

The Relationship Between Voice Part and Self-Selected Pitch

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Vocal pedagogy has been undergone significant change in recent times. Technological breakthroughs have provided new tools that have allowed researchers unprecedented methods of observing and analyzing the human voice. These observations and analyses have in turn been used to reevaluate the basic assumptions behind much vocal pedagogy. Despite this expanding pool of knowledge, there are many traditional vocal pedagogy constructs that have been perpetuated despite a lack of data in these areas. One such construct is the common use of voice range categories. Voice range categories such as *bass*, *tenor*, *alto* or *soprano* have been used by composers for centuries, yet there has been very little research conducted with regards to these categories.

There have been studies in related areas such as the personality structure of musicians, pitch range, and the self-identity of singers. In a series of articles, Kemp (1982a, b) surveyed more than 1350 musicians in an attempt to generate a multidimensional model of personality structure among musicians. These structures were analyzed in terms of age, sex, instrument, and other factors in an effort to better understand those ways in which musicians differ from both the population at large and from one another. A smaller scale study, specifically of university voice majors, was conducted in which a limited number of participants were interviewed directly by the author (Roberts, 1997). This study suggested that singers have a self-identity that is distinct from that of instrumentalists, and that this distinction may be related to the fact that the singer *is* the instrument.

Several studies have been conducted with regards to pitch and singing. Green looked into the effect of vocal modeling on pitch-matching accuracy, determining that children's pitch accuracy was significantly better when responding to either a child or female adult model (Green, 1990). A further study found that pitch accuracy was better when performing in a group than when singing alone (Green, 1994).

Flowers and Dunne-Sousa (1990) investigated vocal range and pitch pattern accuracy among preschool children. They found that vocal range was significantly larger when the children were echoing short pitch patterns than when singing songs which required the same range of pitches. This suggests that vocal range may be both physiologically and situationally determined. In his historical review of studies on vocal range, Welch noted that while many studies of vocal range have reported different findings, these differences are largely attributable to differing methodologies and age differences among participants (Welch, 1979).

Recently there have been a few studies on self-selected starting pitch. Moore and Kemp (1991) found that both children and adults who selected their own starting pitch tended to sing melodies at the bottom of their vocal ranges. Umemoto (1993) disputed these findings, suggesting that singers tend to sing known songs near the original key at which the song was learned when not provided with a reference pitch. Therefore, participants singing known songs will be predisposed to start near the pitch on which the song was learned. Later research found that Umemoto's findings apply when a melody is low in the singer's range, but that singers will pitch high pieces down 4-5 semitones from the original key (Ogawa, 1997).

The purpose of this study is to investigate the relationship between voice part and self-selection of a single pitch. By having singers perform only one pitch, song range and the learning effect should be minimized. In doing so, the researcher hopes to contribute data that may help in determining whether voice categories such as *alto* and *soprano* are physiologically valid musical constructs. A pilot study was completed prior to engaging in the full study in order to assess the test instruments.

Method – Pilot Study

Participants

Volunteer participants were drawn from four university choruses, with a sample of $N=62$. Participants were female students who attend a large Midwestern university and are actively involved in at least one choir.

Instrument

Participants were assessed using a two-part test. Part one was conducted in a small rehearsal room. Each participant was admitted to the room along with the investigator and stood in a consistent spot facing a specified direction. The participant was then asked to sing the vowel *ah* for five seconds on a comfortable pitch of their choosing. Each participant was recorded using a compact handheld audio recording device. A mechanical reference tone was recorded in order to ensure pitch accuracy during playback.

For part two, which took place in the same room immediately following each audio sample, each participant was asked to provide written responses to a series of three questions designed to assess their voice part identity (alto or soprano) and the reasons for their chosen identity. The first question was, "For how many years have you sung?" with room for a numerical answer. The second question was, "Do you consider yourself an alto or a soprano?" with the participant asked to circle the appropriate term. The final question was, "Why do you consider yourself to be either an alto or soprano (as indicated above)?" with several blank lines provided for an open-ended response. Forms were collected and given a participant number corresponding to the related audio sample.

Results – Pilot Study

The pitch of each individual's sung sample was determined by comparison with a calibrated sound source. Pitch accuracy was determined to the nearest semitone. Based on the results of the second written question, the total sample was divided into two groups, those who self-identified as alto and those who self-identified as soprano. The mean pitch selected by each group was determined, as was the standard deviation. A t-test was used to test significance of difference between the mean pitch selected by altos and that selected by sopranos.

Altos ($n=25$) had a mean pitch of $f\#^1$ (minus 16 cents) with a standard deviation of 3.47 semitones. Sopranos ($n=37$) had a mean pitch of a^1 (minus 43 cents) with a standard deviation of 3.12 semitones. Variances were compared with a table value and considered equal. A t-test resulted in a value of 3.228 at an alpha level of $p < 0.05$, as compared with a table value of 2.000. Therefore the null hypothesis was rejected: there is a statistically significant difference between the pitches chosen by those who self-identify as alto and those who self-identify as soprano. While no calculations have been performed on the results of question three, the raw text suggests that there are a variety of reasons why an individual may identify with a particular voice part. Results of question one were not included in the pilot study.

Method – Full Study

Participants

Volunteer participants were drawn from six university choruses, with a sample of $N=174$. Participants were both female and male students who attend a large Midwestern university and are actively involved in at least one choir.

Instrument

Participants were assessed using the same two-part test as implemented in the pilot study, with two modifications. The second question, "Do you consider yourself an alto or

a soprano?" was asked of the female singers, while males were asked, "Do you consider yourself a tenor or a bass?" Question three was similarly modified for male participants. Forms were collected and given a participant number corresponding to the related audio sample, which was collected in the same manner as in the pilot study.

Results – Full Study

Based on the results of the second written question, the total sample was divided into two groups, female and male. The female group was further sub-divided into those who self-identified as alto and those who self-identified as soprano. The male group was further sub-divided into those who self-identified as tenor and those who self-identified as bass. The mean pitch selected by each group (female, male, soprano, alto, tenor, and bass) was determined, as was the standard deviation. Three t-tests were used to test significance of difference between the mean pitch selected by females and that selected by males, sopranos and that selected by altos, and tenors and that selected by basses. The average pitch selected by females was compared directly with that selected by males by mathematically lowering the average female pitch by one octave for this test only.

Females ($n=92$) had a mean pitch of g' (minus 10 cents) with a standard deviation of 4.15 semitones. Males ($n=82$) had a mean pitch of $f\sharp'$ (minus 4 cents) with a standard deviation of 4.68 semitones. Variances were compared with a table value and considered equal. A t-test resulted in a value of 2.06 at an alpha level of $p < 0.05$, as compared with a table value of 1.98. Therefore, the null hypothesis was rejected: there is a statistically significant difference between the pitches chosen by females and males, having adjusted for a one-octave difference.

Sopranos ($n=56$) had a mean pitch of a' (minus 29 cents) with a standard deviation of 3.35 semitones. Altos ($n=35$) had a mean pitch of $f\sharp'$ (minus 19 cents) with a standard deviation of 4.68 semitones. One alto was excluded from this calculation due to potentially spurious data. Variances were compared with a table value and considered equal. A t-test resulted in a value of 4.53 at an alpha level of $p < 0.05$, as compared with a table value of 1.99. Therefore, the null hypothesis was rejected: there is a statistically significant difference between the pitches chosen by those who self-identify as alto and those who self-identify as soprano. The t-test was recalculated at an alpha level of $p < 0.001$ with no change in overall findings.

Tenors ($n=42$) had a mean pitch of a (minus 79 cents) with a standard deviation of 3.63 semitones. Basses ($n=40$) had a mean pitch of e (minus 40 cents) with a standard deviation of 4.51 semitones. Variances were compared with a table value and considered equal. A t-test resulted in a value of 5.11 at an alpha level of $p < 0.05$, as compared with a table value of 1.99. Therefore, the null hypothesis was rejected: there is a statistically significant difference between the pitches chosen by those who self-identify as tenor and those who self-identify as bass. As with the soprano/alto test, the t-test was recalculated at an alpha level of $p < 0.001$ with no change in overall findings.

Regarding question one, the average number of years singing as reported by all participants was 9.2 years. The female average was 10.6 years (soprano average 11.4 years, alto average 9.4 years), and the male average was 7.5 years (as were both the tenor and bass averages). Due to variations in individual interpretation of the question, "for how many years have you sung," no further calculations were performed on this data.

While the core purpose of this study was not directly related to question three, the raw text suggests that there are a variety of reasons why an individual may identify with a particular voice part. A summary content analysis indicated five main headings under which most of the responses could fit. The most common response to question three referred to range as a defining factor in determining vocal self-identity. A total of 86 respondents referred to range, either using the word directly, citing specific pitches, or discussing voice placement in terms of high versus low. The second most common response to question three was the use of the word "comfort" or one of its derivatives (comfortable, uncomfortable, and

comfortably). A total of 54 participants used one of these words to explain their vocal self-identity.

The third most common area of response to question three was through reference to timbre, through such words as "tone," "colour," "fuller," "quality of sound," "stronger," "resonance," "richer," and "sounds better." Timbre was referred to by 37 participants. A total of 15 participants made reference to tradition as the defining reason for their vocal self-identity ("I've always sung _____"), while 14 participants cited expert evaluation by a voice teacher or conductor. The total of these responses is greater than 174 (the number of participants) due to some responses fitting into multiple categories.

Discussion

As indicated above, the results suggest a statistically significant difference between the pitches chosen by those who self-identify as alto or soprano, respectively. The difference in mean average pitch was less than three semitones. Assuming there is a link between the average pitch selected and overall vocal range, this suggests that a range difference between altos and sopranos may exist, although it may be less pronounced than previously believed. This may have implications for the composition of music, in that alto and soprano parts may not necessarily need to differ greatly in pitch centre. The results suggest a similar relationship between those who self-identify as tenor or bass, respectively, although the pitch difference between these two groups was five semitones.

While the t-test results of the comparison of female and male average pitches suggest a significant difference in average pitch, these findings should be approached cautiously. The overall average, when adjusted by one octave, differs by less than one semitone (96 cents). Such a narrow margin could be significant, but it could also have been introduced through data rounding used in the sampling and calculation phases of the study. Regardless, the findings seem to confirm the widely held belief that women's and men's voices vary by one octave.

Results of question three suggest that participants vary in the criteria they apply in determining their respective voice part identity. Examples of criteria used include pitch range, comfort level, predisposition toward singing melody or harmony, vocal timbre, and adoption of external expert labelling. While this study allowed participants to self-identify their voice part, categorization according to any one of the above criteria may cause a change in the distribution of subjects as alto or soprano which may change the results.

Certain complications in the methodology may have impacted the participants' choice of pitch. Each participant was brought to the investigation room directly from a choral rehearsal in which they were participating. As the experiment was run over a period of four days, with each choral rehearsal changing music every five to ten minutes, the likelihood of one particular musical tonality impacting the results is low. Still, time of day factors or testing before first daily exposure to music could cause results to differ.

Of further interest to the researcher is whether the results of this study are representative only of trained musicians, or also of the population at large. Sampling of a broader population appears to be possible using the present methodology. Another issue is that of regional and/or cultural bias, which could be accounted for by replicating the study in other areas around the globe.

While the results of the present study shed some light on the validity of voice part labels, it is the researcher's belief that there are still a number of unanswered questions that require further investigation. Using the present study as a benchmark, it should be possible to better define the terms *soprano*, *alto*, *tenor* and *bass*.

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