The Development of a Hierarchy of Basic Rhythmic Bowing Skills for String Sight-Reading

Michael Alexander
Baylor University

Background

Many consider the ability to sight-read to be an indispensable skill that must be included in the preparation of musicians (Lehmann & McArthur, 2002). Skilled sight-readers typically perceive patterns of rhythms and pitches instead of individual notes (Gromko, 2004) and usually perceive more of this information, and at a faster rate, than less successful sight-readers (Smith, 1989). Poor sight-readers tend to focus on single notes and rests, not patterns (Goolsby, 1994). While overall success in sight-reading may imply mastery of many individual component skills, it may also involve an interaction between them (Henry, 2011). In string sight-reading, the performance of pitch and rhythm patterns may be further complicated by the bowing patterns (separate, slurred, linked/hooked) required for their performance (Alexander & Henry, 2015).

Previous researchers have recommended teaching or assessing sight-reading through the use of tonal or rhythmic patterns (Delzell, Rohwer, & Ballard, 1999; Fine, Berry, & Rosner, 2006; Gordon, 1997; Gromko, 2004; Grutzmacher, 1987; Henry, 2001; MacKnight, 1975). Edwin Gordon's research into audiation promoted teaching melodic sight-reading supported by functional harmony (Gordon, 1997). Imbedding patterns into a melodic context has been shown to be useful as an authentic assessment of successful sight-reading (Alexander & Henry, 2012, 2014, 2015; Boyle & Lucas, 1990; Henry, 2001, 2003, 2009, 2011; Killian, 1991).

Alexander and Henry (2012) developed a sight-reading pitch skill hierarchy for string players through a replication of Henry's (2001) study of vocalists. High school string students obtained a mean success rate of 27.28 out of 31 (88%) on a modified version of the VSRI (Vocal Sight-Reading Inventory), in which melodic material appeared in the keys of D, Eb, and E. Success rates ranging from .99 to .72 were established for 31 pitch skills, grouped into eight tonal

categories. Significant differences were found between the 11 skills that appeared both in the key of D and E major. A .95 correlation between note-by-note and skill-based scoring systems estimated skill-based scoring to be a valid measurement of string player's sight-reading of tonal pitch skills within a melodic context.

In a replication of Henry's (2009) study, Alexander and Henry (2014) sought to identify a rhythm skill hierarchy for string sight-reading by incorporating Henry's previously-identified 26 rhythm skills and embedding them into four 8-measure melodies. The melodies appeared in three different keys (D, E, and Eb Major) with occasional designated bowings. Several skills were presented in versions starting both down bow and up bow. High school string players obtained a mean score of 19. 10 out of 26 (or 73%), with success rates ranging from .94 to .20 for individual skills. Significant differences were found between skills appearing in D and Eb but no significant differences were found between selected skills started both down bow and up bow.

With hierarchies of pitch skills and rhythm skills established for string sight-reading, Alexander and Henry (2015) sought to determine the interaction of those two factors on string sight-reading performance. Nine pitch skills and nine rhythm skills, determined as representative of easy, medium, or hard (Alexander & Henry, 2012, 2014) were embedded into three 8-measure melodies. High school string students achieved a mean success rate of 14.01 out of 18 (78%) for the nine pitch tasks combined with the nine rhythm tasks. The mean score for pitch alone was 7.86 out of a possible score of nine. The mean score for rhythm was 6.14 out of a possible score of 9. These results mirrored the overall results for the 792 questions (9 each for 88 participants), indicating that participants had substantially greater achievement for pitch tasks than rhythm tasks, regardless of the difficulty levels of either. In their recommendations for future research, Alexander and Henry (2014, 2015) directed researchers to further examine the effects of bowing skills on sight-reading accuracy.

While much has been written in the pedagogical literature regarding the teaching of bowing styles (separate, slurred, linked / hooked, legato, staccato, loure', spiccato, etc.), with recommendations for specific bowings and principles to be taught at various levels of instruction

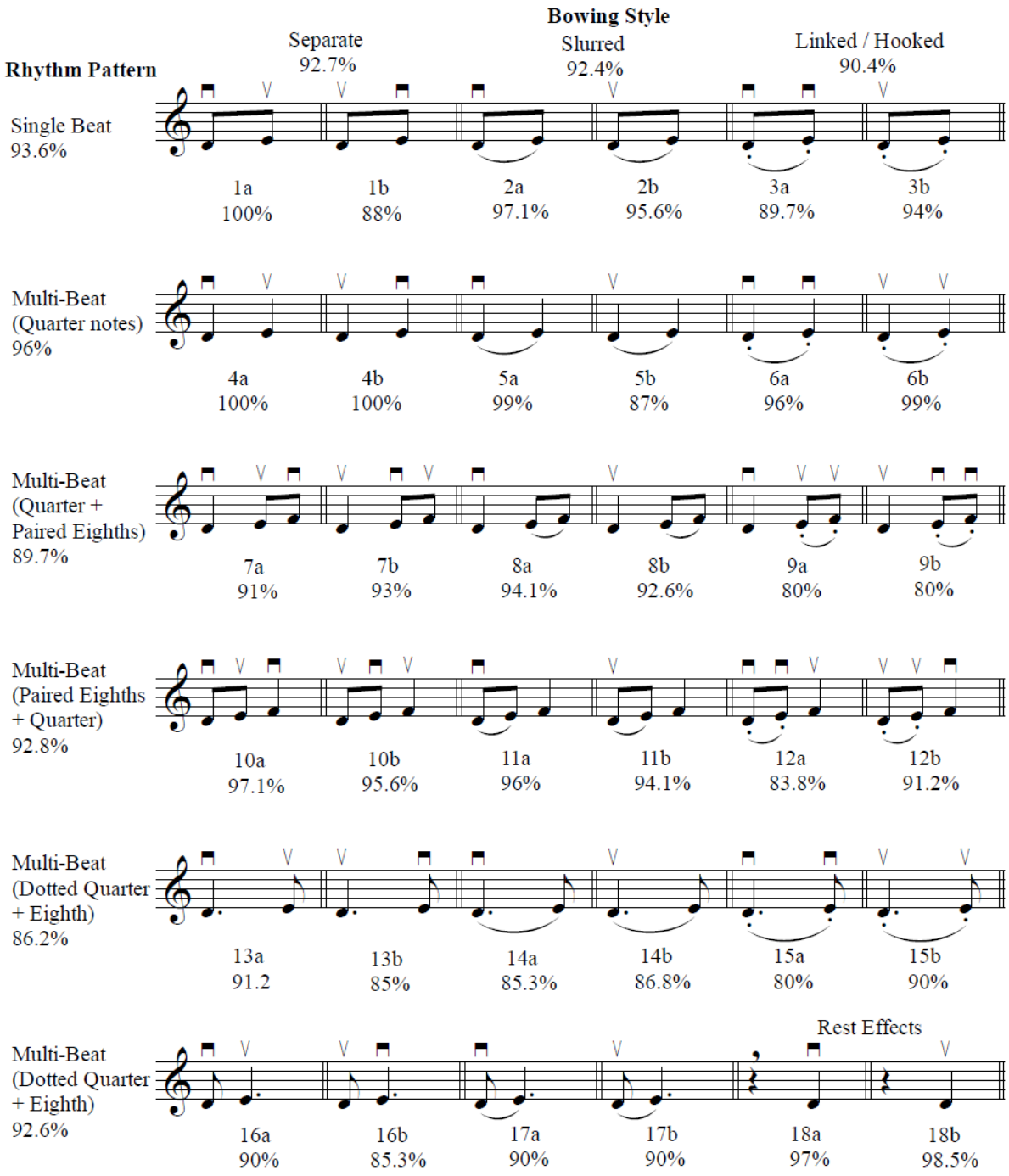
(Green, 1990, 1999; Hamann & Gillespie, 2009; Witt, Angeles, Kempter, & Kjelland, 1991), these recommendations appear to be based on either personal preference, tradition, or common practice, not empirical research. According to Cooper and Hamann (2010), pedagogues are in disagreement as to the sequential order in which to present bowing styles. They cited the examples of Paul Rolland (1974), who considered detaché as the fundamental bow stroke, versus Ivan Galamian (1985), who endorsed martelé. The introduction or sequence of teaching specific rhythm patterns has also been a point of debate. While many modern string method books begin with quarter note patterns, noted pedagogue Shinichi Suzuki begins his study of *Twinkle Variations* with a pattern consisting of four eighth-notes plus two quarter-notes (Starr, 2000).

While previous research on string sight-reading has identified difficulty levels for pitch and rhythm skills both individually and in combination (Alexander & Henry, 2012, 2014, 2015), a search of the research literature did not produce any additional studies that addressed the relative difficulty levels of basic bowing skills (separate, slurred, linked, and hooked) performed in various rudimentary rhythm patterns. For the purpose of this article, the combination of these two elements will be referred to as *rhythmic bowing skills*. Research questions included:

1. How do basic rhythmic bowing skills affect sight-reading accuracy?
2. What is the success rate of each rhythmic bowing skill performed during sight-reading?
3. Does instrument type, grade level, gender, or private lesson participation affect rhythmic bowing skill accuracy?

Method

Eighteen rhythmic bowing skills were selected from extant first- and second-year string method books that used separate, slurred, linked, and hooked bowings to perform rhythm patterns containing eighth notes, quarter notes, and dotted-quarter notes. The bowing skills were divided into categories by rhythm pattern and bowing style (see Figure 1).



[a]Success rates for each skill, pattern or style are shown as percentages.

Figure 1. Success rates for 36 rhythmic bowing skills (bowing style by rhythm pattern)[a]

The skills were then distributed across four step-wise, eight-measure melodies in which each skill occurred in versions starting both down bow and up bow. Effort was made to make each melody of similar difficulty by dispersing the different categories of skills as evenly as possible

among the melodies (See Figure 2).

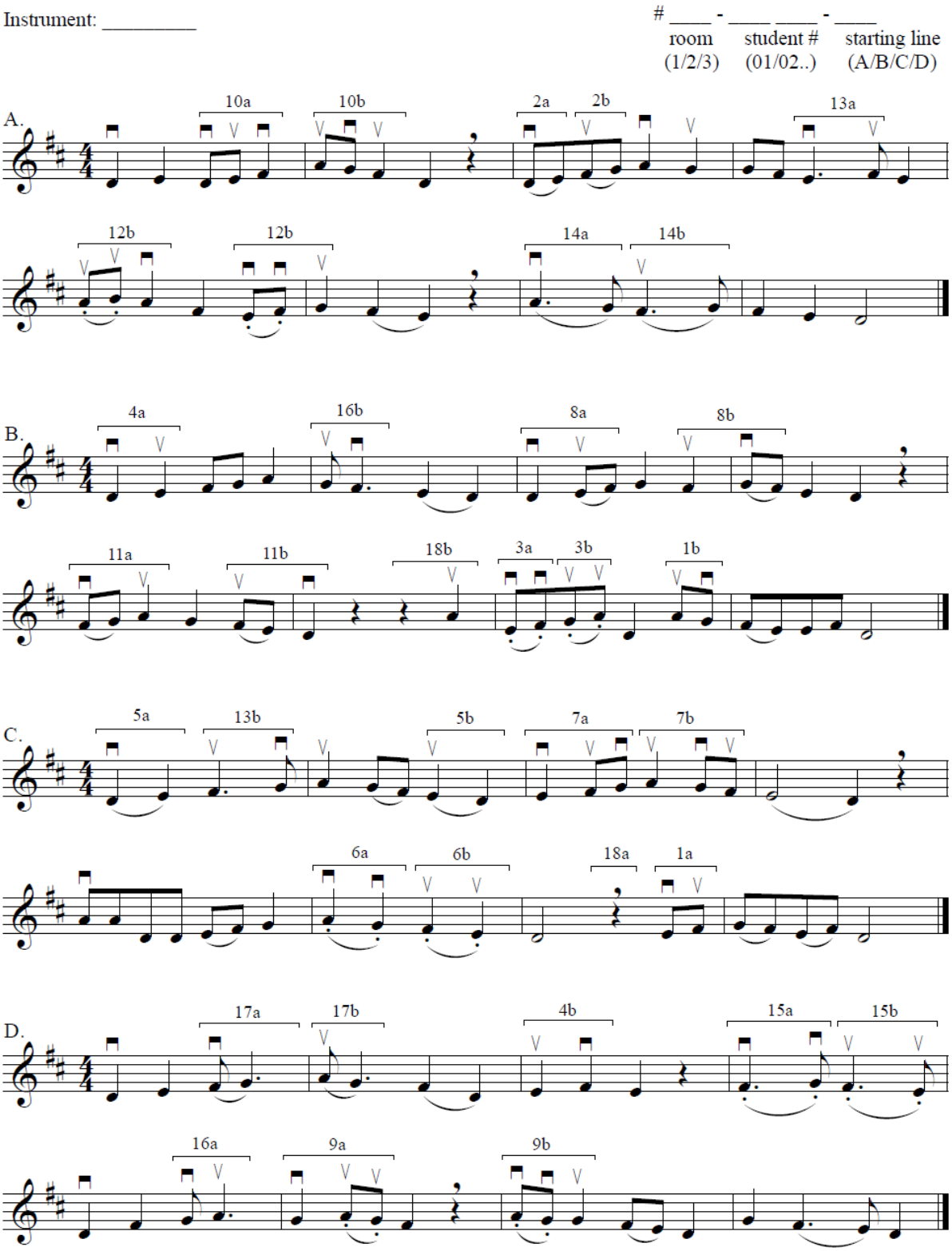


Figure 2. Sight-reading score sheet for rhythmic bowing skills.

High school string players (N = 68) from a high school summer camp held at a university in Texas, participated in the study. Each participant was randomly assigned to one of two testing rooms where they performed all four melodies, thereby attempting all 18 rhythmic bowing patterns, in both down bow and up bow versions, during the sight-reading assessment. The order of the melodies was rotated with each new participant within each room to offset any effect of the sequence of presentation. Prior to entering the testing room, participants completed a survey requesting demographic information that included: grade level, instrument, gender, years playing their instrument, years of private study on their instrument, and years of piano study.

Testing procedures were modeled after those used in previous studies (Alexander & Henry, 2012, 2014, 2015), which were originally adopted from the Texas All-State vocal audition process. After instructions were read, each participant was given 30 seconds to study and practice each melody silently in the manner of their choice. At the conclusion of each study period, the participant then performed each melody.

Scoring occurred in real time by the test administrators, using scoring procedures outlined in the VSRI (Henry, 2001). One point was awarded for correct performance of each of the target skills. Approximately 35% of the trials were scored by both scorers, resulting in .95 reliability between scorers, using the agreements / agreements + disagreements formula (Madsen & Madsen, 1998).

Results

A total of 68 high school string players participated in the study from the following grade levels: 9th (n = 5), 10th (n = 24), 11th (n = 20), and 12th (n = 19). Participation by instrument type was: violin (n = 31), viola (n = 20), cello (n = 8), bass (n = 9). Females (n = 39) and males (n = 29) comprised the total number of participants by gender. Participants were also identified as having piano experience (n = 39) or not (n = 29) and by years of private lesson experience on their instrument. Each participant performed four melodies, achieving a mean score of 33.07 out of 36 (92%) on 18 rhythmic bowing skills starting in both up bow and down bow versions (a = down, b = up). The

mean scores for the five categories of rhythm patterns, the three categories of bowing styles, and each of the individual rhythmic bowing skills, can be found in Figure 1.

Success levels were established for each of the individual rhythmic bowing skills that provided a rank order of skill difficulty (See Table 1). An arbitrary division of the rank order into three categories of success (80-89%, 90-94%, and 95-100%) did not reveal any consistent qualities (by rhythm or bowing) between the individual skills in each category.

Table 1. Success Rates for 36 Rhythmic Bowings Skills in Rank Order.

1a	100%	8a	94.10%	3a	89.70%
4a	100%	11b	94.10%	5b	87.00%
4b	100%	3b	94.00%	1b	88.00%
5a	99.00%	7b	93.00%	14b	86.80%
6b	99.00%	8b	92.60%	14a	85.30%
2a	97.10%	12b	91.20%	16b	85.30%
10a	97.10%	13a	91.20%	13b	85.00%
18a	97.00%	7a	91.00%	12a	83.80%
6a	96.00%	15b	90.00%	9a	80.00%
11a	96.00%	16a	90.00%	9b	80.00%
2b	95.60%	17a	90.00%	15a	80.00%
10b	95.60%	17b	90.00%		
18b	95.00%				

Analysis of Variance (ANOVA) was used to test for any effects of selected demographic variables on sight-reading success. Alpha was set at .05 for all tests. No significant effects were found on the variables of instrument type, grade level, gender, or piano experience on overall sight-reading success. To determine any differences in sight-reading accuracy for those with and without private lessons on their instrument, participants were identified as belonging to one of three categories as established by Alexander & Henry (2015): private lessons for 0-3 years (n = 25), 4-6 years (n = 29), or seven years or more (n = 14). There was a significant effect of private lessons on the sight-reading task for the three conditions [F (2, 65) = 4.12, p = 0.021]. Post hoc comparisons were made using the Tukey HSD test. The mean score for 0-3 years of private lessons (M = 31.00, SD = 7.04)

was significantly different than 4-6 years of private lessons (M = 34.55, SD = 2.02) but not so for seven or more years (M = 33.71, SD = 2.58).

Discussion

Reading music at sight involves the simultaneous execution of numerous skills. While the successful performance of a rhythmic bowing skill may indicate complete mastery of the holistic skill, partial success may still reflect mastery of some sub-tasks (rhythmic pattern or bowing style). Based on the preliminary findings regarding bow direction by Alexander and Henry (2014), and their recommendations for further research (2014, 2015), the current study sought to create a hierarchy of rhythmic bowing skills and study possible effects of those skills on sight-reading accuracy. The results of this study indicated that high school string players, motivated to attend a summer orchestra camp, achieved a high overall success rate (92%) while performing selected basic rhythmic bowing skills. This may indicate that the skills assessed have already been mastered by many string players at the high school level. Future research should utilize less-experienced participants to discover at what age these concepts are learned.

A hierarchy of difficulty for basic rhythmic bowing skills resulted from this study (See Table 1). Such a hierarchy may inform those developing new pedagogical material or in the creation of new sight-reading assessments. Replication of this study with additional or less-experienced participants may provide for greater delineation between the various rhythmic bowing skills.

The individual rhythmic bowing skills were grouped into the categories of rhythm patterns, bowing styles, and starting bow direction (See Figure 1). By examining the effects of rhythm patterns on total score, separate quarter-note patterns appear to be easier to perform than dotted-quarter-note + eighth-note patterns. Replication of this study with additional or less-experienced participants may further clarify effects by rhythm patterns and allow for a greater dispersion of scores across the other variables.

When examining the accuracy of those participants with and without piano experience or private instruction, the results of this study are in contrast to those of previous investigations

(Alexander & Henry 2012, 2014, 2015; Demorest, 1998; Demorest & May, 1995; Henry & Demorest, 1994; Killian & Henry, 2005; Tucker, 1969). The current study found that those participants with piano experience did not score significantly higher than those without piano experience. This finding (as well as the overall high rate of success) may be the result of assessing skills already mastered by many high school string players in the sample. In regard to the effect of private lessons on overall score, it is understandable that those participants with 0-3 years of private lessons scored significantly worse than those with 4-6 years of lessons but unexplainable why they did not also score significantly worse than their counterparts with seven or more years of lessons. The small cell size (n = 14) of those with seven or more years' experience may explain this anomaly. The effects of private lesson instruction and piano experience may be further explained or clarified through replication of this study with a larger or less-experienced sample.

The establishment of a hierarchy of rhythmic bowing skills allows researchers and instructors a tool to better identify and specify the overall difficulty of any given sight-reading example. Knowing that the skills assessed in the current study were performed at a high level by high school string players should confirm that these are basic skills that should be introduced at younger levels. This information should prove helpful in the future for authors, researchers and teachers developing sequential sight-reading materials and to those attempting to stipulate difficulty levels for research studies, auditions, and daily sequential instruction, as well as those desiring to increase their students' overall sight-reading skill. Future research should explore the effects of expressive markings on string sight-reading performance.

Keywords

sight-reading, string players, rhythmic skills, string bowing

Address for correspondence

Dr. Michael Alexander, One Bear Place #97408, Baylor University, Waco TX 76798; *Email:* Michael_L_Alexander@baylor.edu

References

Alexander, M., & Henry, M. (2012). The development of a string sight-reading pitch skill hierarchy. *Journal of Research in Music Education. 60*(1)*, 201-216*. doi: 10.1177/0022429412446375

Alexander, M., & Henry, M. (2014). The development of a detache' rhythm hierarchy for string sight-reading. *Journal of String Research. 5,* 73-86. Retrieved from http://www.astaweb.com//App_Themes/Public/Uploads/SRJs/SRJ_Vol_V.pdf

Alexander, M., & Henry, M. (February, 2015). The effects of pitch and rhythm difficulty on string sight-reading performance. Research Poster presented at the Texas Music Educators Association, San Antonio, TX.

Boyle, J., & Lucas, K. (1990). The effect of context on sightsinging. *Bulletin of the Council for Research in Music Education, 106,* 1-9. Retrieved from http://www.jstor.org/stable/40318858

Cooper, S.C., & Hamann, D. L. (2010). Perceived articulation uniformity between trumpet and violin performances. *Contributions to Music Education, 37*(2), 29-44. URL: http://www.jstor.org/stable/24127225

Delzell, J. K., Rohwer, D. A., Ballard, D. E. (1999). Effects of melodic pattern difficulty and performance experience on ability to play by ear. *Journal of Research in Music Education, 47* (1), 53-63. doi: 10.2307/3345828

Demorest, S. (1998). Improving sight-singing performance in the choral ensemble: The effect of individual testing. *Journal of Research in Music Education, 46,* 182-192. doi: 10.2307/3345622

Demorest, S., & May, W. (1995). Sight-singing instruction in the choral ensemble: Factors related to individual performance. *Journal of Research in Music Education, 43,* 156-167. doi: 10.2307/3345676

Fine, P., Berry, A., & Rosner, B. (2006). The effect of pattern recognition and tonal predictability on sight-singing ability. *Psychology of Music, 34* (4), 431-447. doi: 10.1177/0305735606067152

Galamian, I. (1985). Principles of violin playing and teaching (2nd ed.). Englewood Cliffs, NJ: Prentice-Hall, Inc.

Goolsby, T. W. (1994). Profiles of processing: Eye movements during sight-reading. *Music Perception: An Interdisciplinary Journal, 12*(1), 97-123. doi: 10.2307/40285757

Gordon, Edwin (1997). *Learning sequences in music.* Chicago: GIA Publications.

Green, E. (1990). Orchestral bowings and routines. Fairfax, VA: American String Teachers Association.

Green, E. (1999). Teaching stringed instruments in classes. Fairfax, VA: American String Teachers Association.

Gromko, J. E. (2004). Predictors of music sight-reading ability in high school wind players. *Journal of Research in Music Education, 52*(1), 6-15. doi: 10.2307/3345521

Grutzmacher, P. A. (1987). The effect of tonal pattern training on the aural perception, reading recognition, and melodic sight-reading achievement of first-year instrumental music students. *Journal of Research in Music Education, 35* (3), 171-181. doi: 10.2307/3344959

Hamann, D. L., & Gillespie, R. (2009). Strategies for teaching strings. New York: Oxford University Press.

Henry, M. (2001). The development of an individual vocal sight-reading inventory. *Bulletin of the Council for Research in Music Education*, (150), 21-35. doi: 10.1177/0022429410397199

Henry, M. (2003). A comparison of testing formats for vocal sight reading. *Texas Music Education Research*, 1-9. Retrieved from http://www.tmea.org/assets/pdf/research/TexasMusicEducationResearch_2003.pdf

Henry, M. (February, 2009). The development of a rhythm hierarchy for vocal sight-reading. Research Poster presented at the Texas Music Educators Association, San Antonio, TX.

Henry, M. (2011). The effect of pitch and rhythm difficulty on vocal sight-reading performance. *Journal of Research in Music Education, 59* (1), 72-84. doi: 10.1177/0022429410397199

Henry, M., & Demorest, S. (1994). Individual sight-singing achievement in successful choral ensembles. *Update: Applications of Research in Music Education, 13,* 4-8.

Killian, J. (1991). The relationship between sightsinging accuracy and error detection in junior high singers. *Journal of Research in Music Education, 39,* 216-224. doi: 10.2307/3344721

Killian J. N., & Henry M. L. (2005). A comparison of successful and unsuccessful strategies in individual sight-singing preparation and performance. *Journal of Research in Music Education, 53,* 51-65. doi: 10.1177/002242940505300105

Lamb, N., & Cook, Susan J. (1971). Guide to teaching strings. New York: McGraw-Hill

Lehmann, A., & McArthur, V. (2002). Sight-reading. In R. Parncutt & G. McPherson (Eds.), *The Science & Psychology of Music Performance: Creative Strategies for Teaching and Learning* (135-165). New York: Oxford University Press.

MacKnight, C. (1975). Music reading ability of beginning wind instrumentalists after melodic instruction. *Journal of Research in Music Education, 23(*1), 23-34. doi: 10.2307/3345200

Madsen, C.K.. & Madsen, C.H. (1998). *Teaching/Discipline: A positive approach for educational development.* (Fourth edition). Raleigh, NC: Contemporary Publishing Company of Raleigh, Inc.

Rolland, P. (1974). The teaching of action in string playing: Developmental and remedial technique [for] violin and viola. Urbana: Illinois String Research Associates.

Smith, D. J. (1989). An investigation of the effects of varying temporal settings on eye movements while sight-reading trumpet music and while reading language aloud (Doctoral dissertation, Pennsylvania State University, 1988). *Dissertation Abstracts International, 50,* 383.

Star, W. (2000). The Suzuki Violinist. Miami, FL: Summy-Birchard.

Tucker, D. (1969). Factors related to musical reading ability of senior high school students participating in choral groups. (Doctoral dissertation, University of California, Berkeley), *Dissertation Abstracts International, 31,* 2427A.

Witt, A., Angeles, D., Kempter, D., & Kjelland, J. (1991). Teaching stringed instruments: A course of study. Reston, Virginia: Music Educators National Conference.