Music, Movement and Marimba: An Investigation of the Role of Movement and Gesture in Communicating Musical Expression to an Audience

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Abstract

The experiment reported in this article investigated the assumption that visual movement plays a role in musician-to-audience communication in marimba performance. Body movement is of particular relevance here as the expressive capabilities of the marimba are relatively restricted, and the movements required to play it are visible. Twenty-four musically trained and 24 musically untrained observers rated auditory-only and auditory-visual presentations of 20th-century solo marimba excerpts for perceived expressiveness and interest. Performances were given by a male and a female professional musician in projected (public performance expression) and deadpan (minimized expressive features) performance manners. As hypothesized, higher ratings were recorded in response to projected performances than to deadpan. The hypothesized interaction between modality and performance manner was observed. Musically trained participants recorded higher ratings than musically untrained observers, upholding the final hypothesis. Expressive body movement plays an important role in the communication between marimba performer and audience – a role relevant for both performers and educators.

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Music performance involves high-level perceptual and motor skills with an added dimension of non-verbal communication. Just as people gesture when speaking (e.g., Kendon, 2004; Iverson & Goldin-Meadow, 2001; Iverson & Thelen, 1999; McNeill, 1992), musicians tend to move expressively as they perform (Davidson & Correia, 2002). Inhibiting bodily movement can impact upon music performance, for example, by affecting musicians' sense of timing (Wanderley, Vines, Middleton, McKay, & Hatch, 2005). Performers' bodily movements also create visual information that can have an impact on the perception and judgment of music performance by an audience (Davidson, 1993). This article focuses on audience perception of western contemporary classical acoustic solo marimba1 performance. Physical movement is of vital importance in percussion, including marimba, performance. The movements necessary to create sound occur externally to the human body, therefore the sonic event is closely related to observable movements of the performer (McClaren, 1988). For example, Dahl (2000) noted that in performing an accent on a drum, percussionists would use a higher stroke and lengthen the duration of the interval between the accented note and the next note.

Sonic expression and the nature of the marimba

For percussionists, the main means of performing expressively are variation of dynamics and the timing of inter-note intervals (Dahl, 2000). Performers of other instruments have a broader palate of expressive capabilities to draw from, such as articulation, timbre, intonation and duration (Dahl, 2000; Dahl & Friberg, 2007). Like the drum, the marimba is an inherently staccato instrument. Once a note is struck, there is a very fast decay (Fletcher & Rossing, 1998). While striking the bar in different places may provide some control over the timbre of the sound, primary timbral changes are instigated by the marimba player's choice of mallet (Fletcher & Rossing, 1998). Usually, the marimbist is not able to change mallets while playing and so must make do with the initial choice, and therefore the same timbral quality, for all or a significant part of a piece. Further, the marimba player is not able to alter the sound, other than to shorten the duration by performing a 'deadstroke', where the mallet head is pressed into the bar as it strikes the bar (Dahl & Friberg, 2007). Given these limitations for sonic expression, the marimba player's bodily movements may be of upmost importance in communicating musical expressive intention to an audience.

Modern technology has not yet reached a point where it can address the sonic expressive limitations inherent in the marimba within the genre of western contemporary classical acoustic solo marimba performance. Some use of technology, involving microphones, pickup systems and MIDI technology, has enabled amplification of the marimba and real-time processing of sonic parameters of the sound such as timbre and control over decay (Mattingly, 1997). However, this gives rise to a style of composition, such as soundscapes, possibly involving elements of improvisation, that exerts different technical demands on the performer. Performance in this mode of electronically modified instruments is beyond the scope of this article.

Is it advantageous to see and hear a marimba performance?

In the present experimental study, we investigated whether observers are sensitive to changes in performer audio and visual expression across auditory-only and auditoryvisual conditions in western contemporary classical acoustic solo marimba performance. Given the acoustic limitations of the instrument, and traditional pedagogical approaches to instrumental music performance that emphasize the sonic event, we ask the question: 'Is there a perceptual advantage for an audience in seeing and hearing a marimba performance compared to a listening-only experience?' An audio-visual presentation may provide the audience further opportunities to understand the expressive musical intentions of the marimba performer. In addition, the performer may capitalize on the opportunity to communicate with their audience, or even manipulate their audience's concert experience through their movements and gestures. Finally, an audio-visual presentation of marimba performance may provide the observer with a richer, more interesting musical experience. We now turn to research that may bolster these claims.

Multimodal perception in music

Before inventions such as the radio and gramophone, music performance was an audio-visual phenomenon (Clarke 2002b; Thompson, Graham, & Russo, 2005). While technologies such as these allowed the dissemination of music through audio recordings to a wider audience, an inherent side-effect was the separation of auditory and visual components of music performance. In a contemporary context, while the visual aspect has been reintroduced to the auditory component as evidenced in the music video clip and use of visual technologies in live performances, music is accessed today predominantly via auditory means (Thompson et al., 2005). While the aural component is the focal point of music performance,

both auditory and visual modes integrate and can influence the audience member's aesthetic experience (McClaren, 1988).

Recent studies have demonstrated that sensory modalities interact with and are integrated in the perception of music performance. Schutz and Lipscomb (2007) found that long and short gestures accompanying the striking of a marimba note influenced participants' judgements of the duration of the note as being long or short, even though acoustically the duration was the same. These recent findings have demonstrated a cross-modal interaction where vision dominated temporal judgements of auditory information using ecologically valid musical stimuli (Schutz & Lipscomb, 2007).

Vines and colleagues (Vines, Krumhansl, Wanderley, & Levitin, 2006) proposed an emergence of features from the interaction of auditory and visual sensory modalities in contemporary clarinet performance. The results demonstrated an interaction between auditory and visual sensory modalities that either enhanced or diminished judgements of perceived tension (an affective index) or phrasing (an indicator of musical structure). Specifically, while sound dominated observers' perceptual experience of tension, participants' judgements of tension at significant points in the performances were either enhanced or diminished by the visual component in the audio-visual condition. While auditory and visual modes conveyed similar information with regard to phrasing, in the audio-visual condition the performers' gesturing served to increase participants' sense of phrasing. Visual information indicated the onset of phrases to the observer as well as extending the sense of phrase length into silence. Findings illustrated that the performer's movements could highlight and guide the observer through their interpretation of affective and structural content. While the study of affective or structural communication was not the focus of the experiment reported here, the findings of Vines and colleagues (2006) provide evidence that a multi-modal presentation of music performance can be advantageous for both performer and observer.

McClaren (1988) examined the effects of performers' visual attributes (body movements) on perceived quality assessments of performances of a 20th-century solo marimba piece by university students. Results revealed that, a 'positive' visual display coupled with a high-quality aural component, led to judgements of the marimba performance as being of a better quality. 'Negative' performances did not receive significantly different ratings in audio-only and audio-visual conditions. McClaren (1988) concluded that the basis of a good musical performance is a high-quality aural performance, with positive visual

attributes enhancing audience perception of it as a better quality performance. McClaren's (1988) findings both fulfil and contest expectations with regard to multi-modal perception of marimba performance. Given that 'positive' visual attributes enhanced judgements of the aural component of a performance, it could also be expected that 'negative' or constrained or reduced visual attributes would lead to decreased judgments with respect to the aural component. The experiment reported here investigates this new hypothesis. In addition to gathering responses to perceived quality assessment by way of perceived expressiveness, we investigated whether visual movement leads to a peak in observers' global interest in performances in audio-only and audio-visual conditions.

In the present study, an attempt was made to address possible confounds that may have exerted an influence on results in McClaren's (1988) study through more strict control of variables. A range of 20th-century repertoires that differed in style, tempo and level of difficulty were audio and visually recorded for construction of the stimulus material. Performances were given by one male and one female professional percussionist to control for possible effects resulting from gender bias (Davidson & Edgar, 2003; Elliot, 1995/1996). The manners in which the marimba players performed the selected repertoire were manipulated systematically to investigate responses. These were defined for the performers to ensure there was a shared understanding of what was required of their performances. In McClaren's study, participants viewed recordings showing the whole body of the performers, including faces and, therefore, facial expression. The present study was concerned with investigating the perception of body movement as an element of expressive behaviour in marimba performance. Since facial expression has already been demonstrated to be an effective communicator of emotion (Buck, Savin, Miller, & Caul, 1972; Ekman, 1999), in the present study the performers' faces were digitally masked to eliminate the possible influence facial expression could exert on results.

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Expressive intention

The body plays an important role, not only in the physicalities of playing the instrument, but also in communicating expressive intention to an audience (Clarke, 2002a; Davidson & Correia, 2002). Investigations have been conducted to investigate observers' sensitivity to performers' emotional expressive intentions in audio-only and visual-only

conditions. While emotional content is not the focus of the present study, it is important to note that observers could generally correctly interpret performers' intentions in audio-only (Gabrielsson & Juslin, 1996) and visual-only (Camurri, Lagerlöf, & Volpe, 2003; Dahl & Friberg, 2007) conditions in music and dance.

Davidson (1993) demonstrated the important role visual information plays in conveying different levels of intended expression in music performance. Findings indicated that there was agreement between performer intention and audience detection of expressive performance manner in audio-only, visual-only and combined audio-visual conditions. Davidson (1993) concluded that vision alone seemed to provide more information as to expressive intention.

The experiment reported in this article builds on the foundational work of Davidson (1993) and investigates whether results generalize from studies of violin and piano to marimba performance. For reasons of ecological validity, the vision-only condition was omitted in the present study. In authentic contexts, musical performances are experienced through either listening, or seeing and listening. Of particular interest was the comparison of responses to deadpan performances in audio-only and audio-visual modes. Davidson (1993) observed a significant difference between audioonly and audio-visual ratings for deadpan performances involving violinists. No such significant result was observed for the pianist's deadpan performance comparing audio-only and audio-visual conditions. If visual information provides more information as to a performer's expressive intention, then audio-visual presentations of deadpan marimba performances could be expected to result in diminished judgments of expressiveness compared with audio-only presentations.

The present study made use of the definitions of performance manner stated by Davidson (1993): 'Deadpan' (with minimal expressive interpretation of the music), 'projected' (consistent with public performance), and 'exaggerated' (where all aspects of the expressive features are overstated). Deadpan and exaggerated performance manners are performable expressive states and directions commonly given to students by teachers in order to focus the student's attention on technical issues, or to achieve a greater range of expressive features respectively. To perform in a projected manner is to perform with a level of expression midway between the extremes of deadpan and exaggerated. Therefore, because of their extensive training, professional musicians are aware of these levels of expression and are able to replicate these without specific directions regarding movements or gestures. In

addition, without movements being dictated performers are free to move in their individual style.

Although the performers in the present experiment were aware of the deadpan, projected and exaggerated performance manners and their relative definitions for reference purposes, they were directed to perform the excerpts of marimba repertoire only in deadpan and projected performance manners. The exaggerated performance manner, where the performer would overstate all aspects of the expressive features, was omitted because of experimental time constraints. Exaggerated movements also interfered with the performers' ability to play the repertoire satisfactorily.

In the present study, we controlled possible extraneous or confounding variables. Specifically, the stimulus material comprised a variety of marimba repertoire excerpts selected by the experimenters, rather than being left up to the personal choice of the performers. This controlled possible confounding variables such as tempo, style and level of difficulty. The repertoire was performed by a male and a female professional marimba player, both with many years of performing experience, rather than student musicians. The two-gender approach to the creation of the stimulus materials was adopted to control for possible gender bias that was not addressed in previous studies. A further development was to include an additional dependent measure: interest. This second dependent measure differs from the first dependent measure, expressiveness, in that it draws on the listener's response to the musical experience as a whole and not their judgment of the stimuli alone.

Attention and interest

Factors aside from the sound, such as the influence of visual stimuli provided by the musician's body movement, may provide a means of performer connecting with audience, and maintaining the audience member's attention and interest in the performance. Attentional shifts towards stimuli can occur either voluntarily or involuntarily (Franconeri & Simons, 2003). Dynamic events such as novel or unexpected stimuli, and motion including sudden or looming movement can capture attention (Franconeri & Simons, 2003). Habituation occurs when a pleasant stimulus is repeated sufficiently for the response to diminish (Berlyne, 1970). In lay terms, this translates as boredom. Novelty, attention demand and exploration of features of an activity contribute to instant enjoyment and situational interest in that activity (Chen, Darst, & Pangrazi, 2001). According to Hidi and Anderson's definition, situational

interest is ‘the appealing effect of an activity … on an individual, rather than the individual’s personal preference for the activity’ (1992, cited in Chen et al., 2001, p. 384).

It was predicted that an expressive audio-visual presentation of marimba performance, where audio and visual channels are congruent, would be more interesting for an observer, when compared with an inexpressive performance. It was anticipated that observers’ interest would peak in an expressive audio-visual marimba performance due to the meaningful coupling of sound and expressive body movement creating visual variety and cues to heighten and maintain observers’ interest and attention to the musical experience.

Audience expertise

Audience members bring their musical knowledge and experience to the task of listening to a musical performance. It has been suggested that experienced listeners may be more used to judging performances and particular musical styles than their nonexperienced counterparts (Clarke, 2002b). There are arguments that support and refute the notion that the musical training of respondents exerts an effect on judgements assigned to musical performance. It appears that musical training is not a prerequisite for performance on certain perceptual cognitive and affective listening tasks, but rather exposure to music (Bigand & Poulin-Charronnat, 2006). However, musical training and knowledge has been found to affect listeners’ judgements pertaining to perception of music from certain different historical periods (Gromko, 1993).

In most of the studies reviewed earlier, either musically trained (Davidson, 1993; Vines et al., 2006), or musically untrained (McClaren, 1988) participants performed the final rating tasks, so a possible effect of musical training is not known. According to Vines et al. (2006), pilot testing indicated that musicians and non-musicians performed similarly on perceptual tasks, so results could be generalized to both populations. McClaren (1988) revealed that results obtained from presenting the same tapes to a panel of professional percussionists at the 1987 Percussive Arts Society International Convention were similar to those from non-musicians. In subsequent testing, Schutz and Lipscomb (2007) found that non-musicians performed similarly to the musically trained non-percussionists in their perceptual task.

In the study reported in this article, it was expected that musical training would affect observers’ responses. Particularly, it was anticipated that musically trained participants would

be more confident with the experimental task because of their experience in assessing musical performances. In addition, musically trained participants were expected to be more knowledgeable about and familiar with the contemporary western classical art music genre and this would be reflected in higher ratings.

Aim, design and hypotheses

The aim was to test the assumption that body movements and gestures play a role in communicating musical expression to an audience in western contemporary classical acoustic solo marimba performance. The experimental design consisted of three independent variables: level of expertise of the observer (musically trained or musically untrained), modality (audio-only or audio-visual) and performance manner (projected or deadpan). The latter two variables were within-subject variables. The dependent variables were ratings of expressiveness and interest.

It was hypothesized that participants assign higher ratings to pieces performed in a projected manner than those performed in a deadpan manner; that an interaction occurs between modality and performance manner (specifically, that participants assign higher ratings to pieces performed in a projected manner, and lower ratings to pieces performed in a deadpan manner, when presented audio-visually in comparison to an audio-only condition); and that musically trained participants, relative to participants without musical training, assign higher ratings to pieces.

Method

Participants

A total of 48 participants took part in the experiment (17 males, mean age 24.94 years, *SD* 7.09; 31 females, mean age 23.06 years, *SD* 9.38). The sample was divided into two equal groups of 24 (musically trained and musically untrained), based on information about each participant's musical experience gathered via questionnaire. Musically trained participants were those who had completed at least six years of formal training in music and were currently active as performing, teaching or composing musicians (17.29 mean years' training, *SD* 11.2). Musically untrained participants had undertaken less than two years of formal music training (0.7 mean years' training, *SD* 0.83). Participants were recruited through a convenience strategy from universities in Sydney, Australia, the National Music Camp for students in Canberra, Australia, and music teachers from schools in Canberra. Psychology

students from the University of Western Sydney received course credit for their participation. It was stipulated that participants must have normal or corrected to-normal vision and normal hearing for inclusion in the study.

Stimuli

Two professional percussionists, dressed in black, performed a fast-tempo and a slow tempo excerpt from four pieces of 20th-century marimba repertoire by four different composers. The repertoire selected ranged in level of difficulty from intermediate to advanced. A male and a female performer were used to record the stimulus material to distribute possible effects of gender preference that may exert an influence on participants' judgements. Excerpts of compositions performed were Movements II and III from *Marimba Dances* by Australian composer Ross Edwards (1990); Movements I and III from *Suite No.2 for Marimba* by Japanese composer and marimbist Takayoshi Yoshioka (1995); *Nancy* by Emanuel Séjourné (1989) from France and *Merlin* by Andrew Thomas (1989) of the USA. The performers played these excerpts in two different performance manners – projected, as in public performance, and deadpan (without projection as in public performance). Excerpts were recorded in an audio-visual format. The microphone was situated next to the camera, which was placed directly in front of the performer, taking into view the length of the marimba and the full height of the performer.

The audio-visual recordings were edited to make a total of 96, 20–25-second selections (clips) that included complete musical phrases. The audio-visual computer files (.avi) were converted into .wav files. Group normalization was performed on the .wav files in order to equalize the volume between performers playing the same excerpt. This also ensured that there were comparable dynamics between projected and deadpan performances. Each normalized .wav file was then relinked to its matching video footage. In order to control possible confounds such as facial expression, an opaque, rectangular box was created using the plain off-white-coloured background and laid across the area where the head moved in each clip. This disguised the face of the performer without interfering with the observer's ability to view the whole body of the performer, including the performer's head.

The 96 audio-visual clips were divided into six sets of 16 clips, balanced in terms of gender of performer and performance manner. Each set contained selections from the fast and slow excerpts of all pieces performed. No set of clips contained performances of the same

20–25-second clip either by the same performer in both performance manners, or by both performers. Individual clips were only included once within each set.

Within the six audio-visual sets constructed, each of the 16 clips was presented twice. Title frames of two seconds in duration were inserted into the timeline to mark the first and second presentation of each clip. Following the second presentation of a clip, a title frame was inserted that contained the instructions to the participant that they had 15 seconds to record their response before the next clip would begin. A gap of 1.5 seconds was left between clips and titles on the timeline.

Once completed, each of the six sets was individually imported into the master timeline window and the auto-colour correction effect was applied from the effects window, to eliminate noticeable changes in lighting that had occurred during the recording phase of the stimulus preparation. An audio-only version of each set of clips was created by removing the video footage of performances from the audiovisual version, but leaving the sound and titles intact. Participants saw a black screen when the audio-only stimulus was presented. From the master timeline window, each of the six audio-only and audio-visual sets was exported as an .avi file. Each set of clips was 20 minutes in duration.

Equipment

Excerpts were performed on a Malletech Stiletto marimba using Encore Nancy Zeltsman series mallets and Mike Balter mallets. Recordings were made on a Panasonic digital video camera (NV-MX300EN/A) with an external RØDE NT4 stereo condenser microphone providing sound through a Behringer mixing desk. Video editing was performed using Adobe Premier Pro 1.5. The audio-visual computer files (.avi) were converted into .wav files using River Past Audio Converter 6.5. Group normalization was performed on the .wav files using Adobe Audition 2.0. The stimuli were presented to participants via Windows Media® Player on an LG LS70 Express laptop computer from a Maxtor One Touch II 200 GB portable external hard-drive. Audio was provided through Koss (UR20) headphones.

Procedure

Participants were presented with an information sheet outlining the study and written consent was gained prior to testing. The testing procedure was conducted on an individual basis in a quiet room. Participants were presented with one of the six sets of audio-only clips and a different set of clips selected from the six audio-visual sets. No participant received the

same set of excerpts in the audio-only and audio-visual conditions. The order of presentation of audio-only and audio-visual sets was counterbalanced in both the musically trained and musically untrained groups. All order permutations of audio-only and audio-visual sets received ratings from two different participants in both the musically trained and musically untrained groups of participants. Every excerpt set in both the audio-only and audio-visual conditions was presented in the first and second position twice.

Each audio-only or audio-visual clip contained within a set of excerpts was presented twice. After the second viewing, participants were requested to record their responses of expressiveness (how expressive they deemed the clip to be), and interest (indicating their level of interest in the clip). Responses to expressiveness and interest were recorded by circling a number on two separate 7-point Likert scales (*very inexpressive–very expressive; very uninterested–very interested*) that best fitted their judgement. Participants were instructed that their ratings of expressiveness and interest may or may not be related. Similar or dissimilar responses to excerpts on the two scales were equally valid. In the audio-only condition, participants recorded their judgements based solely on the auditory information they received. In the audio-visual condition, participants recorded their responses based on the auditory and the visual information they received. Participants were given a oneminute break between the presentation of audio-only and audio-visual sets. Each set was 20 minutes in duration. Upon completion of the testing procedure, information relating to each participant's concert attendance habits and personal musical taste was gathered via a questionnaire. The questionnaire also contained questions relating to personal taste for the sound of the marimba. The experiment took 50 minutes to complete.

Results

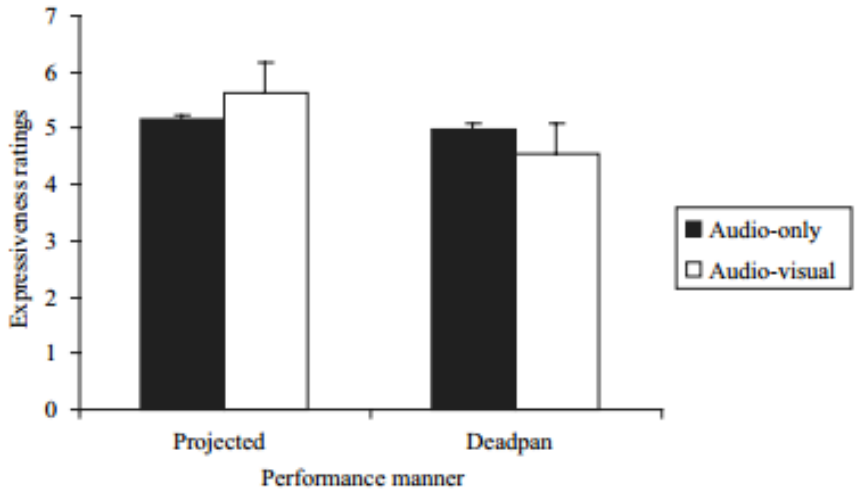
Data consisted of expressiveness and interest ratings and responses to questions regarding concert attendance habits and the marimba. Expressiveness and interest ratings were analysed separately using 2 three-way analyses of variance followed by planned comparisons. Results of analyses of expressiveness and interest ratings are reported separately. Following these analyses, questionnaire data from musically trained and untrained groups are described.

Expressiveness Ratings

The first hypothesis stated that participants assign higher expressiveness ratings to pieces performed in a projected manner than those performed in a deadpan manner. A significant main effect was observed, $F(1,46)$ 60.734, p .001, in support of the hypothesis with mean expressiveness ratings recorded for performances of 5.4 (*SD* 0.81) in the projected manner and 4.77 (*SD* 0.93) in the deadpan manner.

It was hypothesized that an interaction occurs between modality and performance manner. Specifically, it was anticipated that participants would assign higher expressiveness ratings to pieces performed in a projected manner, and lower ratings to pieces performed in a deadpan manner presented in the audio-visual condition in comparison to the audio-only condition. A significant interaction was observed between modality and performance manner (see Figure 1). Investigation by way of planned comparisons revealed a significant difference in mean expressiveness ratings as hypothesized between audio-only (*M* 5.16, *SD* 0.78) and audio-visual (*M* 5.63, *SD* 0.79) conditions for performances in a projected manner $F(1,46)$ 20.486, p .001, as well as between audio-only (*M* 4.98, *SD* 0.83) and audio-visual (*M* 4.56, *SD* 0.98) conditions for deadpan performances $F(1,46)$ 14.295, p .001.

The final hypothesis stated that participants with musical training assign higher expressiveness ratings to pieces relative to participants without musical training. This effect was observed $F(1,46)$ 7.203, p .05, with mean expressiveness ratings recorded by trained participants of 5.34 (*SD* 0.89) compared with 4.82 (*SD* 0.89) for untrained participants.



Note: Error bars refer to standard error of the mean.

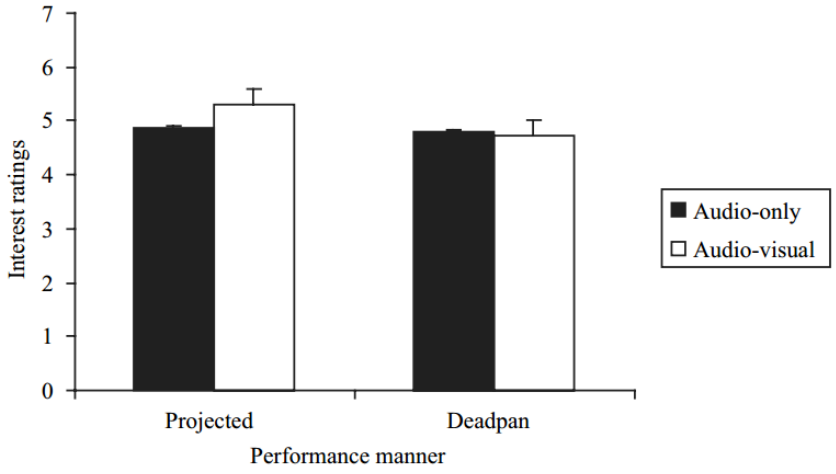
FIGURE 1 *Mean expressiveness ratings: modality by performance manner interaction.*

Interest Ratings

The first hypothesis stated that participants assign higher interest ratings to pieces performed in a projected manner than those performed in a deadpan manner. The anticipated main effect was observed, $F(1,46)$ 25.102, p .001, in support of the hypothesis with mean interest ratings recorded for performances being 5.09 (*SD* 0.87) in the projected manner and 4.76 (*SD* 0.86) in the deadpan manner.

It was hypothesized that an interaction occurs between modality and performance manner. It was anticipated that participants assign higher interest ratings to pieces performed in a projected performance manner, and lower ratings to pieces performed in a deadpan manner presented in the audio-visual condition in comparison to the audio-only condition. A significant interaction was observed between modality and performance manner (see Figure 2). A significant difference in mean interest ratings was observed between audio-only (*M* 4.88, *SD* 0.81) and audio-visual (*M* 5.29, *SD* 0.89) conditions for projected performances $F(1,46)$ 24.183, p .001, but no significant difference in mean interest ratings between audio-only and audio-visual conditions was observed in the deadpan performance manner condition $F(1,46)$ 1.2, p .28.

The final hypothesis predicted that participants with musical training assign higher interest ratings to pieces relative to participants without musical training. This effect was observed $F(1,46)$ 7.442, p .01, with the mean interest ratings recorded by trained participants being 5.21 (*SD* 0.85) compared with a mean of 4.64 (*SD* 0.81) recorded by untrained participants.



Note: Error bars refer to the standard error of the mean.

FIGURE 2 *Mean interest ratings: modality by performance manner interaction*.

Musically Trained and Untrained Participants' Concert Attendance Habits and Responses to Questions Regarding the Marimba

Questionnaire data gathered from participants revealed that musically trained participants attended more concerts than musically untrained participants (musically trained 100%, musically untrained 58%). On average, musically trained participants (*M* 9.96, *SD* 13.03) attended more concerts in a six-month period than their musically untrained counterparts (*M* 0.79, *SD* 1.32). Whereas musically trained participants had heard of the marimba (95.83%) and had prior exposure to the sound of the instrument (100%), only a small number of musically untrained participants had heard of the marimba (16.67%) or had heard the sound of the marimba (20.83%) prior to taking part in the study. All of the musically trained participants (100%) and most of the musically untrained participants (91.67%) expressed a liking for the sound of the marimba.

Discussion

Higher ratings were recorded by observers for pieces performed in a projected manner compared with those pieces performed in a deadpan manner in support of the first hypothesis. It was demonstrated empirically that observers of western contemporary classical acoustic solo marimba performance are sensitive to changes in expressive intention across audio-only and audio-visual conditions (Davidson, 1993). Also highlighted was body movement functioning not only as instrumental technique, but also as means to communicate

expressivity through sound and vision (Clarke, 2002a; Davidson & Correia, 2002). When performing in a deadpan manner, the prevailing remaining body movements were those necessary to play the required notes. Observers could differentiate between this baseline of functional movement and performances that involved expressive movement.

The predicted interaction between modality and performance manner was supported by significant results for both dependent variables. A significant difference was observed between audio-only and audio-visual modes for projected and deadpan performances on the expressiveness-dependent variable. A similar difference was only observed for the projected performances on the interest-dependent variable. These findings support the assumption that there are perceptual advantages to experiencing a marimba performance through complementary multiple sensory modalities. For a performer, presenting marimba performance in a projected manner through auditory and visual channels offers enhanced opportunities to engage and communicate with an audience.

The observed interaction between modality and performance manner demonstrated that observers could most effectively detect differences in musical expression in marimba performance when the presentation was audio-visual. Significantly different judgements between audio-only and audio-visual presentations of both projected and deadpan performances indicated that visual information, provided by way of expressive body movement, influenced perception of the aural component of marimba performances (Schutz & Lipscomb, 2007; Vines et al., 2006). In particular, expressive movement provided cues to an audience as to a musically expressive marimba performance (Davidson, 1993; McClaren, 1988). Results support but also challenge findings from earlier studies. The significant difference between audio-only and audio-visual modes observed for deadpan violin performances in Davidson's (1993) study is supported by results from the present study. This result, however, challenges the findings of Davidson (1993), who observed no significant difference between audio-only and audio-visual conditions for the pianist's deadpan performance. Similarly, and contrary to the results of the present study, McClaren (1988) observed no significant difference between audio-only and audio-visual conditions for 'negative' performances. This pattern of results could be a result of the individual skills of the performers involved in the study. The present findings highlight the capacity for the marimba player to manipulate observers' aesthetic experience through their use of expressive body movement and multi-modal perception.

Regarding the interest-dependent variable, a significant difference between audioonly and audio-visual means was only observed for the projected performances. It appears that a richer, more interesting experience is offered to the observer by being able to both see and hear a marimba player perform than being able to hear only. However, this effect is dependent on the performance being in a projected, expressive manner. An audio-visual presentation of marimba performance is no more interesting for the observer than an audio-only presentation if the visuals are somewhat static. This provides support for the concept that novelty and variety in dynamic visual information command audience attention (Franconeri & Simons, 2003), and contributes to observers' interest in marimba performance (Chen et al., 2001).

As visual perception of movement can arouse and maintain attention and interest on the part of the audience, it would be to the performers' advantage to consider how they move when preparing for public performance. In particular, performers should bear in mind the importance of movement that is congruent with the inherent expressiveness in the musical score, as occurred in the projected manner in this study. Musically trained participants assigned higher ratings, regardless of modality of presentation, to pieces relative to participants without musical training, supporting the final hypothesis. The significant effect of musical training observed in the present study that was not found in the literature reviewed (McClaren, 1988; Schutz & Lipscomb, 2007; Vines et al., 2006) could reflect the demands of the task. Results may suggest that musically trained participants are more experienced with the task of appraising classical music performances and more familiar with, or sensitive to the 20th-century contemporary classical music genre than their musically untrained counterparts (Clarke, 2002b; Gromko, 1993). With explicit training in the task of judging musical expression in performance, and with exposure to the 20th-century classical art music genre, musically untrained participants may perform similarly to participants with extensive, formal musical training (Bigand & Poulin-Charronnat, 2006; Clarke, 2002b; Gromko, 1993). Higher ratings assigned by musically trained participants could also be related to personal taste for the music, prior exposure to the marimba and familiarity with the classical music performance setting. While it was presumed that people in today's western society would be equally experienced with music in audio-only and audio-visual formats (Thompson et al., 2005), higher ratings assigned by musically trained participants may be related to the frequency of their interaction with classical music as concert audience members. It would be interesting to replicate the experiment with a repertoire from other periods or genres of

music, as well as with improvised music. Replication of the study with additional male and female performers would further validate results.

While previous research provided a starting point for the present experiment (e.g., Davidson, 1993; McClaren, 1988), the design of the current study extended the research with more stringent control of variables through counterbalancing performer gender and selection of repertoire with varied tempi, musical styles and levels of difficulty, and inclusion of a new dependent measure: interest. In addition, the present experiment investigated the contribution of visual information in deliberately minimally expressive marimba performances to observer judgments in audio-only and audio-visual conditions. This was particularly pertinent given the limited sonic expressive capabilities of the marimba, and mixed, sometimes contradictory, findings in the literature.

Although this study was conducted under laboratory conditions for reasons of experimental control, efforts were made to present stimulus material that was as ecologically valid as possible. While this experiment approximated a concert setting, it allowed the researchers to investigate and confirm current theorizing with regard to the contribution that body movements and gestures make to the perception of marimba performance. The confirmation of perceptual assumptions now permits exploration of the role of body movement in marimba playing in more ecologically valid settings.

Implications and conclusions

There are implications for instrumental music pedagogy and performance in these results. Findings demonstrated, by way of musically rich and valid stimuli, the positive (or negative) impact a performer's movements (or lack of movement) can exert on an audience's global judgments of musically expressive marimba performance. Also demonstrated was the influence expressive body movement can have on observers' interest in marimba performance. It was assumed that the meaningful coordination of a performer's movements and sound in particular, rather than mere variety in visual movement, guides an audience member through a music performance, maintaining their attention and interest. It may be the case that the congruency of the performers' movements with the sound reinforces communication of the musical message, as opposed to simple variety in movement. A visually and sonically expressive and congruent music performance may be the result of a performer embodying their musical interpretation in functional and expressive movement. A

future experiment could explore whether movement stimuli unrelated to the performance will yield similar results to the findings of this experiment.

Future research will draw on Rudolph Laban's theories of movement and method of movement analysis to study selected performances from this investigation. The movements of the performers in items that scored most and least favourably will be analysed to identify what a performer was or was not doing that led to positive or negative judgments. This will ultimately lead to the development of methods for training advanced music students, enhancing their expressive and communicative performance skills. Future research will build on the findings from this experiment and attempt to address the ecological limitations imposed by laboratory experimental conditions by situating a future experiment in a live concert setting.

For performers of instruments whose sonic expressive capabilities are relatively restricted, such as the marimba, expressive body movement can provide an important channel of communication in effectively disseminating musical expressive intention to an audience. In marimba performance, the visual mode can serve to augment communication of aural content. In addition to enhancing communication of expressive intention, a congruent and expressive audio-visual presentation of marimba performance can lead to increased interest in the performance on the part of the audience. These findings are of relevance to those involved in the performance of music who like to play to an audience, and would like the audience to want to come back.

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Note

1. The western, classical version of the marimba is made up of wooden bars suspended over metal resonators, or amplification tubes. The range of the instrument is between four and five octaves measuring up to approximately 2.5 metres in length. It is usually played by the performer using two or four (two in each hand) mallets (sticks with yarn-wrapped heads).

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