

The Effect of Phonetic Vowel Spelling Variations on Singers' Performed Vowel

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Abstract

The purpose of this study was to examine the extent to which various phonetic spellings of a single vowel can influence singers' performed vowel, and to explore whether the International Phonetic Alphabet (IPA) may provide an alternative to phonetic spelling in sheet music. I prepared two short, sight-singable melodies of similar range and difficulty; one had vowels written as IPA symbols under the staff, including the /u/ vowel, while the other had the vowels written out phonetically, including two occurrences of the /u/ vowel, spelled in two different ways ("oo" and "ooh"). Each participant ($N=41$) performed both conditions in a randomized order. I recorded their performances and used the linguistics software Praat to analyze the frequencies of the first and second formants (F1 and F2) for each condition. I found no significant differences in formant frequencies between the conditions. In their exit survey responses, many participants indicated that they recognized a difference in the pronunciation of "oo" and "ooh." Participants also indicated a slight, though not significant, preference for phonetic spelling over IPA. These results suggest that while some singers believe that "oo" and "ooh" should be sung differently, this belief is not reflected in their performance. Results also suggest that IPA is no better at eliciting a specific pronunciation than either phonetic spelling, and is not recommended as a replacement to phonetic spelling in sheet music. I discuss the implications of these findings for choral teachers and composers, and suggest avenues for further research.

The Effect of Phonetic Vowel Spelling Variances on Singers' Performed Vowel

Choral compositions often make use of held vowels—a single non-word vowel held over multiple beats. Composers often communicate these vowels in the score with a phonetic spelling of the desired vowel, written underneath the notes to which it applies. However, some vowels have multiple accepted phonetic spellings (e.g., the vowel /u/ can be spelled "oo" or "ooh"). To date, no known researchers have empirically studied the effect of various spelling choices on singers' performances of the vowel.

The International Phonetic Alphabet (IPA), a system of phonetic notation in which each phoneme is assigned a distinct symbol, is an alternative way of communicating desired vowels. While IPA is regularly used in classical singing circles, particularly when singing in foreign languages, it is rarely written directly into sheet music in the way that phonetic syllables are. It is possible that this use of IPA could provide an unambiguous alternative to phonetic spelling of vowels in sheet music, to those who are familiar with the alphabet.

A deeper understanding of how singers respond to different phonetic spellings, as well as IPA, would benefit composers and music teachers who must choose between these possible spellings in order to most clearly and accurately communicate their desired pronunciation to the singers. Towards this end, my research questions are the following: (1) To what extent will singers perform an excerpt of music with the written vowel "oo" with a detectably different vowel than one with the written vowel "ooh," as measured by different first and second formant frequencies? (2) Will the vowel performed in response to these phonetic spellings differ from that performed in response to IPA notation? (3) Will singers indicate a preference between singing from sheet music with vowels spelled phonetically versus with vowels written in IPA notation?

Justification for Research

From the composer's vision of their piece to a choir's performance, there are several steps of communication which must take place. Composers will not likely have direct communication with many of the ensembles that will perform their piece, so they must communicate their intention to the best of their ability through the sheet music. The director will then study this sheet music and formulate the sound they wish for their singers to achieve, and then help the choir attain this goal using various teaching tools. At the same time, the singers will interpret the information given to them by both the sheet music itself and their director to inform their ultimate performance. In every step of this process, the only direct communication from the composer is the sheet music, and this sheet music directly informs the decisions of all other parties. It is therefore important for the composer to understand the effectiveness of these tools to aid in this communication. One such tool may be phonetic spelling for non-word syllables. In order to facilitate clear and specific communication by the composer, an objective, empirical understanding of the extent to which singers' vowels can be influenced by phonetic spelling may be valuable.

Although IPA is not commonly written into sheet music in the way lyrics are, its unambiguous nature could make it a clearer alternative to phonetic spelling. However, IPA is generally only taught to advanced singers at collegiate levels of musical study, so composers and directors working with amateur singers cannot assume their students have the necessary knowledge to understand IPA. In addition, IPA is rarely used in sheet music, so even singers who are familiar with IPA will likely not be accustomed to seeing it in their score. If in this study, I find that IPA results in less variation in pronunciation than phonetic spelling, then perhaps a reasonable conclusion would be that there is value in learning IPA at a younger age.

However, because IPA is not currently used in this way, a deeper understanding of the effects of phonetic spelling variations is still necessary.

Visual Cues for Musicians

Several researchers have explored how musical notation itself—the way music is represented on paper—affects musicians' accuracy while performing and sight-reading. Even minor changes to the traditional syntax of Western music notation can impact musicians' sight-reading success either positively or negatively. For example, adding whitespace between the phrases of marimba excerpts in order to visually separate individual musical ideas caused collegiate percussion musicians to sight-read with fewer pitch and rhythm errors (Stenberg & Cross, 2019). Alternatively, Brodsky and Kessler (2017) found that when musicians and non-musician undergraduate students were asked to judge the overall contour (ascending, descending, or staying the same) of a beamed set of four eighth notes, both groups performed worse (less accuracy and longer response times) when the slope of the beam did not match the contour of the note heads. Both of these results demonstrate that visual cues given through the sheet music can impact musicians' performance.

There are certainly limitations to the applicability of these studies to the subject of vowel spelling. To begin, in both studies, researchers judged success by accurate identification or performance of notes and rhythms. This measure is discrete and clearly has a "correct" response, whereas vowel pronunciation is a continuous variable whose correctness can only be judged in comparison to the composer's and director's intention. However, it is evident that the way musical information is presented on the page can influence elements of its ultimate performance, giving some credence to the hypothesis that different vowel spellings could do the same.

More specifically relevant to singers, there is evidence that visual cues given to singers before and during a performance can affect elements of their physiology while performing. Daugherty and Brunkan (2013) found that when watching a choral conductor who modeled lip rounding on the /u/ vowels of Mozart's Ave Verum Corpus, singers of various ages and experience levels performed said vowels with more exaggerated lip rounding than when they watched a conductor who did not demonstrate lip rounding. A small group of trained collegiate singers similarly adjusted their facial expressions in the listening, pre-performance, performance, and post-performance periods when asked to watch a model singer demonstrating an emotion and emulate their performance in Livingstone et. al.'s (2009) study. These findings demonstrate that singers make physiological changes while singing in response to what they see.

These studies' findings indicate that changes to the traditional notation of Western sheet music can affect musicians' accuracy in performance by introducing either clarifying or confusing information. However, researchers have not explored the effect of sheet music presentation on variables beyond the accuracy of notes and rhythms. Similarly, researchers have studied several factors as potentially manipulating singers' vowel shape or similar aspects of performance. But, these studies tend to focus on the effects of modeling or other interventions by a person, rather than the direct effects of the sheet music itself. While such variables are unquestionably important to understand, and can inform how a director communicates to a choir, they skip over the important step of how the director or singer initially interprets the composer's vision through the sheet music. In the present study, I wish to explore this interpretation process more fully.

A Linguistic Understanding

The topic of vowel spelling in sheet music falls into the overlap of singing and linguistics, and while many studies have explored adjacent topics in one of these subjects, very few have delved into their intersection. Although recent linguistics researchers have not reached a consensus on the precise mechanisms by which we translate between spelling and speech, one thing is clear: English vowel pronunciation is complicated. Not only can many vowel sounds be spelled in multiple ways (Sun-Alperin & Wang, 2008), many vowel letters and letter combinations can also be pronounced in multiple ways (Kessler & Treiman, 2001). In considering which of these many spellings or pronunciations English speakers choose when reading and writing, past research is largely inconclusive. Some researchers (Kessler & Treiman, 2001; Treiman & Kessler, 2016) have suggested that the interaction between the vowel and final consonant of a syllable most strongly determines the pronunciation of the vowel. Other researchers (Andrews & Scarratt, 1998; Caravolas et. al., 2005) identified other factors, such as the frequency of a vowel's spelling-sound combination in age-appropriate literature, or pronunciation of words with a similar irregular spelling, as playing a stronger role in determining pronunciation.

A majority of these studies, however, focus on the spelling and pronunciation of vowels in the context of words. These factors are removed when singers are asked to sing extended, pure vowels. Furthermore, many more factors are introduced, such as the interaction of vowel and pitch, the spellings of held vowels which are not commonly encountered in written language, and the potential distraction of the other elements of music notation. Given these considerations, a deeper understanding of this particular intersection of singing and linguistics may prove valuable.

Measurement Considerations

Studies which measure changes in vocal performance typically fall into three categories of measurement designs. The first, as seen in Livingstone et. al. (2009), is physiological. In studies such as this one, researchers used tracking devices to record the movement of the face. The second, demonstrated by Daugherty and Brunkan (2013), is audio-based. In these studies, the researchers extracted data about the performance from audio recordings. The final category, used by Erickson and Perry (2003), is the expert panel. Here, pairs of live performances or recordings were compared by a panel of judges for differences in a particular variable.

Notably, Daugherty and Brunkan (2013) employed all three of these methods, expressing some hesitancy that any method on its own could definitively demonstrate a difference in performance. Certainly, demonstrating a change in both physiological and audio-based measurements, corroborated by a panel of experts, would strengthen the credibility of a conclusion that a change in performed vowel had taken place. However, given my limitations of budget, expertise, and access to technical equipment, I employed only an audio-based measurement to collect data.

As mentioned earlier, while IPA is particularly adept at unambiguously communicating a desired vowel, it is not commonly written in sheet music itself. Because this study focused on the information communicated directly from the sheet music, it was prudent to also investigate whether singers could accurately and comfortably sing music written with IPA "lyrics," in order to determine whether IPA could serve as an alternative to spelling vowels phonetically in sheet music. For this reason, in my design I included a trial in which the participants sang from IPA notation in order to gauge their accuracy and comfort with this potential alternative.

The purpose of this study was to examine the extent to which various phonetic spellings of the vowel /u/ can influence singers' performed vowel, and to explore whether the International

Phonetic Alphabet (IPA) may provide an alternative to phonetic spelling in sheet music. My specific research questions included:

1. To what extent will singers perform an excerpt of music with the written vowel "oo" with a detectably different vowel than one with the written vowel "ooh," as measured by different first and second formant frequencies?
2. Will the vowel performed in response to these phonetic spellings differ from that performed in response to IPA notation?
3. Will singers indicate a preference between singing from sheet music with vowels spelled phonetically vs. with vowels written in IPA notation?

Method

To quantify vowel shape in an audio-based measurement, I extracted data on formants from audio recordings. The vocal tract produces resonant frequencies, known as formants, which change as the shape of the vocal tract is manipulated through the movement of the lips, tongue, jaw, soft palate, and larynx (Bozeman, 2013). It is these changes in formants that give rise to different timbres of the voice. Depending on voice type, the first three to five formants play the greatest role in shaping the qualities of the voice, with formants F1 and F2 predominantly determining the perceived vowel (Bergelson et. al., 2013; Bozeman, 2013). For this reason, I focused my analysis on these two "vowel formants."

I chose to examine the /u/ vowel in this study, both because it is consistent with Daugherty and Brunkan's (2013) study, and because its status as a closed back vowel means that F1 and F2 should move parallel to each other (rather than in contrary motion) in response to changes in pronunciation (Bozeman, 2013). This parallel movement allowed for greater clarity in

analysis once the data were collected. By comparing the F1 and F2 frequencies associated with different spellings, I attempted to determine if singers pronounced the two /u/ vowels differently.

Participants

The participants in this study were undergraduate music majors with a primary emphasis in voice (one participant indicated a double emphasis in voice and violin), all of whom had completed at least one semester of singer's diction courses which emphasized IPA. Among the 41 participants, I collected data on gender (female, $n=24$; male, $n=14$; nonbinary, $n=3$), age ($M = 20.34$; $SD = 1.02$), year in school (sophomore, $n=12$; junior, $n=10$; senior, $n=19$), years of formal singing experience not limited to classical ($M = 9.51$; $SD = 2.44$), semesters of completed diction/IPA courses ($M = 3.15$; $SD = 1.04$), language(s) the participant grew up speaking (English, $n=37$; English and Spanish, $n=2$; English and Hungarian, $n=1$; Korean, $n=1$), and other languages spoken (none, $n=36$; Spanish, $n=3$; English, $n=1$; American Sign Language, $n=1$).

I recruited participants through emails and class announcements, focusing particularly on choir classes, where the highest percentage of students were eligible. Prior to signing up, the participants were informed that the purpose of the study was to explore how phonetic spelling of vowels in sheet music affects singers' pronunciation, and that their participation would involve sight singing two short passages of music, followed by completing a short questionnaire about the experience. They were not informed which vowel would be measured.

Stimulus

So that the specific vowel I was measuring was not immediately obvious to participants, I composed two vocal melodies of equal length and difficulty, with "lyrics" consisting of held vowels, and I transcribed both into sheet music. In Passage A, the lyrics were written under the

staff in IPA notation. In Passage B, the lyrics were written phonetically, using English spelling conventions (see Figure 1 and Figure 2 in Tables and Figures).

Both Passage A and Passage B were eight measures long consisting of two four-measure phrases, were written in the key of D major, and consisted of diatonic pitches and intervals no larger than a major third. For both passages, participants could choose to sing in the D3 or D4 octave. These specifications were made so that the passages could be sight-sung easily by trained singers, and in a comfortable range regardless of voice type, so as to decrease confounding variables resulting from the challenge of sight-singing. See Figures 1 and 2 for more detail.

For both passages, the "lyrics" consisted exclusively of the vowels /u/ (spelled "oo" and "ooh" in the phonetic spelling passage), /i/ (spelled "ee" in the phonetic spelling passage), and /a/ (spelled "ah" in the phonetic spelling passage). The spelling of the /u/ vowel served as the independent variable. The other vowels were not measured, but were included to simulate the experience of reading sheet music. The front vowel /i/ was chosen as a contrast to the back vowel /u/, and the open central vowel /a/ was chosen to contrast the closed vowels /i/ and /u/ and to act as a reset between them, eliminating some potential for carryover effects from the previous vowel.

In each passage, the /u/ vowel occurred twice: on beats 3-4 of measure 3, and on beats 1-2 of measure 6. All instances of the /u/ vowel occurred on an F#, immediately following an /a/ vowel on the preceding beat, which was also sung on an F#. In this way, the approach of the vowel to be measured was standardized across all conditions, eliminating effects of variables such as range and carryover effects of the previous vowel.

To control for order effects, I created two versions of Passage B. In the first, which I called B1, the vowel spelled "oo" occurred in measure 3 while the vowel spelled "ooh" occurred

in measure 6. In the second version, or B2, the spelling placements were reversed. All participants read Passage A, and each participant was randomly assigned to read either Passage B1 or B2. Furthermore, the order in which they read Passages A and B was also randomized. This organization created four possible sequences for a participant to read, outlined in Table 1.

Procedure

I met with each participant privately in a classroom in the music building with a piano. Prior to meeting with participants, I connected a Blue Yeti microphone to my laptop, to record into the audio editing program Audacity. Each meeting took approximately fifteen minutes. Upon entering, the participant filled out the informed consent form and the demographic survey. I then instructed them to stand approximately two feet from the microphone, facing at a diagonal angle to the microphone. I instructed them to sing any comfortable scale, and adjusted the gain on the microphone to ensure that no clipping occurred on any part of their range.

Once the microphone was appropriately set, I read the following instructions: *In a moment, I will hand you a sheet of paper with an 8-measure passage of music on it. The lyrics written under the music will be vowels [written in IPA / spelled phonetically, using English spelling rules]. You may take up to five minutes to practice the passage, and you may use the piano while doing so. You may also ask to hear the tempo. When you are ready to perform the passage, let me know, and I will begin recording. Perform the passage strictly as the sheet music indicates, without adding any personal interpretation. Do you have any questions?*

I answered any questions they had about the procedure, and then followed the procedure indicated in the instructions. During the practice time, I offered minor feedback if I noticed a participant struggling, or repeatedly making a pitch or rhythm mistake. I did not give any feedback on participants' vowel pronunciation. If participants asked to hear the tempo during the

practice time, I played it for them using a metronome app. Before recording, I played the metronome for a few seconds to remind them of the tempo; however, while recording, the metronome was not played. If the participant sang one of the /u/ vowels on the wrong pitch during the recording, I allowed them one chance to re-record. Otherwise, I accepted their recording, even if they made other mistakes. No participant needed more than two trials to sing the /u/ vowels correctly.

After they performed the first passage, I read them the other set of instructions, and repeated the procedure with the second passage. Once the participant had recorded both passages, they filled out a written exit survey with the following questions: *(1) Which passage did you find easier to sing: IPA or phonetic spelling? Why? (2) (a) Did you notice that in the passage with phonetic spelling, one vowel was spelled "oo" while another was spelled "ooh?" (b) Do you think that you sang those two vowels differently? If so, how did your pronunciation differ, and why do you think you did so?*

Audio Analysis

Six participants were excluded from the audio analysis because of major audio interferences during their recording, or because their response to the IPA condition indicated an insufficient familiarity with IPA symbols. This omission left a total of 35 participants for the audio analysis. After completing the procedure, each participant had sung four instances of the /u/ vowel: one in response to each of the two phonetic spellings, and two in response to IPA notation. For each participant, I analyzed the vowel sung in response to each phonetic spelling, as well as the first vowel sung in response to IPA notation (measure 3 of Passage A). Because each occurrence of the /u/ vowel was sung on a half note at 95 bpm, each /u/ vowel was held for a duration of approximately 1.33 seconds. I selected a one-second period in the middle of this

duration to extract from the full recording , and imported this one-second audio clip into Praat, a linguistic analysis software capable of analyzing formants.

Derdemezis et. al. (2015) note that linguistic analysis software sometimes fail to correctly differentiate the F1 and F2 formants for back vowels such as /u/. They recommend that users compare the formant readings visually against a spectrogram, and then adjust the settings on a case-by-case basis to give the clearest reading. Consistent with these recommendations, I adjusted the setting for the number of formants to be analyzed for each singer so that the formants appeared as steady as possible throughout the clip when overlaid on the audio spectrogram. In all cases, the clearest reading was achieved when analyzing for either five or six formants. Once the clearest formant reading had been achieved, I used Praat's "Get formant" function to extract the mean F1 and F2 values of the clip. With these data collected, I conducted a repeated measures, within-factors ANCOVA with vowel spelling (IPA, "oo," and "ooh") as the independent variable, and participant awareness of spelling difference as a covariate.

Exit Survey Analysis

All 41 participants were included in the exit survey analysis because regardless of their success with the procedure, their responses were still meaningful. I encoded participants' answers to the exit survey to provide context to the above analyses. For question 2b, I sorted participants' responses into three categories: (1) sung "oo" and "ooh" as two different vowels (such as /u/ and /o/), (2) sung "oo" and "ooh" as the same vowel but with different qualities (such as self-reporting that they sang "ooh" more open than "oo"), and (3) sung "oo" and "ooh" the same.

Though I did not explicitly ask a question about this, some participants indicated in their responses that although they sang "oo" and "ooh" the same, they believed they should have sung them differently. This prompted me to also collect data for whether the participant believed that "oo" and "ooh" *should* be sung differently, regardless of whether they reported that they actually

did so. Finally, I collected and sorted the descriptive keywords participants used to explain how "oo" and "ooh" were sung or should be sung.

Results

Audio Analysis Results

There were no significant differences in F1 or F2 frequency between the IPA, "oo," and "ooh" conditions. As seen in Table 2, the F1 and F2 means were slightly higher for "ooh" as compared to "oo;" however, the standard deviations for both were much wider than this difference. Comparing the two phonetic spelling conditions to the IPA condition, IPA F1 was very similar to "oo" F1 in both mean and SD, but IPA F2 was higher than either "oo" or "ooh," and had a higher SD than either. This finding suggests that IPA is no better at eliciting a specific pronunciation than either phonetic spelling.

Participant awareness of spelling difference (i.e. participants' answer to exit survey question 2a) was a significant covariate for F1, but not F2 ($F(2,66) = 4.63, p < 0.05$). This covariate was not pairwise significant, however, meaning that when considering only the difference between the "oo" and "ooh" conditions, participant awareness of spelling difference was not significant.

Exit survey responses

Of the 41 participants included in the exit survey analysis, 22 (53.7%) indicated a preference for phonetic spelling over IPA, 16 (39.0%) indicated a preference for IPA over phonetic spelling, and 3 (7.3%) indicated no preference between the two. Excluding those with no preference, I conducted a chi-square test on the remaining 38 responses, and found it to be not significant ($p > .05$).

Almost half ($n = 19, 46\%$) of the participants indicated that they noticed the difference in spelling between "oo" and "ooh." Of these 19, 14 (34%) reported that they sang the two vowels

differently in some way, with 6 reporting that they sang them as two different vowels ("oo" as /u/ and "ooh" as /o/ in all cases), and 8 reporting that they sang the same vowel for both conditions but described a difference in the quality of the vowel. Six participants wrote in their responses that they sang the "oo" and "ooh" conditions the same because they did not notice the difference in spelling, but would have sung them differently if they had noticed the spelling. Taking these participants into account, I found that of the 41 participants, 20 (48.7%) indicated a belief that "oo" and "ooh" should be sung differently. Words used to describe the pronunciation of "oo" included "IPA /u/" (6), "closed" (4), "rounded" (2), and "tunnel sound" (1). Words used to describe the pronunciation of "ooh" included "more open" (10), "IPA /o/ or /ɔ/" (7) "rounded" (1), "lighter" (1), "more mouth space" (1), "'a' in back" (1), "raised" (1), and "breathier" (1).

Discussion

The findings of this study corroborate the consensus of linguistics literature: vowel pronunciation is an incredibly complicated psychological phenomenon whose many factors are extremely difficult to parse. With this understanding, it is not surprising that a research design that looked at the subject through such a narrow lens did not produce significant results. Nevertheless, the exit survey responses provide interesting context when compared with the null result of the formant analysis. Nearly half of the participants recognized a theoretical difference in pronunciation between "oo" and "ooh," and the words participants used to describe this difference (e.g. that "ooh" is "more open," "raised," "closer to /o/," etc.) are generally associated with higher formants. I note additionally that the exit survey did not explicitly ask how participants thought the vowels should be pronounced; it only asked how the participant actually pronounced them. Had I included a question about how participants believed the vowels should be sung, even more may have indicated a belief that they should be sung differently.

One possibility to account for this discrepancy may simply be that formants are not a fully complete measurement tool for vowel pronunciation in singing. While this measure is commonly used in linguistics research, very few classical voice researchers have employed it as a measurement tool, and those that have, have done so with an abundance of caution, and often in conjunction with other measurement tools (Daugherty & Brunkan, 2013). Future researchers on this subject may consider an expert panel as a replacement for, or in addition to, formant analysis; after all, what matters in performance is not the formant frequencies themselves, but the audience perception of vowel placement and unification.

Another possibility that may help account for the discrepancy is that although many singers may recognize a theoretical difference in the pronunciation of "oo" and "ooh," the complex task of processing new music caused them to either not notice the spelling difference, or prioritize their attention towards other elements of the music. This observation was confirmed to be the case for at least six participants through their exit survey responses, and it is possible there were even more.

Whatever the cause, these results underscore the critical role of the choir director in unifying a choir's vowel. Singers in a choir may be contending with many different elements of music reading and performing during a rehearsal, which is likely to result in many different interpretations of a given vowel. The director, on the other hand, will thoroughly study the score beforehand, giving them more opportunity to notice and interpret any nuances in spelling and pronunciation. It is then their responsibility to bring this insight to the rehearsal, and blend the many interpretations within the choir into a single unified vowel sound. To do this, directors need strong abilities in both score study and discerning vowel unification; teacher education programs should provide instruction on these subjects.

Given the lack of any clear advantage in using IPA, combined with the slight singer preference for phonetic spelling, I do not believe it is advisable to use IPA in sheet music as an alternative to phonetic spelling. This is not an indictment of IPA as a whole - including an IPA guide at the beginning or end of a piece, or writing the IPA for an individual, unusually-spelled syllable in the margins would be constructive. However, choirs will likely have less difficulty when phonetic spellings are written into the score itself.

The findings of this study may not be generalizable to students of all ages and experiences, because of the limited population in this study. All of the participants were experienced young adult musicians with extensive familiarity with IPA. Future researchers may choose to include participants with a greater variety in age, singing experience, and familiarity with IPA.

Another important variable that future researchers may consider is the primary language of participants. There is evidence that a person's primary language may affect the way in which they translate between spelling and speech (Jared & Kroll, 2001; Sun-Alperin & Wang, 2008). In 2021, 21.6% of children in the US spoke a language other than English at home (US Census Bureau, 2021). It is therefore important to understand the role of primary language in affecting the performed vowel, in order to give a more comprehensive picture of how to teach and communicate with all students.

Future researchers exploring this subject may wish to make some additional modifications to the procedure, including (a) giving participants a longer period of time to prepare passages, to better simulate the conditions of a prepared performance; (b) incorporating a group preparation period, where participants learn the passages together in a choral setting before collecting recordings, to better simulate the effects of a rehearsal setting; (c) teaching relevant

IPA symbols to young singers who have not yet been exposed to it, before collecting recordings; (d) including an exit survey question regarding how participants think “oo” and “ooh” should be pronounced (regardless of how they actually pronounced them).

While this study has raised more questions than it answered, it has also revealed a need for a deeper understanding of how singers process phonetic spelling of vowels in sheet music, and why many singers' apparent beliefs about the nuances of spelling may not be reflected in their performance. Continued research focused on isolating the relevant variables may prove valuable in developing a more thorough understanding of this subject.

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Tables and Figures

Table 1

Sequences for Participants to Read

Order	Description
A-B1	Participant reads Passage A (IPA), then Passage B1 ("oo" then "ooh")
A-B2	Participant reads Passage A (IPA), then Passage B2 ("ooh" then "oo")
B1-A	Participant reads Passage B1 ("oo" then "ooh"), then Passage A (IPA)
B2-A	Participant reads Passage B2 ("ooh" then "oo"), then Passage A (IPA)

Table 2

Formant Analysis Results

Condition	F1		F2	
	<i>M</i> (Hz)	<i>Standard Deviation</i>	<i>M</i> (Hz)	<i>Standard Deviation</i>
IPA	404.89	41.38	894.92	134.93
"oo"	409.05	47.04	873.15	118.03
"ooh"	423.19	56.57	882.00	116.62

Figure 1

Passage A

The "lyrics" of this passage are written in International Phonetic Alphabet (IPA) notation.
Please perform the passage at a tempo of quarter=95.

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Figure 2

Passage B1

The "lyrics" of this passage are written phonetically.
Please perform the passage at a tempo of quarter=95.

