The Effects of Model Timbre and Register Differences on Middle School Brass and Woodwind Performance

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ABSTRACT

The purpose of the study was to determine the effects that timbre and register characteristics of instrumental models have on the music performance achievement of middle school instrumentalists. A counterbalanced design was used in which participants (N = 32) were randomly assigned to three conditions creating 96 independent treatment sessions. Students in each of the four treatment conditions listened to a model performance of a piece being learned while a control group did not. Model recordings heard by treatment group participants were an amalgamation of two timbre conditions (same, different) and two register conditions (same, different). Multivariate analyses of variance revealed that there were no differences between control and treatment groups. Furthermore, no differences existed between the four treatment conditions. It appears that the register and timbre of the instrument used for the model may be of little relevance to the learning of a new piece of music.

INTRODUCTION

Social learning theorists believe that much learning takes place through observation of the modeled behaviors of other individuals (Bandura, 1997; Ormrod, 1999; Schunk, 2004). Through observing models, students gain knowledge they may not demonstrate at the onset of learning (Rosenthal & Zimmerman, 1978). When learning motor skills, a student often forms a conceptual representation by transforming observed behaviors into visual and symbolic codes that are then cognitively rehearsed. Individuals usually have a mental model of a skill before they attempt to perform it. In the case of complex behaviors, as when a young instrumentalist is learning a new piece of music, students may have no such mental model and need to observe demonstrations prior to attempting the behaviors (Schunk, 2004).

The effectiveness of performance models in learning new pieces of music has been well documented in the literature (Anderson, 1981; Dickey, 1991, 1992; Hewitt, 2001, 2002; Linklater, 1997; Rosenthal, 1984; Rosenthal, Wilson, Evans & Greenwalt, 1988;

Zurcher, 1975). Madsen, Greer, and Madsen (1975) define modeling as the presentation, either live or recorded, of anything that may later be imitated by an observer. Tait (1992) presents three major areas of modeling that transpire in music teaching. The first, musical modeling, happens when the teacher provides a *total image* of the desired behavior either vocally or instrumentally. Aural modeling is the use of phonetic vocalization in order to convey particular meanings or points of emphasis in the music. This vocalization can be demonstrated through humming, using syllables, or other vocal means. Physical modeling includes facial expressions, physical gestures, and more formal conducting. Often, physical and aural modeling occur simultaneously. Tait also states that although these three types of modeling exist, they are all generally referred to as "modeling".

Limited studies in instrumental music education have specifically addressed the issue of model characteristics on music performance, though a variety of model types have been used as stimuli. Linklater (1997) found that clarinet players who observed videotapes of clarinet models over an 8-week period improved their music performance as much as those who did not observe the tape. Puopolo (1971) found positive effects for elementary-aged beginning trumpet players who listened to trumpet performances on audiotape as part of a 10-week programmed practice procedure. Hewitt (2001, 2002) found that junior high instrumentalists who listened to like instrument models for six weeks were able to improve their music performance though they did not improve their self-evaluation accuracy or practice attitude. Anderson (1981) found that elementary woodwind students who listened to a model clarinet performance during an 8-week treatment period did no better on either a prepared or a sight-reading piece. The use of play-along recordings that utilized the student's own instrument as a model over a six-week period was effective for improving gross pitch discrimination, pitch matching, rhythmic discrimination, and time spent in practice, but not for tempo stability or fingering/slide position errors (Zurcher, 1975).

Sang (1987) examined nineteen teachers and 204 of their students to determine the degree to which teachers' modeling skills impacted their students' music performance. Through use of a multiple regression analysis he found that a large part of the variance in student performance was attributed to teachers' abilities to model on the instruments being taught in the class as well as on the teacher's primary instrument. Teachers' abilities to sight-read on secondary instruments, perform a prepared piece on their major instrument, and play brief melodic and rhythmic sequences by ear were also variables that correlated with their students' performance achievement. Additionally, Sang determined that teachers who had better modeling skills tended to use them in the classroom more often than teachers who lacked those skills.

The characteristics of model recordings have been explored in a few settings. Rosenthal (1984) examined the effects that a violin model and guided verbal model (both alone and in combination) had on university woodwind and brass performers' music achievement. She concluded that instrumental modeling, with no added words,

may be most effective for improving note accuracy, rhythm, dynamics, and tempo but not phrasing. A verbal model had no benefits for musicians' performance accuracy. Similarly, Dickey (1991) examined whether instrumental modeling strategies yielded superior results in instructional effectiveness when compared to verbal strategies. He found that cycles of teacher demonstration followed by student imitation were superior to that of teacher verbal descriptions with student responses. These results show that models exhibiting different characteristics may impact music performance.

Though little work has been done in instrumental music education regarding the effects that differing characteristics of models may have, more work has been done in vocal music, particularly as it relates to pitch matching ability of elementary students. Primarily, investigations have centered on the variables of children's, adult female, adult male and non-vocal models. Green (1990) investigated influences that listening to model performances sung by either a child, adult female or adult male had on elementary students' pitch matching ability. She found that the child model allowed elementary students to make the most correct responses while the least number of correct responses were made by children when listening to the male model. Small and McCachern (1983) found that an adult female model was more effective than an adult male for children trying to match pitch. Uncertain (poor) singers may be affected differently by model types than certain (good) singers (Yarbrough, Bowers, & Benson, 1992).

The register in which the model was performed appeared to be a factor affecting students' pitch accuracy as girls were more accurate while listening to higher pitched models and boys were more accurate when listening to lower pitched models (Bentley, 1968; Price, Yarbrough, Jones & Moore, 1994; Yarbrough, Green, Benson & Bowers, 1991). Furthermore, students were not accurate when singing in response to male models in the lower register. Also, students appear to be more accurate when listening to vocal models rather than instrumental models (Petzold, 1966; Price et al., 1994).

Research on timbre in music education has often focused on preferences listeners and performers have for certain instrument sounds (Bernier & Stafford, 1972; Cutietta & Foustalieraki, 1990; Gordon, 1986, 1991; Kelly, 1997). It seems that young students who choose to play an instrument whose timbre they prefer tend to remain in instrumental music classes longer than those who do not play a preferred instrument (Gordon, 1986, 1991). Wapnick and Rosenquist (1991) investigated preference differences of music majors for acoustic and synthesized timbres and found no differences except for recording quality where synthesized timbres were preferred. Price (1995/1996) found that musicians' reactions to synthesizer timbres were considerably less favorable than non-musicians for tone quality and pleasantness. Timbre may also affect undergraduate music majors' perceptions of intonation as they seem to associate darkness with flatness and brightness with sharpness when the tone being evaluated is of the other (bright or dark) type (Wapnick & Freeman, 1980). Intonation differences are more easily detected when listening to dissimilar rather than similar timbre combinations.

The use of models has been shown to be effective for learning music among instrumentalists, but surprisingly few investigations have been undertaken that examine the effects that specific model characteristics have on music performance. Two model characteristics, timbre and register, have been investigated in vocal, yet not instrumental, music learning. If instrumental music findings are to mirror those in vocal music, it seems that models closest to the instrument being performed would be most effective for improving performance. The purpose of the present study was to determine the effects that instrumental model characteristics have on the music performance achievement of middle school instrumentalists. Specifically, are there differences between model timbre and register, considered alone and in combination, and music performance achievement?

METHODOLOGY

Sample

Middle school instrumentalists who were scheduled to enter the fifth- (n = 1) sixth- (n = 6) seventh- (n = 10) eighth- (n = 9), and ninth- (n = 6) grades participated in the study. The 12 woodwind and 20 brass students were enrolled as part of a summer music day camp at a large mid-Atlantic research university. Students admitted to the camp were not required to pass an audition. Rather, the camp was open to anyone who had at least one school year of performance experience on the instrument and enrolled before the camp deadline. Students were invited to participate by letter and all students who returned a signed consent form prior to the beginning of the camp were allowed to participate. Participants reported that they had been performing on their instruments a mean of 2.70 (SD = 1.16) years. Eighteen of the students had regularly taken private lessons. The mean number of years of private lessons for all participants was 0.94 (SD = 1.11) . An equal number of males and females participated.

Design

This study utilized a counterbalanced design in which each participant received three of the five treatments. This design has strong internal validity as history, maturation, regression, selection, and mortality are all generally well controlled. The major limitation of the study is a potential order effect, thus a Latin square was created with all possible combinations for three of five treatment conditions. Students were then randomly assigned to one of the following conditions: No Model (n = 20) Same Timbre x Same Register (n = 19), Same Timbre x Different Register (n = 19), Different Timbre x Same Register (n = 19), Different Timbre x Different Register (n = 19).

Independent variables

There were four treatment conditions consisting of amalgamations of two timbre model conditions (same, different) and two register model conditions (same, different).

A group in which participants did not listen to a model was used as a control group. Students in the Same Timbre x Same Register group listened to a model recording of the piece performed by their instrument, while those assigned to the Same Timbre x Different Register group heard a model from their family (woodwind or brass) but in a different octave. Participants in the Different Timbre x Same Register condition heard an instrument in a different family (woodwind or brass) and same register, while students in the Different Timbre x Different Register group heard a different family (brass or woodwind) and different octave. If an instrument model from the *different* family could not play in the same register as the original instrument (i.e. flute), then the instrument model closest to the original was used.

Dependent variables

Student performances were appraised by three independent evaluators using the Woodwind Brass Solo Evaluation Form [WBSEF] (Saunders & Holahan, 1997). This 5-point criteria-specific rating scale includes the areas of tone, melodic accuracy, intonation, rhythmic accuracy, tempo, interpretation and technique/articulation. Evaluators choose the descriptor that most accurately describes the performance being evaluated. Though an additive approach is used to evaluate technique/articulation, the other areas use a continuous performance scale. Internal reliability of the WBSEF has been found to be high (α = .92) overall and for each instrument used in the current study (α = .91 - .93). The validity of the instrument in terms of its diagnostic ability is strong as there appears to be a high positive correlation between each subarea and the overall score coupled with low correlations among the subareas themselves.

Procedures

The musical excerpts used in the study were selected based on established criteria. The criteria established were that the work must (a) incorporate a diversity of technical components appropriate for middle school musicians including a variety of articulations, styles, dynamics, rhythmic patterns, and a moderately wide melodic range; (b) be of appropriate difficulty so a "ceiling effect" would not be established, and c) be of similar difficulty for each instrument involved in the study. The chosen music was independently examined by three middle school band directors to determine if it met the criteria, and was concluded by all that it did. The three "songs" lasted from 35-45 seconds. Song #1 was in the concert key of Bb and was slow, legato and utilized extensive slurring. Also, in the key of Bb, the Song #2 was a *Gigue* in 6/8 meter marked *Allegro*. Song #3 was in the concert key of Ab with a time signature indicating 2/4 and marked *Allegretto con moto.* Recordings of the model performances were created in a professional recording studio and were performed by college-level musicians who were majoring on one of the instruments used in the study.

The study was implemented during individual 20-minute segments. Students entered a practice room that contained a SONY CFD-510 CD Radio Cassette-Recorder, a SONY Minidisc Player/Recorder with microphone, a SONY Premium Recordable Minidisc, a chair and music stand. They were shown Song #1 and, if in a model treatment condition, were instructed to place their finger on the first note and follow the music as the model recording was played. Students then listened to the appropriate model performance and were observed by a research assistant to be sure they were tracking the musical score. Students then heard the piece again and were instructed to finger along on their instrument while the same model recording was again heard. Students were then told to play-through (but not practice) the piece once in its entirety. Finally, the students performed through the piece and it was recorded. Students in the no model condition completed the same steps listed above, but did not listen to a model while tracking the music or fingering their part.

Microsoft Sound Recorder 5.0 was used to transfer students' individual recordings from minidisks to computer. They were then edited for duration using the Audacity Digital Audio Editor and burned to compact discs with RealPlayer 10.0. Three experienced instrumental music educators who were not familiar with the aims of the project were recruited to evaluate the performances. To control for order effect three separate discs were created with performances recorded in random order. Sample recordings of the music performed by students were used to help train evaluators in the use of the WBSEF. They then independently listened to and evaluated the performances. The mean reliability as measured by Cronbach's Alpha coefficient for all subarea scores collectively was .98. Individual subarea (again using Cronbach's alpha) reliability coefficient means ranged from .87 for tone to .94 for melodic accuracy. Judges' mean scores were determined for each participant for all subareas and used for the data analyses.

Table 1
Means and standard deviations for Model x No Model conditions

	Model		No Model	
Subarea	M	SD	M	SD
Tone	2.71	.92	2.57	.85
Melody	2.59	1.16	2.42	1.20
Intonation	2.13	.82	1.97	.80
Rhythm	2.51	1.11	2.25	1.12
Tempo	2.11	1.12	1.16	.85
Interpretation	2.09	.90	1.85	.89
Tech./Articulation	.82	1.00	.47	.74
Total	14.98	.73	13.37	1.43

RESULTS

An initial multivariate analysis of variance was performed to determine if differences existed between the control and model groups for each subarea of the WBSEF. No statistically significant findings were revealed [F (7, 88) = .59, p = .76, η^2= .03] between participants in the model condition (M = 14.98, SD = .73) and those in the no model condition (M = 13.37, SD = 1.43). Table 1 depicts the means and standard deviations for modeling condition on all subareas.

A 2 x 2 factorial multivariate analysis was performed to determine relationships among two register conditions (same, different) two timbre conditions (same, different) and seven WBSEF performance subareas (tone, melodic accuracy, intonation, rhythmic accuracy, tempo, interpretation, technique/articulation). The two-way interaction for register and timbre was found to be statistically nonsignificant [F (7, 66) = .80, p = .59, η^2= .08]. Similarly, the main effects for both register [F (7, 66) = 1.70, p = .12, η^2= .15] and timbre [F (7, 66) = .29, p = .96, η^2= .03] were not statistically significant. Since the data revealed no statistically significant relationships, further analyses were not undertaken.

DISCUSSION

The purpose of this study was to determine the effects that model timbre and register had on the music performance achievement of middle school instrumentalists. The main and interaction effects of two timbre conditions (same, different) were examined along with two register conditions (same, different) on seven subareas of music performance (tone, melodic accuracy, intonation, rhythmic accuracy, tempo, interpretation, technique/articulation). Results indicated that no differences were found among any of the variables.

It appears that the register and timbre of a model had no direct effect on the performance of this small group of middle school instrumentalists as examined within the limitations of the present study. Although the type of model heard by singers affects pitch accuracy (Bentley, 1968; Price, Yarbrough, Jones & Moore, 1994; Green, 1990; Yarbrough, Green, Benson & Bowers, 1991), the instrumental musicians in the present study performed equally well (for intonation and all other subareas) when listening to models in same and different registers. The measurement tool used in the studies may explain why intonation was not different among groups. The scale used in those studies measured intonation discrepancies in fairly small increments while the WBSEF (Saunders & Holahan, 1997) utilized a more global measure, asking evaluators to select from one of five options ranging from "Intonation is not accurate. Student's performance is continually out of tune." to "Intonation is accurate throughout, in all ranges and registers" (p. 265). Although intonational differences may have been present among the students in the current study, they are neither readily nor practically apparent as measured by the WBSEF.

A second possible explanation for not finding a difference in intonation may be that the voice, which is internally located within the body, is a much more elusive instrument in terms of pitch definition. Whereas a woodwind performer needs only to press a series of keys to generate a pitch that is relatively close to the targeted tone, a singer must manipulate unseen mechanisms, a process which is much more difficult to control. In a similar notion, brass instrument performers have a somewhat more intangible instrument than woodwind players as they must not only manipulate the correct valves they must also accurately form the embouchure in a way that produces the proper enharmonic. Within the brass family, trombonists' use of the slide may inhibit proper production more so than valved brass instruments. Each of these differences should be explored in future analyses.

Teachers who use modeling techniques in their instrumental classrooms generally elicit better performance results from their students than teachers who do not model (Dickey, 1991; Sang, 1987). Although the present study suggests that teachers may not need to model on the instrument students are learning in order for it to be effective, additional study, perhaps of a longer duration, is necessary to examine the question more thoroughly. Sang (1987) found that teachers' abilities to model on secondary instruments was related to student performance, he did not look at the specific effects that modeling on these secondary instruments had. Perhaps the conclusion that can be asserted from Sang's study and the present one is that though teachers should model performances in the classroom, they do not necessarily need to model on the instrument students are playing for students to be initially successful. It could also be projected that teachers who are more comfortable on *more* secondary instruments actually model more. If the findings of this particular study are upheld in others it seems that teachers of woodwind and brass students may not need to model performances on the same instrument that students are performing on to be effective, at least at the onset of learning a new piece. This could be particularly helpful to teachers of large and small instrument classes who instruct students learning multiple instruments in the same class.

The current study lasted only 20 minutes for each student and the time frame for learning each piece was less than that since students learned three different pieces during the scheduled period. Although this study was of limited duration, it is quite typical of middle school, elementary or private lesson instrumental teaching situations. When introducing a new musical line in a method book or a new piece of literature, teachers often model for students and then allow them to play through it at first. It is this experience that prepares them for a practice routine in which they will attempt to rehearse independently until the next instructional episode. In fact, the effectiveness of preliminary learning strategy could be the formative element for successful autonomous learning. Many instrumental music students quite often hear multiple models throughout their musical careers. Perhaps it is this long-term exposure to models that may affect improvement of their overall performance and be cumulative over time. This may be particularly true of those subareas of music performance that are not related

to the performance of a specific piece such as tone or intonation. The effectiveness of listening to models with different characteristics over an extended time period should be explored in future research.

This study investigated the effects of two varying model characteristics, timbre and register, on middle school woodwind and brass players' initial music performances. Of course, this is only a small part of the investigation into characteristics of models that may be important in instrumental music instruction. The effects that a more similar model has on an instrumentalist over an extended period of time could be important. Perhaps there is a moment when students need to hear the intricacies of tonguing on a bassoon or intonation of a particular note on the clarinet. The timbre variable could be expanded to include comparisons of other popular instruments used in instrumental classrooms such as the voice and piano. It would also be of interest to examine the positive and negative effects of percussion, string and MIDI instruments on specific aspects of music performance. Price et al. (1994) found that singers often responded to sine wave models by trying to match the tone quality of the model as well as the pitch. Does a trombonist perform with a sound quality more like a bassoon when they hear that model? If a clarinet player needs to play with a more "robust tone quality," should they listen to a bass trombone? Finally, others (most notably Gordon, 1986, 1991) have found that musicians and non-musicians often express a preference for certain timbres. Could a musician's preference for a particular instrument affect their motivation or even their ability to respond? Each of these questions should be investigated for possible future influences in music education.

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