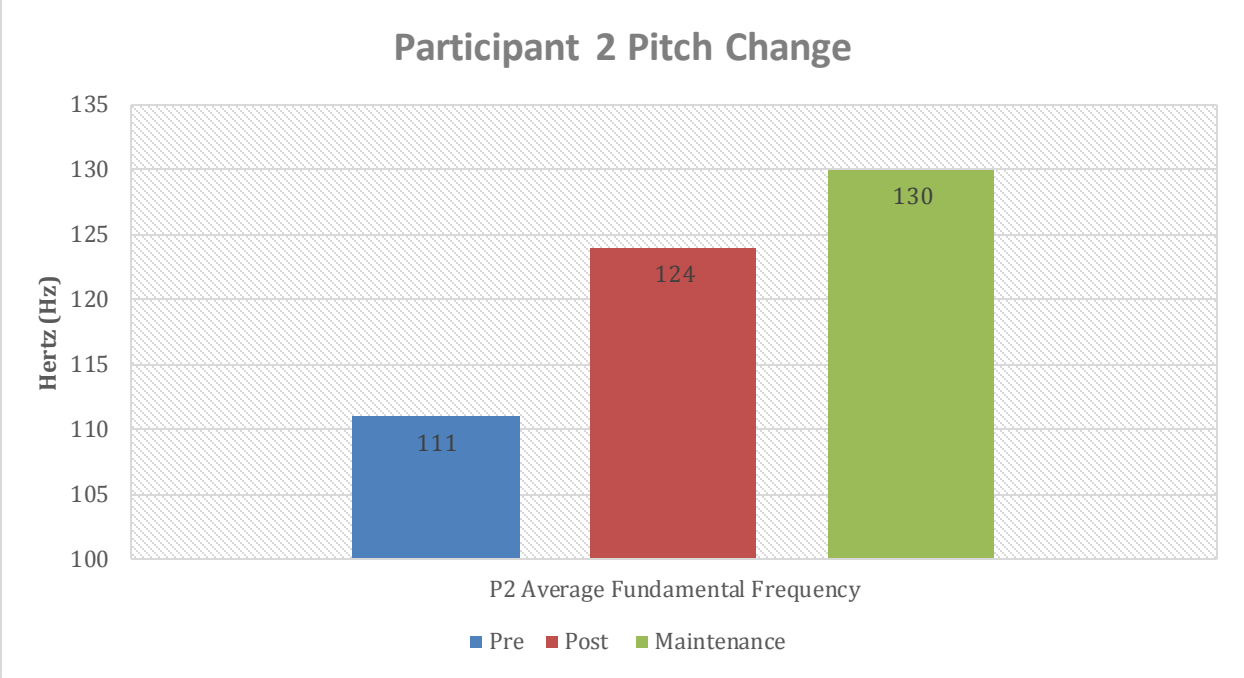

Figure 4 Pitch was objectively measured using the Real Time Pitch program of the Kay Pentax VisiPitch; Hz = Hertz; Average male pitch 118 Hz, Average female pitch 205 Hz.

Figure 5
Average Rating of Femininity by Each Naïve Listener: Participant 1

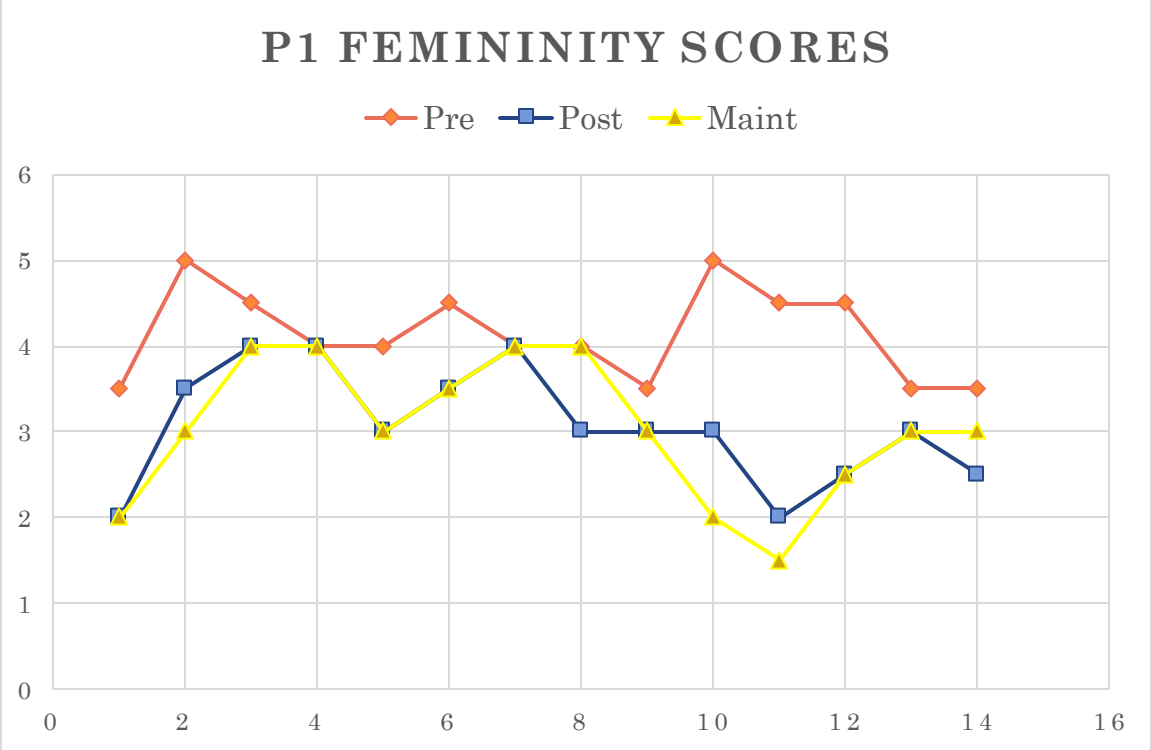

Figure 5. Scatter plot representing the average rating for each of the fourteen naïve listeners. "1" = Very Female; "2" = Somewhat Female, "3" = Gender Neutral; "4" = Somewhat Male; "5"= Very Male.

Figure 6
Average Rating of Femininity by Each Naïve Listener: Participant 2

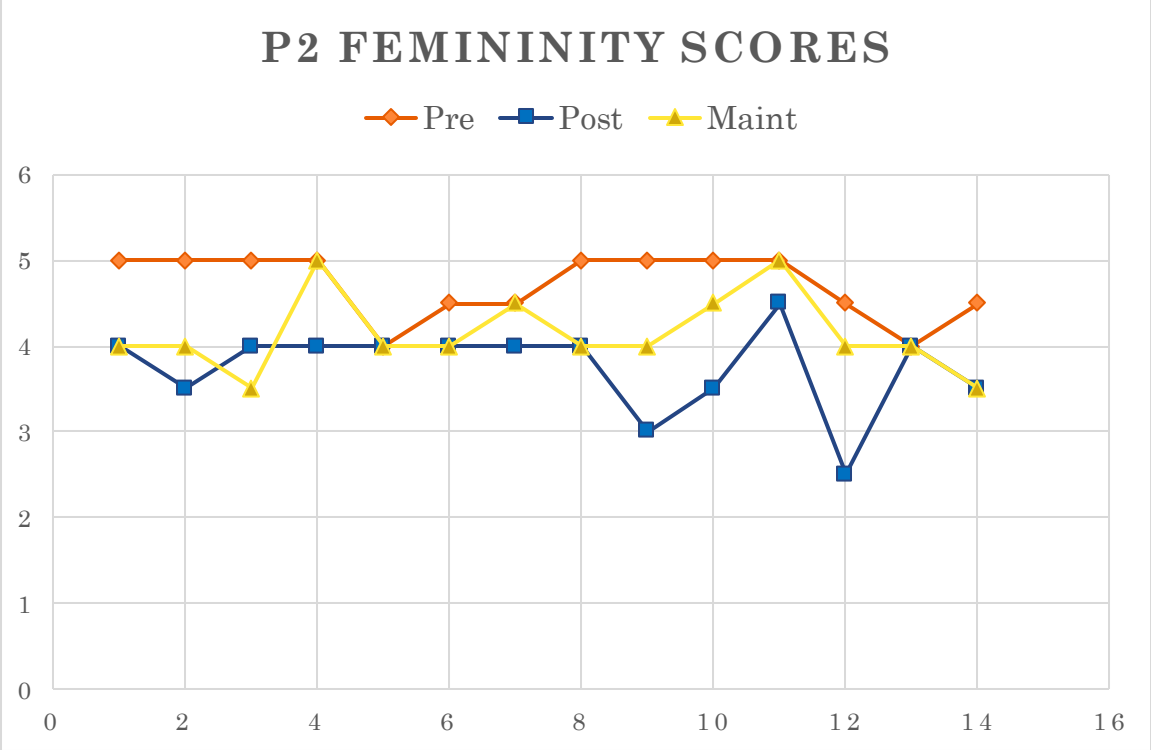

Figure 6. Scatter plot representing the average rating for each of the fourteen naïve listeners. "1" = Very Female; "2" = Somewhat Female, "3" = Gender Neutral; "4" = Somewhat Male; "5"= Very