Effectively Using Affective Gestures What percussionists need to know about movement and perception

By Michael Schutz and Fiona Manning

We are all too familiar with the experience of dashing madly from instrument to instrument during a few beats of "rest" while our non-percussionist colleagues remain comfortably seated around us. Clearly, body movement plays an important role in our performances—both in terms of positioning as well as actually creating sounds. For even when limited to a single instrument such as the marimba the demands of shifting, reaching, and striking require significant motion—often to the visual delight of recital-going audiences.

Therefore, as much as we may (rightly) focus our attention on creating the highest quality of sound at precisely the right time and with the best possible phrasing, evaluations of this sound by audiences, jury panels, and even unscreened audition committees are affected by seeing the movements required for this sound's production. As Steven Schick observed in *The Percussionist's Art*, "Physicality and gesture in percussion music are powerful tools of communication. Anyone who has ever attended a percussion concert can tell you that the experience of percussion music involves the eyes as well as the ears." Although we can debate whether such information "should" play a role, what is now beyond debate is the fact that these movements significantly affect musical evaluations. For reviews illustrating examples on various instruments see Schutz (2008) and/or Thompson, Graham and Russo (2005); or for a meta-analysis of vision's influence see Platz and Kopiez (2012).

Consequently, it is in our interest as performers and educators to understand the musical role (and musical limits) of musical movements. Whether we are striving to perfect our own performances or coaching those of our students, understanding the relationship between body movement and music perception represents an endeavor both fascinating and useful. Ongoing research in the MAPLE (Music, Acoustics, Perception & LEarning) Lab at McMaster University investigates this issue through several projects exploring the perception and reception of percussion performances. Here we will summarize some of the practical applications of this work.

1. TYPES OF GESTURES USED BY MUSICIANS

When discussing the types of body movements used in playing musical instruments, psychologists distinguish between *effective gestures* (movements required for sound production) and *ancillary gestures* (movements not strictly required for sound creation; Wanderley et al., 2005). Ancillary gestures are often thought to be of secondary importance given that they lack acoustic consequences and are rarely dictated by composers. However, these gestures can play important musical roles by shaping an audience's listening experience. Although they are rarely explicitly choreographed, they are surprisingly consistent across multiple performances by individual musicians (Wanderley, 2002).

The fact that ancillary gestures shape the perception of our performances holds both potential and peril. For although they can increase audience interest and judgments of expressivity (Broughton and Stevens, 2008), they have also been shown to lower ratings of performance quality (Wapnick, Mazza, and Darrow, 1998) when used in a displeasing manner. This issue is of particular relevance for percussionists as the high degree of movement inherent in our performances naturally leads to a significant number of ancillary gestures. On occasion this role is even detailed explicitly: in "Six Elegies Dancing" (1987) composer Jennifer Stasack gives elaborate instructions on the motions to be used by the marimbist—many of which have no acoustic consequences. The prevalence of compositions emphasizing gestures can be seen in the subgenre of "theatrical percussion," capitalizing on the tight relationship between gestures, percussion, and perception.

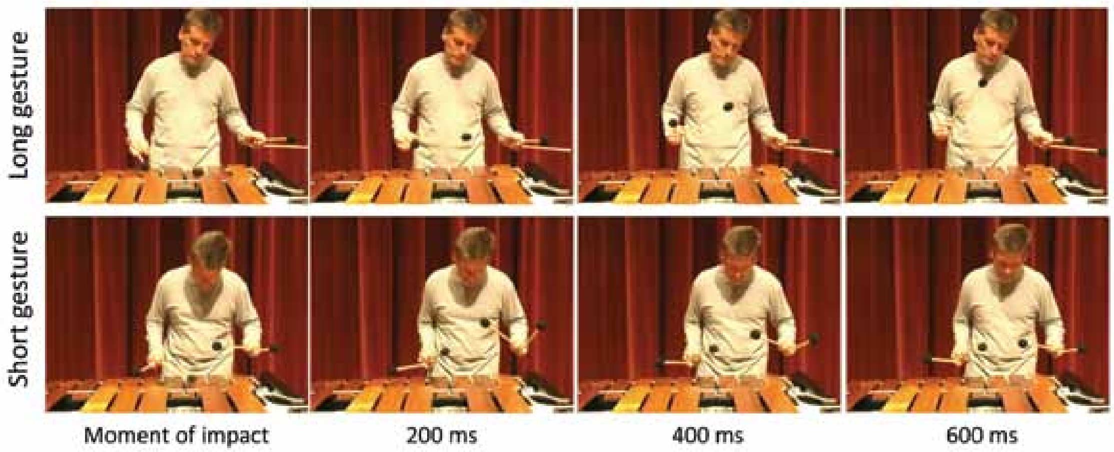
It is important to note that although ancillary gestures are gaining popularity in new music, interest in their musical implications is far from "new." John Cage uses gestures to great effect in a number of compositions such as "Living Room Music" (1940), combining elements of percussion and theatre. Here, the creative freedom for performers to interact with "found objects" such as cups, bowls, books, and other items commonly situated in a living room naturally encourages their use. The variety of creative realizations of this score demonstrates the integral role of gestures (both effective and ancillary), as performers frequently add movements for reasons as much theatric as acoustic. Although the types of gestures used in these pieces are clearly idiomatic, even more common performance movements can enhance our musical communication with audiences.

2. ANCILLARY GESTURES AS COMMUNICATIVE TOOLS

Ancillary gestures are powerful tools in that they offer the ability to work around one of our instruments' acoustic limitations. This is documented through a "musical illusion" resolving a long-standing debate amongst percussionists. The illusion exploits certain quirks of the perceptual system, offering the opportunity to shape an audience's perception of note duration through clever use of ancillary gestures. To illustrate this phenomenon, renowned marimbist Michael Burritt performed a series of "long" and "short" notes in a recital hall on a professional-grade marimba (see Figure 1). The sounds arising from these long and short gestures are acoustically identical; they differ only in the gestures used in their production (Schutz and Lipscomb, 2007). However, the following experiment demonstrates that although the gestures fail to affect *acoustic* note duration, they are (accidentally) successful in affecting our *perception* of acoustic duration.

In the first experiment within this line of research, participants attended to videos of these long and short gestures and judged the durations of the sounds alone (i.e., they were asked to ignore the visible gesture). When the gesture was long, participants rated the corresponding note as *sounding* longer than the note produced by the short gesture (even though the sounds produced by these gestures did not differ acoustically). The difference in tone duration ratings despite instructions to ignore the visible gesture demonstrates that they, in fact, altered listeners' perception of the note. In other words, although the performer's gesture failed to change the (acoustic) sound of the note, it successfully changed *the way the note sounds* (for details and analyses see Schutz, 2009).

Figure 1: Samples of the "long" and "short" gestures performed by marimbist Michael Burritt at 200 ms intervals, illustrating that the short gesture is largely completed by 200 ms after the moment of impact. In contrast, the long, flowing gesture continues for some time. Time-elapsed images taken from *Psychology of Music* (Tan et al., 2010). (For an animated version, see Video 1 in the digital version of this article at www.pas.org/mar13digitaledition/.)



The fact that ancillary gestures can be used to overcome acoustic limitations of the marimba (despite their lack of acoustic consequences) holds clear practical value. Additionally, it raises the issue of whether audio-alone formats such as radio broadcasts and mp3s fully capture the musical experience. Similarly it conjures up questions regarding the degree to which blind auditions serve as the best means of assessment, given that orchestral audiences experience sound concurrent with both effective and ancillary gestures. While raising thought-provoking questions that will undoubtedly continue to be hotly debated, the effect of ancillary gestures on perception nonetheless illustrates the importance of gesture's role in the musical experience.

The idea that *sound*[1] and our *perception of sound* are not always in one-to-one correspondence is well known to psychologists, who frequently research such discrepancies to better understand the brain.[2] However, from discussions following presentations in venues ranging from PASIC and "Day of Percussion" clinics to master classes, music camps, and private lessons, it is clear that this discrepancy is often a stumbling block to understanding the nature of the musical experience in general, and this research in particular. Therefore, before detailing practical uses of these gestures, we will first illustrate the complex yet fascinating relationship between external objects and our internal perception of those objects.

3. OUR MISPERCEPTIONS OF "PERCEPTION"

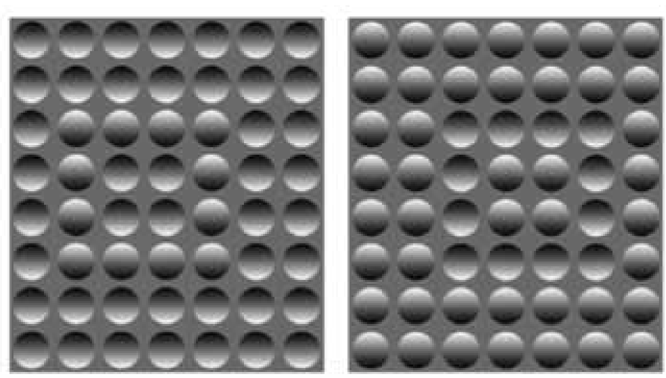
One of the challenges in understanding the relationship between *sound* and the *perception of sound* stems from the ways in which the term "perception" is used. In everyday contexts, it frequently carries a connotation of being incorrect or wrong (e.g., "Although flying is *perceived* as dangerous, it is actually statistically safer than travel by car"). While this is consistent with (one of) its dictionary definitions, it has a different meaning within the context of psychological research. In this context psychologists use it to refer to our *internal experience* of the external world, and it is this domain that forms the heart of the musical experience.

3.1. Perception as an "active process"

Our ability to perceive the world is actually the end result of a complex and fascinating chain of events—yet this process happens so efficiently that we rarely appreciate its complexity. For example, our brains frequently make what psychologists call "implicit assumptions" (i.e., automatic decisions outside our awareness) in order to organize incoming information from multiple senses. These implicit assumptions are helpful in that they afford an *internal perceptual experience* corresponding to the *external state of the world*. Although errant perceptions (i.e., illusions) are intriguing, they are, in fact, exceptions to a generally robust process. Far from being "incorrect" or "wrong," as shown in the following example, these implicit assumptions often lead to perceptions that are actually more accurate than would be expected based on the incoming information alone.

The shaded circles forming a square in the middle of each panel of Figure 2 differ only in that they are shaded on the bottom (left) vs. top (right). Although presented as a flat 2D image on the page or screen, our brains automatically interpret the pattern of light entering the eye such that we *perceive* the image as a three dimensional "bump" when darker on the bottom and a "dent" when darker on the top (Ramachandran, and Rogers-Ramachandran, 2008). This is due to the (generally correct) assumption that light is coming from above our heads. Our brains use this

Figure 2: All circles in this figure are identical in their shading, color, and texture. However, because the image on the right is rotated 180 degrees, the pattern reverses such that the squares in the middle appear to make concave bumps rather than convex dents.



assumption in interpreting the image on our retina, allowing the brain to "decode" the otherwise ambiguous pattern. In doing so, we receive a perceptual experience aligned with the seen object (or in this case an image representing a seen object). In other words, our brains are "thinking for us" so as to provide a rich and useful understanding of the world.

Crucial for music, these perceptual assumptions are not restricted to a single sense, such as vision, but also occur between multiple senses, such as sights and sounds. Our brains organize incoming information in a meaningful way, automatically binding sights and sounds together when they originate from the same event. For example, at a movie theatre the characters' voices seem to originate from the location of their moving lips on-screen; however, they actually originate from stationary speakers fixed at specific locations. Similarly, the well-known "McGurk" effect (Video 2 in the digital version of this article at www.pas.org/mar13digitaledition/) powerfully demonstrates that seeing lip movements can categorically change our perception of heard syllables (McGurk and MacDonald, 1976). That we experience the illusion of unity between disparate sights and sounds is actually a testament to the lengths our brains actively work to construct a compelling narrative of the world around us by binding together related information from multiple senses.

3.2. Do gestures really change what we hear?

Understanding that our brains are "thinking for us" helps to explain the perceptual basis for the note-duration illusion. To trigger this illusion, performers rely on audiences' perceptual sensitivity to the causal link between gesture and sound. Subsequent experiments illustrate sounds that could not be caused by impact gestures, such as those of a clarinet or human voice, fail to integrate with impact motions (see Video 3a in the digital version of this article at www.pas.org/mar13digitaledition/). However, these same gestures do integrate with piano notes—sounds also caused by impacts (see Video 3b). This illustrates the importance of causality in audio-visual perception (Kubovy and Schutz, 2010), something that we can use to great musical advantage, given the clear causal link between our body movements and the consequent sound.

This selective pattern of integration also illustrates that the gestures' effect on duration ratings does not simply reflect "confusion" over the challenge of judging the durations of isolated notes, nor is it merely the result of participants accidentally basing their ratings on the gestures rather than the sounds. Participants can easily ignore the gestures when listening to sounds the movements could not produce, but are unable to ignore gestures that appear to *cause* these sounds. This strongly suggests that their influence is obligatory and automatic. In other words, we are no more able to see the gesture and avoid having it influence our perception of note duration than we are able to see the letters DOG and avoid recognizing it as a reference to man's proverbial best friend.

4. DECONSTRUCTING AND EXPLORING THE STRIKING GESTURES

In order for us to use ancillary gestures effectively in our performances, it is helpful to understand which components drive their effect. Therefore, a subsequent experiment asked a new group of participants to perform the same duration rating task on three kinds of long and short gesture videos: pre-impact (showing only the motion up until the moment of impact, at which point they displayed a still image concurrently with the sound), post-impact (showing only the motion concurrent with the sound), and full-gesture (i.e., the original full gestures). (Samples of these half-gestures can be seen in Video 4 in the digital version of this article at www.pas.org/mar13digitaledition/.) The post-impact and full-gesture videos yielded similar illusions, whereas the pre-impact videos failed to produce any such effect (Schutz and Kubovy, 2009a). This suggests that post-impact movement is the most important part of the gesture for performers to attend to when endeavouring to overcome the marimba's acoustic limitations.

To further explore the motions involved with the long and short gestures, we traced the vertical position of the mallet head (striking implement) over time, and plotted these values against one another (Figure 3; for an animated version see Video 5 in the digital version of this article at www.pas.org/mar13digitaledition/). This illustrates that the gestures differ primarily in their post-impact motion, consistent with the finding that post-impact motion captures most of the illusion (Video 4; Schutz and Kubovy, 2009a).

4.1. Developing new software tools for gesture research

Using the extracted data specifying the precise coordinates of the mallet over time (as well as similar encodings of Michael Burritt's hand, elbow, and shoulder), it was possible to create virtual animations of a marimbist producing long and short notes (Figure 4). Such representa-

Figure 3: Representations of the long (dashed red) and short (solid blue) striking gestures

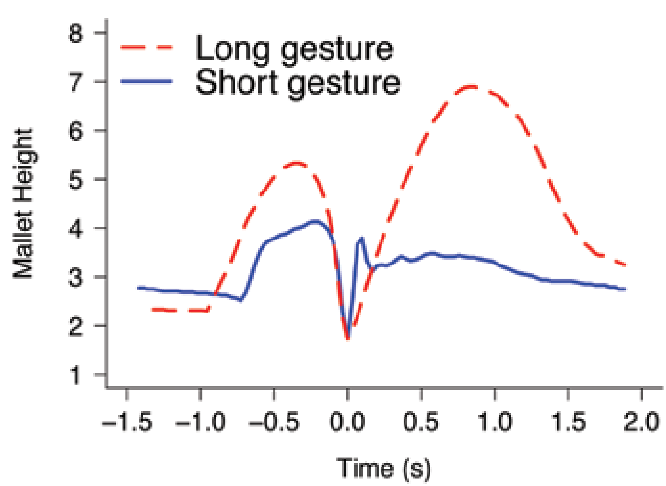
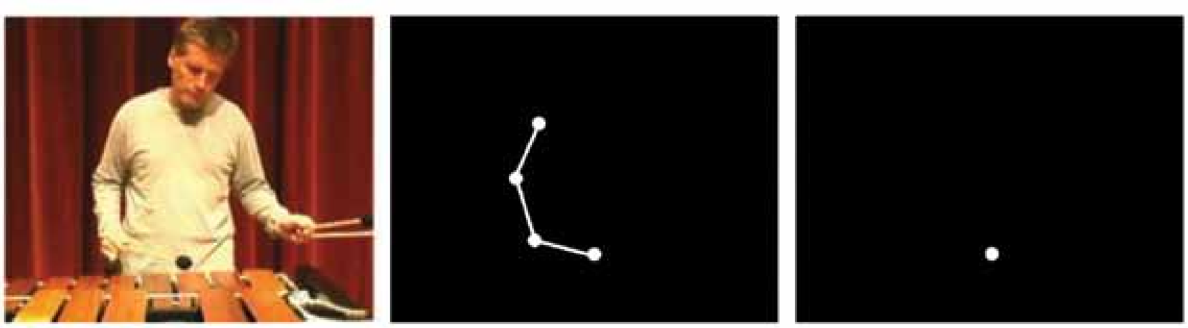


Figure 4: Side-by-side depictions of the original videos (left panel) as well as the 4-point "skeleton" (middle panel) and single dot representations (right panel). (See Video 6 in the digital version of this article at www.pas.org/mar13digitaledition/ for animated renderings of each representation.)



tions are known as a *point-light displays*, a format long used by psychologists to represent human movements (Johansson, 1973) such as walking, drumming, and even dancing. (See Video 6 in the digital version of this article at www.pas.org/mar13digitaledition/ for an illustration of how they saliently mimic the long and short striking gestures used in these experiments.[3])

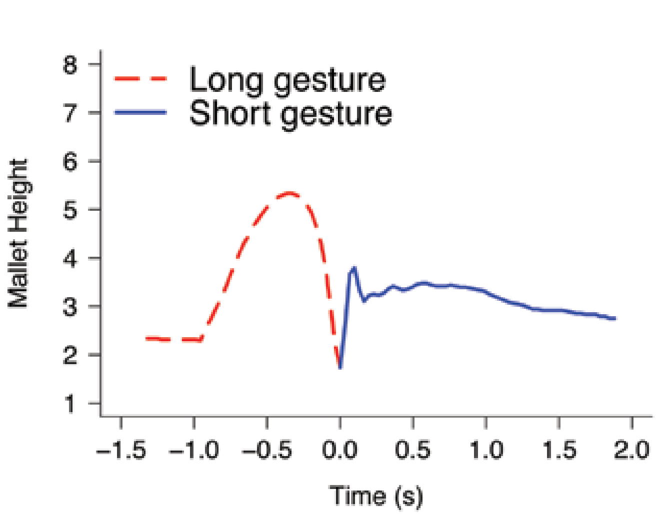
Point-light representations are powerful tools for systematically manipulating human movements while preserving keys aspects of their "realism." In fact, these displays influence auditory perception similarly to the original videos whether using four-point "skeletons" or even single moving dots tracing the motion of the mallet head (Schutz and Kubovy, 2009b). Therefore, these representations are useful tools for synthesizing realistic motion paths offering fine-grained control, and are consequently helpful in deconstructing the gestures to pin-point their salient characteristics. For example, this technology allows for intriguing explorations of "hybrid gestures" mixing pre-impact and post-impact motion, motions that would be difficult to generate with regular video recordings (Figure 5; Video 7 in the digital version of this article at www.pas.org/mar13digitaledition/). Experiments using these hybrid gestures confirm the importance of post-impact motion (Armontrout, Schutz, and Kubovy, 2009), converging with the results obtained using half-gestures (Video 4).

4.2. Deconstructing post-impact motion

The post-impact motion is complex, with the long and short gestures differing along a number of parameters—namely the distance, time, and velocity (i.e., speed) of the motion. As these properties are intertwined, pinpointing their relative influence would be difficult without the fine-grained control afforded by point-light displays. Through a series of comparisons using these representations, Armontrout et al. (2009) determined that it is principally the *duration* of the post-impact motion, rather than velocity, acceleration, or distance covered, that drives this illusion. An illustrative sample of a video pair using longer time/greater distance vs. shorter time/lesser distance with equal motion duration is given in Video 8 in the digital version of this article at www.pas.org/mar13digitaledition/.

This discovery pinpoints the specific cues required to apply these findings to music performance, neatly completing this series of experiments. Together, this research deconstructs the complex motions used by one expert performer to solve an otherwise intractable musical problem—our inability to control acoustic note duration on the marimba independent of other factors such as velocity and pitch. We can take advantage of this knowledge by evaluating our ancillary gestures in light of these findings so as to optimize communication with our audiences.

Figure 5: Hybrid motion path consisting of the pre-impact motion from the long gesture paired with post-impact motion from the short gesture.



5. CLOSING THOUGHTS

5.1 Discussing vs. testing; acoustics vs. perception

Previous debate (i.e., Bailey, 1963; Stevens, 1979) over the role of gesture in controlling note duration has generally been based on personal introspection rather than empirical investigation, and focused on gesture's acoustic rather than perceptual implications. Here we take a different approach by using empirical research to explore gesture's *perceptual* consequences. Our interest in perception stems in part from recognizing gesture's acoustic shortcomings in previous formal tests involving graduate percussion students (Saoud, 2003) as well as marimbist Michael Burritt (Schutz and Lipscomb, 2007). We are aware that some suspect previous acoustic analyses may not tell the full story of this complex issue, and/or that it may be possible to produce reliable acoustic differences given the right combination of mallets, instruments, recital hall, performer expertise, etc. Admittedly, to borrow from another context, "the absence of proof is not proof of absence," and we recognize that it is possible *in principle* for future investigations to discover previously undocumented differences. Therefore we welcome new empirical research aimed at further exploring the acoustic consequences of striking gestures (particularly those on other instruments)—research that would make valuable topics for DMA/MA dissertations, undergraduate thesis projects, or informal explorations. Yet based upon all of the evidence currently at our disposal, we continue to concur with Leigh Stevens' now decades-old position (i.e., *Method of Movement*, 1979) that long and short gestures are acoustically ineffective, a view expressed colorfully in his 2004 email explaining that "stroke height has no more to do with duration of bar ring than the sound of a car crashing is dependent on how long a road trip was taken before the accident." Consequently, we believe the most fruitful way for percussionists to control note duration is by understanding and employing (acoustically ineffective) ancillary gestures capable of altering an audience's perception.

In the context of this discussion, we do feel compelled to mention one report of gesture's acoustic consequences with respect to timbre (Roberts and Larkin, 1994), a finding that may resonate with those who have personally heard differences within their own playing and teaching. Reflecting on my own (MS) near-decade of playing, teaching, and conducting at several universities, I suspect that we employ looser grips when preparing to use long, flowing post-impact motions rather than short, choppy ones. And as pointed out by Gary Cook in *Teaching Percussion*, such differences in grip tension can affect the time-of-contact between the mallet and bar (Cook, 2006, p. 126), leading to differences in timbre.

However, it is important to note that *timbre* and *duration* are distinct qualities, and to the best of my knowledge there is no evidence of gestures' effect on the latter's acoustic structure. Admittedly, I myself have heard "longer sounding" notes produced with long gestures. However, my brain uses the same implicit assumptions (section 3) as yours, and consequently I recognize that this represents a shift in my *perception* of the note's acoustic properties, rather than a change in those properties themselves. Although this distinction may seem academic from a musical perspective (what matters musically is that the gestures "work"), it highlights the value of understanding gestures' true role. For as aptly observed by renowned percussionist Steve Schick, "physicality and gesture are powerful tools of communication."

5.2 Music as an auditory phenomenon

Despite the well-documented role of visual information on the perception of music shown in these experiments as well others (see Platz and Kopiez, 2012; Schutz, 2008; and/or Thompson et al., 2005 for reviews), it is important to recognize that music is at its heart an auditory art form (though not purely an acoustic one). Although our perception of sound is clearly shaped by extra-acoustic factors, such influences "affect the music" only insomuch as they alter our listening experience.

Although judicious use of ancillary gestures can assist with carefully crafting our audiences' perception of a performance, they can also be ineffective or even counter-productive when used inappropriately. Indeed, despite his fascination with the communicative possibilities of gestures, Schick cautions us that inappropriate gestures "usually seem false if not pretentious."

No gesture can substitute for attention to phrasing, sound quality, note accuracy, or any of the other myriad factors important to music making. Likewise, they cannot counteract inadequate preparation or incorrect technique. Ancillary gestures can enhance our performances, but they are only effective when used in conjunction with good musicianship. Nonetheless as performers we are constantly evaluated by brains whose listening is shaped by ancillary gestures. Therefore understanding their uses (and limits) is beneficial for all musicians. As percussionists we are uniquely positioned to benefit or suffer from their consequences, given the large amount of physical movement required in our playing. Consequently much as understanding the historical context and theoretical structure of a composition informs our performance/listening, understanding the perceptual and cognitive processes giving rise to the musical experience is an invaluable and worthwhile endeavor.

5.3 Future directions

Although the perceptual basis of this particular musical illusion is now well understood, we are currently planning several new projects to explore other ancillary gestures. For example, we are interested in extending these studies by recording professional marimbists playing full musical excerpts (rather than single notes), and in running parallel experiments involving other percussion instruments. We are also exploring the effect of "moving to the beat" while listening to rhythmic music, documenting that this movement can actually help improve a listener's understanding of musical rhythm (Manning and Schutz, 2011). Together, these lines of research will help to explore and document a variety of extra-acoustic factors playing a role in musics' perception, which we hope will inform our ability to analyze, understand, and participate in the musical experience. For information on this and other lab projects please visit the MAPLE Lab online at www.maplelab.net.

ACKNOWLEDGEMENTS

This article represents a condensed version of Schutz and Manning (2012), where interested readers can find more extensive discussion of this research's implications for music theory. We would like to acknowledge financial assistance for this research from the Natural Sciences and Engineering Research Council of Canada (NSERC RGPIN/386603-2010), Ontario Early Researcher Award (ER10-07-195), McMaster University Arts Research Board, and the Canadian Foundation for Innovation (CFI-LOF 30101). We would also like to thank Gary Cook, Michael Udow, Michael Overman, Jonathan Latta, Ted Rounds, Charlie Nesmith, Derek McAnally, Adam Campbell, and Eric Hollenbeck for helpful comments on previous drafts of this manuscript. Finally, we would like to thank Michael Burritt for his continued support of this project, as well as Simeon Fitch and Ben Guseman of Elder Research for their software development efforts.

ENDNOTES

1. Here we use the term "sound" to refer to acoustic events in the world (i.e., vibrations of air molecules), irrespective of whether these vibrations are detected/perceived by humans.
2. Psychologists commonly distinguish between the brain (i.e., the "neural hardware" serving as the basis for consciousness) and the mind (i.e., the collection of processes carried out by the brain). In order to focus attention on the musical applications of this research rather than protracted discussions about the brain/mind relationship, here we simply use the term "brain" to refer to all cognitive and neural processing.
3. Once fully developed, we plan on sharing this software through our lab website to allow others to explore new issues by synthesizing their own motions. Please visit http://maplelab.net/software for more details.

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