THE RELATIONSHIP BETWEEN CHILDREN’S USE OF SINGING VOICE AND SINGING ACCURACY

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The purpose of this study was to investigate the nature of the relationship between children’s use of singing voice (vocal register) and singing accuracy. In previous studies recorded examples of kindergartners’ \( (n = 37) \) and first graders’ \( (n = 38) \) singing were assessed with the Singing Voice Development Measure. For this study, these recorded examples were also evaluated for accuracy by two different raters. There was a significant correlation between children’s use of singing voice and singing accuracy, but no significant relationship for either variable with tonal aptitude as measured by Intermediate Measures of Music Audiation. When children’s accuracy was assessed based on their usable register, the influence of register on accuracy was very small suggesting that the relationship between vocal development and accuracy is a function of children’s access to, and control of, a wider singing range. Teachers interested in improving singing accuracy in their students are encouraged to work with them on expanding their usable vocal registers.

Received: June 8, 2014, accepted December 9, 2014.

Key words: children’s singing, singing registers, singing accuracy, music aptitude, early childhood music

Children’s ability to sing in tune and their vocal ranges have been of interest to music education researchers for almost 100 years (Drexler, 1938; Jersild & Bienstock, 1931, 1934; Updegraff, Heiliger, & Learned, 1938; Wilson, 1973). As musicians and music educators, it is reasonable that our main concern is with children’s singing accuracy and how to help children sing more accurately. Numerous studies have focused on this important musical skill and much has been learned about children’s singing ranges and strategies to help them sing better in tune (see Hedden, 2012). However, many children and adults still have difficulty singing and identify themselves as “non-singers” (e.g., Levinowitz et al., 1998; Welch et al., 2011).

Why some children sing in tune and others do not continues to be a topic of much investigation. Children who have nurturing musical environments at home are more likely to be good singers: “The probability is very great that non-singers will come from poor musical environments; where as excellent musical environments will generally produce singers or partial singers with little likelihood of non-singers.” (Kirkpatrick, 1962, p. 147). Even with the increase in music programs for young children and research identifying appropriate means of nurturing musical development (e.g., Burton & Taggart, 2011; Flohr, 2005), many children continue to sing out of tune. A question that has been pondered for quite some time is: Are their singing difficulties the result of an inability to use the singing voice (production) or their inability to hear, discriminate, and process musical pitches (perception)?

Production or Perception

Many researchers in music education and psychology have investigated these possible sources of poor singing. For example, Geringer (1983) investigated the relationship between pitch-matching (production) and pitch-discrimination (perception) abilities of both preschool and fourth grade children \( (n = 144) \). Participants’ scores on two measures were used to categorize them into three ability level groups for pitch matching and pitch discrimination. Pitch-matching scores were not significantly different by the pitch-discrimination groups; differences were found for age. In a study of factors related to children’s singing accuracy, Cooper (1992) found vocal pitch accuracy and pitch discrimination significantly related but the coefficient was not strong, \( r = .24 \) (only 5.76% variance in common). In a study with third graders \( (n = 72) \), Phillips and Aitchison (1997) also found no significant difference in pitch discrimination between accurate and inaccurate singers, but did find a significant difference in tonal aptitude between accurate and inaccurate singers. Based on these and other studies (e.g., Paladino, 1991), it seems pitch discrimination does not play a significant role in elementary children’s singing accuracy but that tonal aptitude may. Hearing the pitches does not seem to be the
issue; the relationships of those pitches and how they are processed musically – audiated – may be.

Results have been different for older children. In studies with adolescent boys (Demorest, 2001; Demorest & Clements, 2007), significant differences between the perceptual abilities of certain, inconsistent, and uncertain singers have been found. As noted by Demorest and Clements (2007), “perception and production may be more related for older singers, at least for adolescent boys going through voice change” (p. 199). These studies imply that the relationship of pitch-matching and pitch-discrimination may be stronger as students age. As Geringer (1983) concluded, “The relative lack of correlation between pitch-discrimination and vocal pitch-matching ability raises some interesting questions of relevance to music educators. It may be that the limitations of pitch-discrimination ability do not operate until the vocal pitch-matching deviations are small enough to be affected by the limit. It is possible that pitch discrimination and pitch matching are simply two independent abilities, or that maturation and training are necessary to develop an interrelationship” (p. 98).

USE OF VOCAL MECHANISM

Given the apparent evidence that children who have difficulty singing in tune do not have difficulty discriminating pitch, it may be that children who sing out of tune do so because they do not have control or full use of their vocal mechanism. For example, a novice clarinetist who only knows how to play an octave on the instrument would, of course, play a song encompassing a 10th out of tune. Research investigating children’s comfortable singing ranges indicate that children tend to focus their singing around C4, C#4, and D4 (e.g., Hedden, 2012; Moore, 1991; Plumridge, 1972; Welch, 1979a; Wilson, 1973), that singing range increases somewhat with age (Sergeant & Welch, 2008; Wassum, 1979; Welch, 1979a), and that approximately 18% of elementary children are considered “non-singers” (Davies & Roberts, 1975; Romaine, 1961), a term that has not been specifically defined but often means those who sing out of tune or in a speaking voice. However, a more recent study by Levinowitz et al. (1998) yielded different results. Students (n = 170) from five elementary schools participated in this study. Each participant was audio-recorded singing two different songs; recordings were evaluated by six independent judges using the Singing Voice Development Measure (SVDM) (Rutkowski, 1990). Seventy-five to ninety percent of the sample was categorized as “non-singers” (having a limited range of A3 to F4) and older children did not exhibit a larger singing range than the younger children.

This limited range, as well as children’s preferred singing pitches, appear to be similar to their speaking voice range, particularly since children approximately eight years and older can use their speaking register to sing higher than C4.

SPEAKING AND SINGING VOICES

A few researchers have investigated if speaking and singing voice registers are related. To investigate the “relationship among acoustical measurements of pitch-matching accuracy, speech fundamental frequency, speech frequency range, age, and gender” (Trollinger, 2003, p. 78), the speaking and singing voices of children ages 36-71 months (n = 70) were recorded and analyzed. Trollinger found the higher the child’s overall speaking voice the more accurately the child sang, particularly the pitch pattern E4-F#4-E4. Higher voiced children sang this pattern, as well as G4-A4-G4, less flat than other children, but sang C4-D4-C4 sharp with particular difficulty matching C4. She noted that vocal models children often hear, particularly in the United States, are low and children mimicking those speech patterns are likely to have difficulty singing beyond a very limited range. She also found that children who used a wider range when speaking tended to use a wider range when singing. These children sang the higher pitch pattern of A4-G4-A4 more accurately. These “findings suggest that children’s development of singing strongly depends on the physical development of the vocal mechanism and use for speech as well as for singing” (p. 91).

Rinta and Welch (2009) investigated whether children’s speaking and singing behaviors are related perceptually. They recorded the singing and speaking behaviors of 60 10-year-olds through several tasks. Three independent judges assessed the recordings with a 7-point continuous scale for 13 parameters; interjudge reliabilities were statistically significant and high (r = .89, p < .05). They found the “overall quality of the participant children’s voices was perceptually similar in the two vocal behaviors” (p. 681).

The relationship between speaking and singing for children who speak other languages has also been a topic of inquiry. In a study to explore the relationship among the speaking and singing voices of first graders from Hong Kong (n = 29), Israel (n = 38), and the United States (n = 21), Rutkowski, Chen-Hafteck, and Gluschankof (2002) found no significant differences in the mean speaking pitches of the children (around A3 to B3). However, the Israeli children used a statistically significant narrower speaking range than the other children. The correlation coefficients indicating the
relationship between the children’s speaking and singing voices were statistically significant but weak – speaking voice with singing using a neutral syllable \( r = .22 \) and with singing using text \( r = .21 \). The researchers noted that the procedures for collecting speaking voice data – having the children describe a picture since they could not read yet – yielded a variety of responses from the utterance of a few words to speaking for two minutes or more. They recommended revisions to this protocol for future research. Trollinger (2004) explored the pitch accuracy of children enrolled in a Cantonese immersion preschool in the United States with children in monolingual environments. Both speech and singing tasks were employed, as in a previous study (Trollinger, 2003). Mean speech frequency “emerged as a strong predictor of pitch-matching accuracy” (p. 229) for the pitch pattern of E4-F#4-E4 but speech range was not a strong predictor of pitch accuracy. So, it appears that speaking and singing are related in some way, but these phenomena certainly deserve continued investigation.

VOCAL REGISTRATIONS

Results of these studies indicate that children’s singing accuracy is not highly related to their pitch discrimination skills and that children favor singing in a range close to their speaking voices. “The variability in results of singing assessments of children suggests that a number of other factors may also affect pitch-matching accuracy, such as unique characteristics of the physical development of the vocal mechanism in each child” (Trollinger, 2003, p. 82). The physical development of children’s vocal mechanism has not received as much attention from the music education community.

Research has identified three distinct registers (lower, middle, upper) in the child voice (e.g., Rutkowski, 1986, 1990, 1996; Rutkowski & Miller, 2003a, 2003b, 2003c; Wurgler, 1990). The first is a lower register in the speaking voice range. For young children, this is typically A3-C4. (Boardman, 1964; Ramsey, 1983). Speaking-range singers connect pitches but stay within the lower register (Boardman, 1964; Harkey, 1978/1979; Jeyner, 1971; Plumridge, 1972; Porter, 1977; Ramsey, 1983; Thurloway, 1977; Udegraff et al., 1938; Welch, 1979b; Young, 1971). However, older children (ages 9 and up) to adults can often sing higher pitches in this register, but generally not above C5. Pushing this register to produce notes that high in the voice can be vocally damaging over time. Within this register, two types of “singers” have been identified – pre-singers and speaking-range singers. Pre-singers chant, or speak as in talking, rather than connect pitches as one does when singing. This behavior is not really “singing,” hence the term, “pre-singer.” Speaking-range singers do connect pitches but sing within a narrow range and their tone quality is often husky or heavy.

Children also exhibit a middle register. Some children use a limited range, D4 to F#4, with this register while others use what it commonly referred to as an initial range, D4 to A4 (Gordon, 1971; Jersild & Bienenstock, 1931; Joyner, 1971; Plumridge, 1972; Thurloway, 1977; Welch, 1979b; Young, 1971). An upper register exists with a lift to this register between A4 and B-flat4 (Gordon, 1971; Smith, 1963; Young, 1971). These children, who are able to use their upper register, are referred to as “singers.”

It seems logical that children often sing accurately in the registers with which they have comfort. However, children who are just beginning to use an initial range (middle register) and/or upper register often have difficulty singing in the lower part of their range, typically D4 and E4. Trollinger (2003) noted a similar phenomena. Once children become comfortable negotiating those registers, the voice seems to relax and those pitches are produced with increasing accuracy. Consequently, children may not sing accurately just because they are not yet physically comfortable with a particular register. So, children’s ability to use their full singing voice (all registers) comfortably likely impacts their singing accuracy, particularly if they are asked to sing pitches beyond the register they can produce. Goetze and Horii (1989) commented, “Subjects who did not sing accurately often reduced the range or droned within a narrow band of pitches near the middle or lower part of the pitch range of the melodic tasks” (pp. 62-63). It also seems that accuracy assessments should take children’s use of vocal registers into account.

PURPOSE AND RESEARCH QUESTIONS

The relationship of children’s use of vocal registers to their ability to sing accurately has not been empirically investigated. The purpose of this study was to investigate the nature of the relationship between children’s use of singing voice (vocal registers) and singing accuracy. In addition, although Phillips and Aitchinson (1997) found differences in tonal aptitude between accurate and inaccurate singers, the relationship between children’s use of singing voice (vocal registers) and tonal aptitude has been mixed (Hornbach & Taggart, 2005; Jaffurs, 2000; Rutkowski, 1986, 1996). Therefore, the relationship of these abilities with music aptitude was of concern given that music aptitude, not pitch discrimination, has been shown to play some role in accurate singing. The following questions framed this investigation:

1. What is the relationship between kindergarten and first grade children’s use of singing voice and singing accuracy?
2. Do kindergarten and first grade children sing patterns more accurately if the pitches of those patterns fall within their accessible registers?
3. What is the relationship between first grade children’s tonal aptitude scores and their singing accuracy or use of singing voice?

**Method**

**OVERVIEW**

This investigation employed a descriptive and correlational design. Recorded examples of children’s singing from previous studies were used. Thirty-eight first grade examples (Rutkowski & Miller, 2003a) and 37 kindergarten examples (Rutkowski, 2014) had been assessed with the Singing Voice Development Measure (SVDM) (Rutkowski, 1986, 1990), a tool that measures children’s use of singing voice, not vocal accuracy (Figure 1). Two raters, experienced with using SVDM, had rated these examples for previous studies. For this study, these recorded examples were also evaluated for accuracy by two independent raters. The first grade children’s tonal aptitude was assessed with the Intermediate Measures of Music Audiation (IMMA). Details are provided in the following sections.

**SINGING TASK**

For the singing task, children individually echoed an adult female singing a series of three-tone patterns, one pattern at a time (see Figure 1). These patterns were established upon an extensive review of the literature regarding melodic and harmonic capabilities of young children.

**Singing Voice Development Measure:**

A Tool to Measure Children’s Use of Singing Voice (not vocal accuracy)

1  "Pre-singer" does not sing but chants the song text.
1.5 "Inconsistent Speaking Range Singer" sometimes chants, sometimes sustains tones and exhibits some sensitivity to pitch but remains in the speaking voice range, lower register (usually A3 to C4).
2  "Speaking Range Singer" sustains tones and exhibits some sensitivity to pitch but remains in the speaking voice range, lower register (usually A3 to C4).
2.5 "Inconsistent Limited Range Singer" wavers between lower and middle registers and uses a limited range when in middle register (usually up to F4).
3  "Limited Range Singer" exhibits consistent use of limited range (usually D4 to F4).
3.5 "Inconsistent Initial Range Singer" sometimes only exhibits use of limited range, but other times exhibits use of initial range (usually D4 to A4).
4  "Initial Range Singer" exhibits consistent use of initial range (usually D4 to A4).
4.5 "Inconsistent Singer" sometimes only exhibits use of initial range, but other times exhibits use of extended singing range, upper register (sings beyond the lift to upper register: B4-flat and above).
5  "Singer" exhibits use of consistent extended range, upper register (sings beyond the lift to upper register: B4-flat and above).

![Figure 1. Singing voice development measure, © Joanne Rutkowski, 1996.](image-url)
Use of Singing Voice and Singing Accuracy

MEASUREMENT TOOLS

Use of singing voice measure. The Singing Voice Development Measure (SVDM) (Figure 1) was used to rate the children’s use of singing voice (vocal registrations). This tool, developed by Rutkowski (1986, 1990, 1996), assesses the physical use of voice a child exhibits when singing rather than singing accuracy. It was developed with the premise that use of singing voice is a construct different from singing accuracy but that the two constructs may not be independent. Both intra-rater and inter-rater reliabilities have been statistically significant and high, typically ranging from $r = .85$ to 1.00 (e.g., Dansereau, 2005; Runfola, Etopio, Hamlen, & Rozendal, 2012; Rutkowski, 1996, 2014; Rutkowski & Chen-Hafteck, 2001; Rutkowski & Miller, 2003a, 2003b, 2003c; Steenwyk, 2004; Vande Wege, 2005). In addition, validity has been established through evidence to support the existence of the singing behaviors and by many different raters’ use of all scoring levels (see Rutkowski, 1990, for further discussion of the measure). SVDM has been used by other researchers in numerous studies including the nation-wide Sing-Up project in the UK (Welch et al., 2011). Steenwyk (2004) noted in her study that “singing voice development will be established by using Rutkowski’s SVDM, a measure already shown to be valid by multiple researchers” (p. 36). Therefore, SVDM, the only measure that exists to measure use of singing voice, was appropriate for use in this study.

Two raters, familiar with SVDM, rated the first graders’ (Rutkowski & Miller, 2003a) and kindergartners’ (Rutkowski, 2014) use of singing voice with SVDM. Although a child’s singing accuracy could potentially influence ratings, these raters have been trained to use the measure and in all directions to them it has been made clear that accuracy is not a concern. Raters completed their assessments independently.

Accuracy measure. The same singing recordings were also rated for accuracy by two different judges. Accuracy was determined by recording the number of pitches each child sang accurately within each pattern. The highest score possible was 24 (8 patterns, 3 pitches each). These two raters, experienced with rating children’s singing accuracy in this manner, were sent CDs with the recorded examples. In addition to providing a total score for each child, the raters indicated the accuracy score for each of the eight patterns for each child.

Tonal aptitude. Tonal music aptitude scores, as measured by the Intermediate Measures of Music Audiation (IMMA) (Gordon, 1986), were collected as data for the

<table>
<thead>
<tr>
<th>GRADE</th>
<th>SVDM</th>
<th>Accuracy</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Text Neutral Syllable</td>
<td>Text Neutral Syllable</td>
</tr>
<tr>
<td>K ($n = 37$)</td>
<td>3.60 (1.22) 4.15 (1.01)</td>
<td>10.95 (7.10) 14.32 (6.31)</td>
</tr>
<tr>
<td>1 ($n = 38$)</td>
<td>3.76 (1.15) 3.59 (1.00)</td>
<td>11.12 (6.48) 10.84 (6.25)</td>
</tr>
</tbody>
</table>

*Highest SVDM score would be 5; highest Accuracy score would be 24 points
first grade children in the Rutkowski and Miller (2003a) study. IMMA is a standardized test of developmental music aptitude appropriate for first grade children and widely used in music education research. The children hear “two parts of a song,” one tonal pattern followed by another. They are to indicate if the two parts of the song sound the same or different by circling the two smiling faces (same) or one smiling and one frowning face (different) on the test sheets provided. Of course, some pitch discrimination is involved in this task, but the children must also audiate the first pattern in order to compare it to the second. A full discussion of the nature of the test and its validity is provided in the test manual. Forty total items comprise the test. IMMA and the Primary Measures of Music Audiation (PMMA) are identical in format; the patterns used for IMMA are more difficult to discriminate. PMMA is standardized for children in kindergarten to third grade; IMMA for first to fourth graders. IMMA was used in this study because it is a more discriminating test for first grade children.

### Results

Inter-judge reliabilities for SVDM ($r = .85$ to $.95$) and the Accuracy Measure (AM) ($r = .91$ to $.97$) were statistically significant ($p < .001$) and high, indicating that raters used each measure in a consistent manner. Means and standard deviations were also calculated for each measure on each task (see Table 1). Prior to running any correlational analyses, a 2 x 2 mixed ANOVA was used to determine if there was a difference in scores by response mode (neutral syllable/text) or grade level (K/1) for both dependent variables (use of singing voice and accuracy). Significant main effects were found for response mode for both dependent variables: use of singing voice, $F(1, 73) = 7.93, p < .01, h^2_p = 0.10$, and accuracy, $F(1, 73) = 5.29, p < .05, h^2_p = 0.07$. There were no significant main effects for grade level for either dependent variable and no significant interactions. Based on these results, subsequent analyses for SVDM and AM were collapsed across grades but neutral syllable and text response modes were treated separately.

#### WHAT IS THE RELATIONSHIP BETWEEN KINDERGARTEN AND FIRST GRADE CHILDREN'S USE OF SINGING VOICE AND SINGING ACCURACY?

Pearson product-moment correlations were run on all 75 children’s singing accuracy (AM) and SVDM scores. There was a strong and significant correlation between SVDM and AM for both neutral syllable, $r(75) = .83$, and text, $r(75) = .82$. To further explore this relationship the children were divided into groups based on their SVDM score for each response condition and then assessed on accuracy only for the patterns associated with their register. Group 1 was classified as singers (SVDM $> 4.5$, $n = 39$) and could sing all eight patterns, Group 2, the initial range and inconsistent singers (SVDM $> 3.5$-$4.5$, $n = 46$), had six of the eight patterns in their register and Group 3, limited range and inconsistent initial range singers (SVDM $> 2.5$-$3.5$, $n = 31$), only had two patterns in their usable range. Accuracy scores were then calculated as a percentage of possible score by register (Table 2). These data were used to answer Question 2.

#### DO KINDERGARTEN AND FIRST GRADE CHILDREN SING PATTERNS MORE ACCURATELY IF THOSE PATTERNS FALL WITHIN THEIR ACCESSIBLE REGISTERS?

In order to investigate if significant differences existed among SVDM groups for accuracy, two MANOVAs were computed. The first MANOVA looked at accuracy in the neutral syllable condition for both percent

<table>
<thead>
<tr>
<th>SVDM Classification</th>
<th>% Accuracy by Register</th>
<th>SD</th>
<th>% Accuracy Total</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limited Range Singer ($n = 11$)</td>
<td>68%</td>
<td>0.24</td>
<td>41%</td>
<td>0.13</td>
</tr>
<tr>
<td>Initial Range Singer ($n = 16$)</td>
<td>58%</td>
<td>0.24</td>
<td>58%</td>
<td>0.21</td>
</tr>
<tr>
<td>Singer ($n = 28$)</td>
<td>76%</td>
<td>0.15</td>
<td>76%</td>
<td>0.15</td>
</tr>
<tr>
<td>Total ($n = 55$)</td>
<td>69%</td>
<td>0.21</td>
<td>64%</td>
<td>0.21</td>
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</table>

<table>
<thead>
<tr>
<th>SVDM Classification</th>
<th>% Accuracy by Register</th>
<th>SD</th>
<th>% Accuracy Total</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limited Range Singer ($n = 14$)</td>
<td>67%</td>
<td>0.23</td>
<td>46%</td>
<td>0.17</td>
</tr>
<tr>
<td>Initial Range Singer ($n = 23$)</td>
<td>68%</td>
<td>0.22</td>
<td>64%</td>
<td>0.19</td>
</tr>
<tr>
<td>Singer ($n = 20$)</td>
<td>81%</td>
<td>0.14</td>
<td>81%</td>
<td>0.14</td>
</tr>
<tr>
<td>Total ($n = 57$)</td>
<td>72%</td>
<td>0.20</td>
<td>65%</td>
<td>0.21</td>
</tr>
</tbody>
</table>
accuracy on the entire measure (8 patterns, 24 pitches) and percent accuracy by available register for the three SVDM groups (limited range singer - two patterns in register; initial range singer - six patterns in register; and singer - all eight patterns in register). There was a significant main effect for group membership for both the total accuracy, $F(2, 52) = 18.25, p < .001, \eta^2_p = .41$, and accuracy by register, $F(2, 52) = 3.75, p < .05, \eta^2_p = .13$. Scheffé post hoc comparisons revealed significant differences between all three SVDM groups for total accuracy but only between the Singer and Limited Range Singer groups for accuracy by register.

The second MANOVA did the same analysis for data in the text condition and found a significant main effect for group membership for total accuracy, $F(2, 54) = 16.56, p < .001, \eta^2_p = .38$, but no group main effect for accuracy by register. Scheffé post hoc comparisons revealed significant differences between all three SVDM groups for total accuracy. Both analyses suggest that children are more accurate when they are assessed with accessible patterns based on their SVDM classification (Figure 2).

**FIGURE 2.** Percent accuracy of SVDM groups for all of the patterns versus the accessible patterns.

**WHAT IS THE RELATIONSHIP BETWEEN FIRST GRADE CHILDREN’S TONAL APTITUDE SCORES AND THEIR SINGING ACCURACY OR USE OF SINGING VOICE?**

Correlation coefficients were also calculated to determine the nature of the relationship between first graders’ IMMA scores and Accuracy Measure scores [$r(38) = .19$ neutral syllable; $r = .03$ text] and IMMA scores and SVDM scores [$r(38) = -.04$ neutral syllable; $r = -.22$ text]. No correlation was statistically significant indicating a lack of relationship for both use of singing voice and singing accuracy with tonal aptitude as measured by IMMA with this sample.

**Discussion, Recommendations, and Conclusion**

**DISCUSSION**

As expected, there was a significant positive relationship between use of singing voice and singing accuracy for kindergarten and first grade children. Those children with use of more vocal registrations – a higher SVDM score – tended to sing more accurately while those at the bottom of the SVDM classification were unable to access pitches at all. Further analysis suggests that the significant relationship between use of singing voice and accuracy is mainly due to developing singers’ limited access to their full voice, all three registers. When register limitations are taken into account, the differences between groups are much smaller (neutral syllable) or disappear entirely (text). Perhaps for children who are still learning to use their singing voices (registers) other factors contribute to singing accuracy in more meaningful ways. Or, more likely based on the results of this study, they just are not able to control their voices enough during this developmental period to exhibit as much accuracy.
Given the lack of relationship that either use of singing voice or singing accuracy had with tonal aptitude, it appears that tonal aptitude is not at play. This finding for SVDM scores is not that surprising since researchers have found a weak relationship between SVDM scores and IMMA scores (Hornbach & Taggart, 2005; Jaffurs, 2000; Rutkowski, 1986, 1996). However, Phillips and Aitchison (1997) found a relationship between singing accuracy and tonal aptitude so a relationship between AM scores and IMMA was expected.

Based on this sample, children do sing a higher percentage of pitches accurately when the pitches they are asked to sing fall within the vocal register(s) that they can access and are comfortable using (see Figure 2). Even so, these children did not sing with 100% accuracy within their comfortable register(s). One explanation may be difficulty managing a new register: I have observed children having difficulty managing their voice when initially learning to use another register and the post hoc analysis supports this conclusion. And, when some children begin to use an initial range or access their upper register, they have difficulty singing in the lower part of middle register. These phenomena, also observed by Trollinger (2003) would, perhaps, explain why 100% accuracy did not result even when the children’s singing accuracy was assessed only on patterns in their comfortable registers. Further analysis of which pitches in each pattern, rather than just the number of pitches, are accurate for various types of singers on SVDM is recommended in future research. In conclusion, it is advisable to measure children’s use of singing voice and vocal accuracy as separate, yet somewhat related, behaviors as some studies have done (Welch et al., 2011). The SSAP in tandem with SVDM could yield important profiles of children’s singing behaviors. When considering instructional applications related to singing accuracy, these results suggest that teachers would benefit from focusing on strategies to develop use of singing voice in addition to singing accuracy. Children, especially initial range singers, sang a higher percentage of pitches accurately when those pitches fall within their comfortable register(s). Therefore, helping all children learn to access all three of their vocal registers would lead to eventual better success at singing and singing more accurately. For children who cannot yet sing in all registers, a focus on how well they sing in tune may not help them learn to sing with more success in the long run.

Author Note

The author is grateful to Steven Demorest for his assistance with data analysis as well as the graduate students and music teachers in Washington State and Pennsylvania for their participation as raters.

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