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The Use of Spectrographic Analysis of
Female Voices in the College Voice Studio
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Good afternoon. It is a pleasure to be in such distinguished company. My friend John Nix says that there are plenty of you who can talk about analysis window sizes and flow declination rates, so that I don't have to talk about them. That's really good, since my ideas on these topics are very slight. What I would like to talk to you about is the practical side of using the spectrograph in an everyday voice studio.

It was at my first Richard Miller seminar that I became interested in spectrographic analysis. At my second one I actually gave up the afternoon master classes to go and sit in the Otto B. Schoepfle Vocal Arts Lab until I began to connect what I saw on the spectrograph with what I heard as a voice teacher. I ended up convinced that a spectrograph would be useful in my studio --

especially when working with beginning students who were trying to develop a resonant sound.

Returning home I dug out an elderly laptop, read Gareth Nair's book, loaded Gram 5.1 on the old laptop, and then I took my very low tech spectrograph into my studio. The students were a little hesitant at first, but once they realized that the technology was not a test, but simply a mirror of their sound, they began to enjoy experimenting with it.

I had by this time realized that my years of performance credentials carried less weight with the college administration than a doctoral degree would, and I entered the DMA program at the University of Georgia. We nice middle-aged ladies in graduate school are just terrible. We are not overawed by professors that look like our husbands, much less by the ones who are younger than we are. We think that we know what we're talking about in fields where we have twenty years' practical experience, and we will argue. We don't even get excited if we're asked to sing at graduation.

By the time I decided to do my document on the use of spectrographic analysis in the voice studio, the UGA voice faculty was resigned to my aberrant behavior, and they found me a ferocious music education professor to supervise my study. I can only thank heaven for Dr. Mary Leglar, who helped me find my way through the underbrush of doing a study like the one I did. Dr. Leglar helped me to devise quantitative measurements that allowed me to compare students' wave files so that my study would be somewhat sturdier than the qualitative analyses that I had envisioned. If you are interested in how I made these measurements, the paper is posted on the UGA website.

The study was limited to female voices because I was working at a women's college at the time. I had read Jean Callahans's *Singing and Voice Science*, and her concerns over the lack of descriptive information about the subjects in earlier studies struck me as significant. I decided that I would make a strong effort to be clear about my students' backgrounds and skill levels.

The equipment that I used was very low tech, because I wanted to limit my technology to what is readily available to most voice teachers. The sample of subjects was limited to the ten students that I was teaching that year. So small a sample, of course, does not allow for statistical analysis, but I was not too worried about that since all of the mathematical procedures used to compare student's wave files were created by me. I hope that further studies will to be done to evaluate my method, or devise better ones. In any case, the methodology supported my pedagogical opinion, which made me comfortable with it.

My research questions were

- (1) What information can be satisfactorily delivered through the study of spectrographic wave files?
- (2) Will subjective data, including the teacher's evaluation and subjects' self evaluation of their performance in the vocal studio, be consistent with the objective data from the spectrographic wave files?

- (3) Will the subjects find the use of the spectrograph helpful?
and
- (4) Will the use of spectrographic technology prove to be compatible with traditional teaching techniques?

The answers that I came up with were

- (1) A rich variety of information can be gleaned from wave files. This information includes, but is not limited to, the strength of upper and lower level frequencies and the presence of vibrato, glottal attacks, uneven breath and diction problems. Teachers of beginning students will find that the most significant information is the dynamic balance between upper and lower frequencies as the student learns to produce a resonant sound. This is, of course, not news to anyone here.
- (2) The spectrographic data were consistent with the instructor's overall assessment of each subject, but little consistency was observed between that data and either the instructor's or the students' assessment of the students'

weekly or long term progress. I think that part, or all, of the problem here was deficiencies in my assessment tools. If I do another study, it will be my object to improve those tools.

- (3) The subjects found the spectrograph helpful and interesting to use. They particularly appreciated its ability to provide a visual picture of vocal strengths and weaknesses.
- (4) The use of the spectrograph is compatible with traditional voice teaching techniques.

It is in these last two points that I may have something to offer this distinguished company. I think that one of the best outcomes from using the spectrograph in a college voice studio is the empowerment that students experience when the technology offers them an assessment of their vocal sound that is not solely dependant on their teacher's ear.

If all that is available to students is the teacher's opinion that this sound is good, that one is bad, the other one is better, students are completely dependant on the teacher's ear. They may feel that the teacher's personal opinions of them are reflected in the teacher's evaluation of their sound, or that the teacher's vocal ideal is something that they cannot accept.

One of the most difficult steps in teaching beginning students is to get them to realize that what they hear when they are singing is not what the audience is hearing. The sound that a singer hears when he or she is producing a resonant sound is often not very appealing. Students find it difficult to believe that when they are hearing such a "nasal", "whiney", or "awful" sound, they are producing a fuller and better sound. We poor voice teachers' are doubted. Our sanity is doubted, and our hearing is doubted. After all, most of us are over thirty and therefore untrustworthy.

In the 17th and 18th centuries students were taken outside into a courtyard to sing toward a wall and hear their reflected voices. Recording technology in the 20th century has been an enormous

improvement over wall-singing, but recording equipment that reproduces accurately is not always available to students. Voice teachers fall back on the good old voice class method whenever we can. In this method the students' peers, who are obviously more trustworthy than any teacher, are amazingly found to affirm that the resonant sound is better than the non-resonant sound.

The spectrograph offers a non-judgmental visual reflection of the student's voice. The students can see what happens in terms of frequencies produced when they make a change in their vocal production. Once they get used to using a spectrograph, they love it. I would like to share my experiences during the study with some of the students who were my subjects.

The 10 subjects ranged in age from 18-23, including 3 freshmen, 1 sophomore, 2 juniors, and 4 seniors. Their majors were vocal performance, music education, arts management, general studies, or musical theater. All were natives of Georgia, Alabama, or South Carolina—a factor in their pronunciation of vowels. Three of the students had backgrounds in African-

American gospel music, which influenced their vocal production. All except the freshmen were familiar with the experimental equipment, having participated during the preceding semester in a pilot study that I had conducted. All but one, a senior, had received all their post-secondary vocal training in my studio and therefore had comparable approaches to vocal technique. I would like to tell you about four of them.

Subject #3

Subject #3 was an 18-year-old Caucasian freshman majoring in vocal performance. Her home was in Gwinnett County, in the northeast part of metropolitan Atlanta. She was exceptionally intelligent, very intense, and very thin. She was a dancer and a gymnast, and her physical intensity tended to have a tension producing effect on her singing. She was conscientious about practicing and made good progress during the semester.

At the beginning of the semester her voice, while not large, was very clear, with little vibrato and a range from a to c³. In my

opinion, the lack of vibrato was due not to unsupported singing, but rather to tension in the muscles around the larynx. She was inclined to over-support, which caused her to flat in the second passaggio area. Her challenge during the semester in which data were collected was to learn to use skill instead of strength to achieve good vocal quality and good tuning. As I saw it, her intonation problems were caused by physical aspects of her technique, not by a lack of musicianship.

Because freshmen in that program did not perform on the midterm or Broadway recitals, Subject #3's first performance, other than in voice major class, was in the end of semester student recital. She had worked very hard on perfecting her song for the recital, and she was successful in her performance.

The spectrograph was an effective tool for Subject #3. Her intellectual approach to singing made her want to understand the mechanics of the voice. Thinking of her sound in terms of frequencies that she could control was a liberating idea for her and seemed to help her take control of her voice.

Subject #5

Subject #5 was a 20-year-old African-American junior majoring in arts management. Her hometown was Birmingham, Alabama. At the time of the data collection she had been a student in the researcher's studio for two years. Voice was her major instrument, and she made excellent progress from an inauspicious beginning.

As a freshman she had a very diffuse vocal production. Although the basic sound was pretty, it was nearly inaudible, lacking energy and focus. Subject #5 had to learn all the resonance techniques. She did not, however, have to overcome problems stemming from singing popular styles, and she had a good background in music and French. She had to learn and consciously practice breath management techniques

Subject #5's voice was a medium-sized, warm, dark-colored lyric mezzo-soprano, heard to advantage in her favorite genres of *lieder* and *mélodies*. Her voice might best be described as

“velvety.” At the time of the data collection she had internalized all the resonance and breath management techniques to the point that she could sing expressively throughout her entire range, as long as she was singing a song. She rarely showed the quality of her voice in exercises. She normally vocalized from a to a², with even vocal production throughout.

In her junior year she began to sing with conviction and skill, and agreed to perform duets in several productions and recitals, something she had avoided in the past. A major problem for Subject #5 was that she had completed all of her music courses, and her heavy load of business courses was interfering with her practice time. At the beginning of the semester she was not practicing as consistently as had been her habit, but she managed to improve her schedule. Aside from a two-week siege of bronchitis, she was healthy throughout the data collection period.

The spectrograph was a tool of enlightenment for Subject #5. During her first two years, she tended to believe that her voice was not as good as some of the other students’ voices. Along with her

shy personality, a lack of self-confidence made her regard herself as a “chorus only” singer. Seeing a spectrographic picture of her voice helped her to value it, particularly as she came to understand that her vocal quality was under her own control.

Subject #7

Subject #7 was a 23-year-old African-American senior majoring in musical theatre. She was from DeKalb County in Atlanta. The semester in which data were gathered was her first after she decided to change her major from vocal performance to musical theatre. Subject #7 had transferred to this college's Bachelor of Music program in January 2000, after spending three years in three different colleges studying music. Her goal was performance, but she was not sure in which area she wanted to perform. She enjoyed opera and musical theatre equally and was planning a recital that would include repertoire from both. She had a leading role in a musical theatre production based on the music

of George Gershwin and was vocally healthy during the data collection semester.

Subject #7's vocal production was very impressive at her scholarship audition. She had a wonderful lyric spinto sound with a long range from f to e^3 and a lovely high pianissimo, but her vocal production was marred by tension in the jaw and tongue that caused an extreme vibrato. Her dramatic and linguistic abilities along with a beautiful natural voice brought her quite a few performance opportunities, including Donna Elvira in a college production of *Don Giovanni* at one of her previous colleges, but her tension issues and disorganized approach to understanding her voice were standing in her way.

Subject #7 was a very intelligent singer who took good care of her voice. As she learned to release the jaw and tongue, she became able to produce her wonderful sound without the enormous physical effort she was putting into voice production. She learned to balance breath management with resonance techniques and to trust that her voice would work for her when she called upon it.

She also found that it was possible to sing with the richness she liked in her lower voice for musical theatre without losing her upper register. Ease in the notes above c^3 came with this process, and her vibrato relaxed to normal levels. One interesting feature of her vocal improvement was an exploration of the mezzo-soprano repertoire. Subject #7 may have the option of choosing soprano or mezzo-soprano roles at some point.

The spectrograph did not play a big role in Subject #7's improvement at first. She tended to find it intrusive until she discovered that resonance techniques could take some of the pressure off her voice. She could see both upper frequencies and vibrato rate as she learned to manipulate each to her advantage.

Subject #9

Subject #9 was a 21-year-old Caucasian senior majoring in musical theatre. She was from Atlanta. During the semester in which data were gathered, she had a leading role in a musical production featuring the music of George Gershwin. She was also

researching her senior thesis project, in which she planned to use music of the 1940's. She had a bout with bronchitis during the semester, but otherwise was healthy.

At the time of the data collection she had been a student in the researcher's studio for two years. When she first entered, her vocal production was very insecure. An excellent actor and dancer, she had almost no musical training and found learning music accurately quite difficult. She attacked the issue of her poor musical training by taking freshman theory and ear training as electives.

Her vocal progress was slow during the first year because she was convinced that the only vocal styles available to her were Broadway-style "belting" and several rock music styles that she had learned from recordings. Fortunately her "belting" style was basically healthy, and her voice was naturally large. Over the next year she moved from her restricted popular vocal styles into a more lyric vocal style, which she gradually accepted as her normal vocal production. She did not lose the ability to "belt" in the style

that is currently accepted on Broadway, but she enlarged her abilities along with her range and expressive possibilities. The summer between her junior and senior years she was hired to work in summer stock in a production in Kansas, and she returned much more confident of her vocal abilities.

Subject #9's voice was a warm lyric mezzo-soprano with a two-octave range from a to a², and her vocal production was even throughout that range. She was beginning to use her g² and a-flat² with confidence and to use her a² and b-flat² without tightening her throat. Her musicianship had improved, and she no longer lost control when she made a pitch error in a melody. She showed every sign of becoming a true musical theatre "triple threat": an actor who can sing and dance with skill.

The spectrograph was a revelation to Subject #9. Having for so long considered herself to be a second-class singer, she was astounded to see the spectrograph screen displaying a full and resonant sound. Since the spectrograph is neutral as to style, it showed her solid and resonant sound without reference to whether

she was singing classical or Broadway vowels. She seemed to gain self-confidence from having technological evidence that she was making a good sound.

Conclusion

Not all of the 10 subjects found the spectrograph to be as useful as these four did. Students who had already developed a resonant and relaxed sound found it to be reassuring, but not extremely informative. One student, who could not accept the ideal of a professional sound, found the visual evidence of her vocal weaknesses annoying. But even she, when she eventually saw the light, also saw the value of the technology.

One of the strengths of this study, in my opinion, is the detailed description of the subjects, their vocal levels, and their reactions to spectrographic technology. My professional opinion of how my students are doing is based on years of experience as a singer and a teacher, but I was happy to be able to validate my opinion through more scholarly methods. I hope that this small

contribution will be of some value to those of you engaged in research on heavier topics.