Entrainment and Embodiment in Musical Performance

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Abstract and Keywords

This chapter introduces three distinct concepts of entrainment and relates them to the topic of musical embodiment. Drawing on work in music and other disciplines, the chapter discusses the relationships between “long-term,” “short-term,” and “physical” entrainment. Given the close relationship between entrainment and bodily movement, it is argued that each of these concepts implies a particular type of musical body. These types are discussed and compared, and their salient differences identified. The chapter closes with a brief exploration of these three types of entrainment and their related musical bodies, as they can be seen and heard in the course of playing J. S. Bach’s Prelude in C minor, BWV 847.

Keywords: entrainment, embodiment, rhythm, meter, habit, BWV 847

ACCORDING to the ethnomusicologist Martin Clayton, entrainment “refers to the process by which independent rhythmical systems interact with each other” (2012, 49). This intentionally broad definition gives a useful practical basis for a range of scholarly work, from field studies, to empirical experiment, to score analysis. It suggests links between music and other disciplines, such as biology and psychology, where the notion of entrainment is already deeply embedded. Moreover, it connects to theoretical concepts of time, rhythmic regularity, and intentional action, concepts that are integrated within the notion of what it is to exist as a human. Such connections lend the concept of entrainment considerable potential for the study of embodiment. This potential, placed in the context of musical embodied experience, is the subject of this chapter.

This investigation of relationships between entrainment and musical embodiment in music begins with a discussion of definitions of entrainment and identifies three distinct threads within the scholarly literature on this topic. Each of these threads can be seen to entail complementary perspectives on the nature, function, and operation of musical embodiment. Taken together, they suggest that the study of entrainment in music offers considerable potential to advance research on the concept of the body in music. In a final brief case study, this chapter shows how intertwining strands of entrainment imply differ-

ent features of musical embodiment in the performance of a keyboard prelude by J. S. Bach.

The concept of entrainment has assumed increasing importance in Anglo-American music scholarship over the past twenty years. The term has become a mainstay for discussions of the complexities of musical rhythm considered as sound, as well as for work on the interactions between humans and the pulses, rhythms, and durational repetitions available within music. Clayton's definition, quoted earlier, provides a useful broad characterization of the concept that underpins most of this work. However, deeper (p. 178) investigation into the "systems" and "interactions" involved in entrainment brings to light some important distinctions between the idea of entrainment that operates across a number of disciplines. This is not a new observation: in 2011 the ethnomusicologist Judith Becker observed: "The term rhythmic entrainment is sometimes used in two different senses, depending on one's disciplinary allegiances" (2011, 49). This chapter goes one step beyond Becker to argue for three distinct, if overlapping, meanings of entrainment in fields as diverse as biology, psychology, and music. In line with the overall focus of this volume, it shows that these three meanings imply distinct perspectives on the notion of embodiment in musical practice: indeed, each entails a specific understanding of what a musical body may be. In order to suggest some of the ways in which these types of entrainment operate within the contexts of playing music, the chapter ends with an analytic case study of a prelude for keyboard by J. S. Bach. This work, with its typical motivic concentration and motoric rhythms, generates a tight relationship between bodily gesture and sonic pattern. It is thus a useful venue for study of the interaction between entrainment and embodiment in performance.

Origins of Entrainment

The concept of entrainment is generally traced back to the discoveries of the Dutch scientist Christiaan Huygens in the second half of the seventeenth century. Huygens was working on navigational devices when he discovered that two pendulums suspended from the same piece of wood tended to synchronize their oscillations over time. Further experiments showed that a similar process occurred in cases where there were more than two pendulums, including those suspended from a board and those placed on one. In all cases, the vital factor in producing the synchronization was the ability of the wooden table or board to transmit the oscillations of the pendula, causing each to affect the other (Pikovsky, Rosenblum, and Kurths 2001, 2–4).

Despite the age of the concept, the term "entrainment" itself does not appear to have achieved common usage until the middle of the last century. It does not appear in regular academic use until the 1960s, where it first emerges in the context of work in biology and physiology. These disciplines tend to deal with the interactions of rhythmical systems over an extended period and many populations, leading to a particular meaning of entrainment, which this chapter terms "long-term" entrainment.

“Long-Term” Entrainment in Biology, Physiology, and Related Sciences

The notion of entrainment as the long-term interaction between two large-scale biological systems emerges through a number of works in chronobiology and physiology (p. 179) beginning in the 1960s and continuing to the present day. It is worthwhile to discuss the topics of some of these studies briefly in order to obtain a sense of their scope. Shepherd Roberts (1965) studied the entrainment of photoreceptors in cockroaches to environmental light cycles, discovering to what degree obstructing these receptors led to a loss of entrainment. In 1966, M. L. Goff studied the effect of light-dark cycles of between sixteen and forty-eight hours on the behavior of rats (Goff and Finger 1966). And Lickey (1969) studied the entrainment between light cycles and a single neuron of the sea hare. There are clear commonalities between these studies that speak to their mutual reliance on long-term entrainment. They are listed as follows:

- All these studies concern the interaction between oscillators over long durations of time of at least several hours.
- All involve the presence of a dominant, external oscillator. This is usually termed the *Zeitgeber*, which the *Oxford English Dictionary* defines as “a rhythmically occurring event, esp. in the environment, which acts as a cue in the regulation of certain biological rhythms in an organism.”[1] It is this event, or more precisely, series of events, to which the individual rat, cockroach, or neuron entrains.
- Both the *Zeitgeber* and the dependent oscillations operate by definition unconsciously, at the level of an automatic system.
- All measure entrainment not through close observation of one particular instance but through statistical studies of many, even thousands, of near-synchronicities between the oscillating systems. In these terms therefore, entrainment is a matter of statistical tendency over a sustained period of time.

All four of these characteristics show that long-term entrainment involves thoroughgoing and large-scale interaction between systems. It is quite distinct therefore from the notion of entrainment as an immediately observable synchronization, which is perhaps where musical discussions of entrainment tend to start. However, long-term entrainment does indeed find employment in music studies, including what may be the first clear use of the concept in music-related scholarship.

“Entrainment Music” and the Entrained Body

The first scholar in Anglo-American music studies to introduce entrainment into the vocabulary of music was the music therapist Mark Rider. In his dissertation (1988) and in a number of articles, Rider argues that entrainment involves a particular relationship between sound and the internal workings of the body. Using the long-term concept of entrainment as outlined in biology and physiology, Rider suggests “entrainment music” may

have a healing effect on the body in direct terms, bypassing consciousness and operating on the level of individual cells. Rider describes entrainment music as a particular genre of music, improvisatory in character and involving select instruments. It aims at (p. 180) setting up synchronization between the rhythmic impulses of the music and the movement of cells in the subject.

Rider's entrainment music is rooted in the same approach as that used in the biological studies discussed above. Like the studies of entrainment among certain animal populations, the effects of entrainment music occur over relatively long durations: it will take many sessions of entrainment therapy to bring about a cure. Similarly, the effect of entrainment can be felt over large populations: indeed, this is its utility. In addition, the importance of the unconscious character of entrainment is apparent in Rider's argument. Christiaan Huygens, observing two clocks gradually achieve synchronicity from his sickbed in 1665, wrote of "la sympathie des horloges" (the sympathy of the clocks). This phrase brilliantly captures the tension between an observer's acknowledgment of the absence of willpower—clocks cannot intend anything—and the apparently inevitable anthropomorphism—yet the process involves sympathy. In a similar way, long-term entrainment implies a capacity to go beyond and behind conscious impulse, to draw out the healing properties of a body's biological structure. There is no immediate volition involved in this concept of entrainment, yet there is nevertheless a strong appeal to an underlying force or power. This approach to entrainment endures in other, largely therapeutic, approaches in music scholarship. One quite recent example occurs in the controversial literature on binaural beats and their efficacy in treating cognitive disorders (Turow and Lane 2011).

"Short-Term" Entrainment and the Psychology of Attention

The long-term model of entrainment emphasizes the force exerted by the *Zeitgeber* mechanism and the consequent passivity of the subordinate oscillators, which are forced to entrain with the former's phase and period. As a contrast, in what this chapter calls the "short-term" model of entrainment, developed primarily through work in psychology and cognition, the activity of the receiver or listener plays a much greater role.

This latter understanding of entrainment finds its origin in the work of the psychologist Mari Riess Jones (see Jones 2009 for a brief overview of her career). Jones set out to explain the mechanisms that control human attention to the external world and found a large part of her answer in the concept of entrainment. For Jones, human attention is essentially rhythmic and periodic: it interacts with the external world through perceiving and locking into similar rhythmic patterns found in its environment. Entrainment thus becomes a fundamental property of human interaction with the outside world.

> We assume that an attender initially entrains to some relatively regular, prominently marked time period within an event. Perhaps in an utterance, it is a person's (p. 181) characteristic articulation rate; in music it may be the beat period

> or measure span. In any case, this period functions as an anchor or referent time level for the perceiver. . . . This referent period provides (a) a temporal reference frame, "locking the attender to the event," and (b) an event-determined time scale that "calibrates time spans."
>
> (Jones and Boltz 1989, 470)

Jones's approach has three central characteristics, (1) it grounds the activity of entrainment in the listener and, given her interest in the immediacy of attention, (2) it emphasizes the short-term importance of locking into attentional rhythms. Indeed, in her earlier work she seems to prefer the term "synchronization" to "entrainment" perhaps in order to avoid the associations of the latter term with long-term durations (Jones 1976). Additionally, given her focus on the cognitive function of attention, her approach to entrainment (3) implies that it interacts with the human potential for expectancy, and thus may link to volitional behavior; an implication mostly absent from the long-term approach described earlier. Developing this third implication, Jones has extended her initial interest in entrainment into deep studies of music as a human activity, studies that investigate questions of attention, expectancy, and rhythmic behavior. Her work has had a foundational influence on the theorization of rhythm and meter in music scholarship. Many scholars have followed her lead in exploring musical rhythm from the perspective of short-term entrainment.

Robert Gjerdingen, for example, studies oscillatory processes of neurons as an example of entrainment, drawing on and developing Jones's emphasis on the function of entrainment in perception (1993). However, the music theorist who has developed Jones's work in the most thorough fashion is undoubtedly Justin London. Working from the concept of entrainment as a fundamental feature of human perception, London proposes, "meter is a specifically musical instance of a more general perceptual facility of temporal attunement or entrainment" (2004, 24). Meter in this sense arises from our capacity to lock into entrainment with music.

This notion of short-term entrainment is primarily a psychological one. London argues the role of musical meter as a type of entrainment is filtered through our capacity for physical movement. "Metric entrainment . . . may be the direct synchronization of our movements to external rhythms" (12). The further question of *what* movements may occur appears to be entirely open, in principle at least, and so the details of what the body does, or how it is, seem relatively unaffected by short-term entrainment. A body may use the entrainment as potential for movement, London suggests, but it is not clear that it has to do so. Rather, if entrainment provides a listener a perception of the potential for movement, then this is enough.

Short-term entrainment implies a listening body, but this body is by and large neutral as regards other aspects of embodiment.[2] In long-term entrainment, the body is understood as the passive receptor of an oscillatory rhythm, which may be targeted to specific bodily parts. In short-term entrainment, the body actively identifies oscillatory rhythms in the environment, seeking out opportunities for entrainment, but without reference to (p. 182)

specific physical features. In other words, as an entrained body, I may move my fingers, toes, nose, ears, hips, or all, or none, without altering what is understood as the characteristic quality of short-term entrainment.

“Physical” Entrainment and Embodied Movement

In recent studies of movement to music, the use of techniques such as video and motion capture has allowed for a more precise study of gesture within the context of a natural musical event (MacRitchie, Buck, and Bailey 2013; Nusseck and Wanderley 2009; Palmer et al. 2009). These studies, taken together, suggest a nascent approach to entrainment that is distinct from the others discussed earlier. Beginning from the central observation that a certain movement or set of movements entrain to one or more musical events, this approach emphasizes the local, physical, and (perhaps) low-level nature of this entrainment. In these cases, entrainment implies an (unconscious) elicitation of a particular, synchronous movement. Thus, this approach joins together certain aspects of both long-term and short-term entrainment in a common foundation of physical movement. This third type, which I call “physical” entrainment, suggests a complex relationship between body and sound.

This emphasis on the physical detail of entrainment is founded in part on an extension of the systematic concept of entrainment to include physical actions in general. Thus, Clayton points out that synchronized oscillators are central to many basic physical acts, even before there is any involvement with music or external sound: “Still within the individual but on a somewhat larger scale, many common actions involve the synchronisation of movements between different body parts—for example walking” (2012, 50). On this reading, fundamental habits such as walking, talking, and tapping involve entrainment within the physical systems of the body.

If entrainment is already present in physical movement, then it assumes a richer significance when the event of musical performance is also taken into consideration. Several scholars have focused attention on rhythmic details of the physical performance of music, as well as its reception. For example, the work of Floris Van Vugt has investigated the specific rhythms of scale patterns played by student pianists, showing how finger actions play particular roles in forming temporal patterns (Van Vugt, Jabusch, and Altenmüller 2012). Edith Van Dyck’s work on dance music has demonstrated that changes in the sound of the bass drum have a consistent relationship with changes in dancers’ head movements (Van Dyck et al. 2013). And work by Caroline Palmer and Marcelo Wanderley has illuminated the role of specific rotation movements by clarinetists in performance (Palmer et al. 2009; Wanderley et al. 2005). These rotations entrain to music on a regular basis, forming an important part of the phenomenology and syntax of musical performance. On a theoretical note, Marc Leman has suggested an amendment to Clayton’s discussion of entrainment, arguing that entrainment to music is not merely a psychological

feature, but (p. 183) includes spatiotemporal aspects in terms of the place and the time in which the entrained body moves (2012).

All these studies suggest that there is the potential for aspects of musical sound to have a direct effect, through entrainment, on particular parts and movements of the body. Such an effect may depend on either or both of the two types of entrainment presented above. However, the third, physical entrainment, is different both in kind and in the potential it offers for research into embodiment, for the following reasons:

- Such body-sound entrainment will be highly contextual, dependent on personal engagement with music in addition to the spatiotemporal qualities mentioned by Leman.
- The connection between sound and body can be considered as a primary foundation, without the necessity to posit a cognitive, psychological process.
- The direct relationship between sound and body movement means that this entrainment is not a conscious, deliberative movement.

In the specific context of the case study at the end of this chapter, some of the implications of physical entrainment for music and the body are outlined. First, however, it will be useful to set out the ways in which these three types of entrainment imply different conceptions of musical embodiment.

The Entrained Body

Each of the three concepts of entrainment I have outlined has implications for the role of the body in music, and research into musical bodies. Indeed, each may be said to imply a particular concept of musical embodiment.

1. **Long-term entrainment and body schemas:** This notion of entrainment, rooted as it is in biology, finds its significance for music in the study of repeated physical actions made in the process of learning a particular instrument or piece. These actions are often regulated by a Z*eitgeber* such as a metronome: this sets a standard for the development of a particular technique and defines a practical ability that may be shared among a group of instrumentalists. The practice of these techniques, which include scales, arpeggios, chords, and so on, may perhaps be an individual affair, but the common nature of the exercises means that they are shared in effect. And therefore it is by no means difficult to imagine a group of instrumentalists together achieving entrainment with a particular metronome mark. Such an achievement will, in fact, develop a specific bodily ability, much like athletic training in a gym. This suggests that research on this type of musical embodiment could focus on the ways in which musical disciplines develop particular movements that come to define bodies.

The embodiment created through such long-term entrainment thus includes innervated physical movements. As the entrained physical movements that typify (p. 184) instrumental training sessions become absorbed within the sound, their status as movements typi-

cally will fade from the consciousness of the player. This fading is, of course, a benefit: it would be impossible to consciously control all aspects of playing a complex piece (Noë 2009). So, for almost all performing musicians, many of the movements that the body makes to produce sound are no longer a conscious focus of attention. Thus, players may no longer consider performance as a series of physical gestures, preferring instead to understand the music as a flow of sounds.

This experience is not confined to musicians: the same can be said of the movements of many others who use physical actions to achieve specific goals external to their bodies, such as athletes. In his work on consciousness and the body, Shaun Gallagher uses the term "body schema" to describe such integration between action and mind developed through repetitive habits. For Gallagher, a body schema is "a system of sensory-motor capacities that function without awareness or the necessity of perceptual monitoring (2005, 24). Typically, body schemas do not need conscious attention: they underlie interaction between the environment and the body, and are experienced in terms of one's engagement with the world. In this sense, to speak of the body of a musical performer is, at least in part, to speak of this collection of innervated movements and capacities for movement: to speak, that is, of a body schema. Studying the operation of long-term entrainment is one way to come to terms with the development of such body schemas by musicians.

2. Short-term entrainment and the listening body: The psychological approach of short-term entrainment depends on someone perceiving an external oscillator. As noted above, such perception is psychological: it does not require any specific bodily activity. This lack of specificity is demonstrated in the traditional use of experiments based on tapping to explore relationships between human perception and musical organization. The bodily activity of tapping is one that offers very little resistance or counterpoint to an external pulse. That, of course, is taken to be one of its benefits for such studies: it appears as a "normalized" activity that represents the best way to gain direct access to the relationship between mind and rhythm. And yet even at the origins of such experiments the details of physicality interrupt this access, thus in the classic studies of Lewis Stevens in the late nineteenth century, the author notes his disappointment at the failure of some of his subjects to overcome tiredness while attempting to complete the required duration of tapping activity (1886). Clearly, the specific context of the physical activity is as an unwelcome distraction: the real interest lies in the mental process of which this activity is, apparently, a product. This attitude illustrates well the particular role of the body in discussions of short-term, psychological entrainment. Bodily movement is held as vital insomuch as it provides evidence of psychological processes, but due to the priority accorded to these processes, the particularity of bodily actions tend to be devalued. The body of this type of entrainment is therefore largely a matter of potentiality rather than actuality. It comes into being as the vehicle of an active, attentive listening that perceives musical rhythms and the potential of entraining to them through unspecified physical actions. It is therefore, at least in part, a virtual, imaginary body. (p. 185)

3. Physical entrainment and the multifaceted body: The particularity of movement, absent from short-term entrainment, is the defining characteristic of physical

entrainment. In relationship with the sound, certain bodily actions become immediately and directly entrained. Since these actions are, by themselves, evidence of entrainment already taking place within the musculature of the body, we can and should regard such activities as examples of entrainment at more than one level: there must be more than two entrained systems involved in such activities. The body that emerges from this notion of entrainment is a decentralized one, consisting of two or more systems that may, or may not, coordinate. When they do, which is whenever entrainment of physical actions to music occurs, there is a nesting of entrained systems, forming what may be hierarchical structures. This picture of embodiment is complex and multifaceted, suggesting that to account for entrainment in this way may take a number of disparate perspectives.

There is much more that might be said about the characteristics of these three types of entrainment, and the ways in which they may imply musical embodiment. This chapter abjures further theoretical discussion, however, in order to examine some of the ways in which these forms of entrainment interact in an analysis of a single piece of music and to discuss some of the implications these interactions may have for embodiment.

Case Study: The Performer's Body as Entrained and Entraining

The following analysis examines the interactions between the previously outlined three forms of entrainment, the characteristic embodiment each brings forth, and their musical consequences. This takes place in the context of a case study of the Prelude in C minor BWV 847 by Johann Sebastian Bach. Figure 10.1 shows the opening measure of this second prelude from Book 1 of the *Well-Tempered Keyboard*.

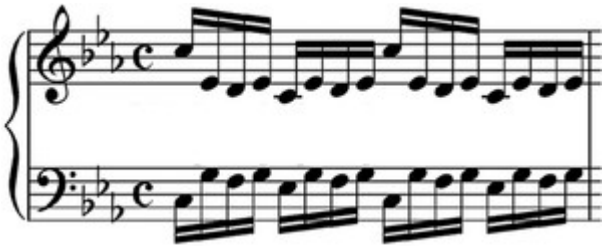

Figure 10.1 The opening measure of J. S. Bach's Prelude in C minor, BWV 847.

(p. 186)

Long-Term Entrainment in the Prelude in C Minor, BWV 847

As in many preludes of this era, there is a constant succession of sixteenth notes. These are grouped in fours, and within each of these groups, the last three notes require the player to make a repeating pattern of movement in which the neighboring fingers of both

the right hand and left simultaneously create a shape that descends a single step and then returns. These shapes continue for most of the piece, so that the experience of playing becomes defined, in part, by the continuous making of this finger shape at regular intervals. Figure 10.2 shows a graphic representation of this shape and generates a formulaic statement of the shape in terms of finger action.

As the graph and formula in Figure 10.2 display, the repetition of these finger movements allows them to be felt and heard as a single gesture, with attendant specific rhythmic and durational characteristics. This gesture continues throughout much of the course of the prelude.

In terms of the long-term entrainment discussed previously, the process of practicing, using the score as a reference point, creates entrainment between fingers and the demands of the notation. While the score itself is, of course, silent—a mere set of instructions—the keyboard player will treat the score as an oscillatory reference point for her practice, turning it into a *Zeitgeber* in functional terms. Over the durational experience of practicing this piece, the constant playing of the finger gesture will allow it to entrain with the demands of the score. Clearly, not every instance of the gesture will entrain exactly to the ideal of evenness notated in the score. But there will be a general tendency, which could be expressed in terms of statistics, for this pattern to conform to the oscillation suggested in the score.

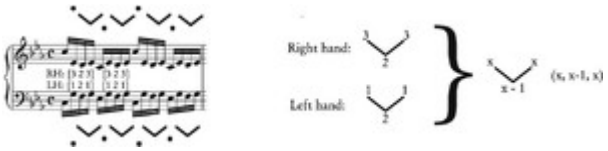

Figure 10.2 The basic gestural shape for the player of BWV 847.

As with the other examples of long-term entrainment discussed above, this long-term process of entraining is not individual: it will be shared across the population of pianists practicing this piece, much as a population of neurons exposed to a certain *Zeitgeber* will eventually entrain to it. To be sure, the oscillation of sixteenth notes represented in the score is of much shorter duration than the circadian-type rhythms discussed earlier. However, the process of bodily adjustment to a regulator rhythm over an extended period of time is a similar type of learning. Through sustained practice, the body attunes to the performance of the sixteenth-note figure, so that its performance becomes a habit (p. 187) in the phenomenological sense: a characteristic capacity of a body that is learned to the point of innervation and no longer demands conscious control (Noë 2009; Talero 2006). The musical body implied by this prelude is, in part, one that has internalized this particular schema. In a general sense, then, this prelude as a piece of music sets up a particular definition of musical embodiment through long-term, background entrainment. A body—any body—that practices this prelude, and successfully realized the score, will incorpo-

rate the gestural and rhythmic schemas shown in Figure 10.2 as defining elements of its constitution.

Short-Term Entrainment in the Prelude in C Minor, BWV 847

Within the particular long-term entrainment involved in playing this prelude comes a short-term potential for the creation of metrical entrainment. This specific short-term sense of synchronization emerges against the regular background of long-term finger gesture. In terms of Figure 10.2, the metric entrainment of this piece is generated by the first sixteenth-note of each four-note group; the dots of Figure 10.2 as opposed to the graphic lines.

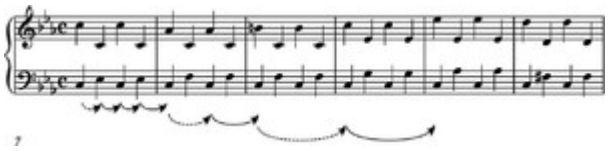

Figure 10.3 Three patterns that may generate short-term entrainment in BWV 847.

Figure 10.3 shows the first sixteenth-note of each grouping of four. The patterns of these notes establish a quadruple meter through what is roughly the first half of the piece. This pattern creates several different levels of possible entrainments, and these are shown on the figure with the curved projective arrows used by Christopher Hasty (1997) in his theory of meter as an essential element of rhythm. For example, at the quarter-note durational level the distinction between the notes of gesture A, and the notes alternately above and below it form one level of potential entrainment, as shown by the shortest projective arrows in Figure 10.3. The up-down-up-down contour at the half-note durational level forms a further potential meter: this is shown by the longer arrows on the second level. The changes in pitch pattern at the whole-note level, and particularly the succession created by the C4–B4 major seventh followed by the C4–C5 octave present another level of entrainment, shown by the longest curved lines on Figure 10.3. Since the first level could nest within the second, and the second within the third, it (p. 188) is possible to shift perception from one level to another during the course of playing Figure 10.3, though one can only attend to one level at any one moment.

To describe these as examples of entrainment raises the question: what is being entrained? In the long-term entrainment that developed the basic gesture as a habit, the answer was clear: the fingers themselves. And it was argued earlier that this entrainment helps define a particular form of musical embodiment. In the case of short-term entrainment, as discussed earlier, the entrainment does not specifically define a musical body. It has, to be sure, bodily correlates. For example, the outlines of the contour in both right and left hands give a rough type of support to the sense of short-term entrainment. More precise and important, however, is the aural distinction between consonance and dissonance in the intervals formed between the notes of Figure 10.3. Thus, the dissonant quali-

ty of the major seventh in measure 3 facilitates a strong sense of arrival on the consonant octave downbeat of measure 4, suggesting a phrase ending. There is no specific bodily correlate to this arrival, other than the experience of hearing the octave as a consonant resolution.

The body implied by this short-term entrainment is, therefore, primarily a listening body rather than an active one. Again, as with the long-term entrainment and the definition of a body schema, the activity of playing and listening to this music has potential to define a particular body. In this case, however, this body is defined through what it may perceive: it is a body defined through perception rather than action.

Physical Entrainment in the Prelude in C Minor BWV 847

In tandem with the other two forms of entrainment, the details of specific physical movements form a third and vital rhythmic element in relation to this piece. This form of entrainment reflects the details of physical engagement with the sound over the duration of the music; as such, to track its course through the music would require a lengthy analysis. In this chapter, therefore, attention is confined to one salient point concerning the interaction of hand shape with short-term, metric entrainment in the prelude.

Figure 10.4 shows the four different shapes the hand assumes in playing this prelude, all the while maintaining the basic gesture, as shown by the V-shaped lines in the example. The shapes are A, in which the basic gesture lies between a descending interval, and mirror A, in which the gesture lies between an ascending interval. B and mirror B follow the same principal, though the notes outside the basic gesture stay either above or below it.

Figure 10.5 shows that in the opening measure the right hand forms shape A, while the left hand forms shape B. This pattern of shapes continues through the first three measures: were the piece to continue in this way here, this pattern of motives could be seen as a durational extension of the long-term entrainment of the background gesture. However, as the music continues, measure 4 defeats this potential through a change in (p. 189) the left-hand shape from B to mirror A. This new beginning coincides with the short-term return to the C octave in measure 4, which marked out a sense of return for the listening body, as discussed previously.

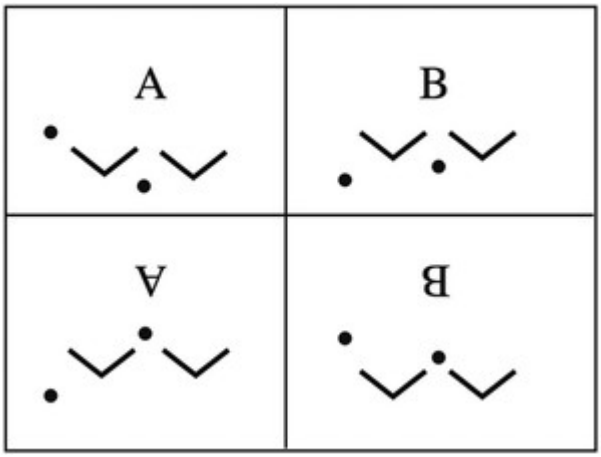

Figure 10.4 The four different varieties of hand shape in the motives of BWV 847.

This change of shape in measure 4 is a marked and specific physical change, creating an important alteration in bodily movement. The specific requirement for the left hand to play G3 above the ongoing ground defines an active body that contrasts with the listening body that hears the returning octave. This body counterpoints the listening one, responding to the heard arrival point of the octave C with a specific physical movement that goes against the grain of the listening body. This Barthesian moment is defined by a concatenation of three different aspects of musical embodiment within the experience of the player. The long-term entrainment with the prelude's characteristic gesture combines with the short-term entrainment created by the experiences of consonance and dissonance. Together with this, the rhythm of the physical shapes of performance provides a further level of entrainment in performance. Through this experience, the musical qualities of measure 4 emerge as the direct products of the interaction between the respective types of entrainment, each of which supports different forms of musical embodiment through the sound.

The experience of these different forms of entrainment becomes a musical feature of this prelude, and physical entrainment, defined through the details of the hand shapes that execute this music, emerges as an important factor at several further points in the prelude. The body that plays and hears this prelude is one that is defined by the body schema of the basic gesture; by its attention to the short-term entrainment of meter, together with its physical correlates; and by its occasional conflicts with this meter in terms of the rhythm of hand shapes. In this sense, there is not just one body that plays and entrains to the rhythm of this music, but, as the musical contexts and moments change, there are potentially many different forms of embodiment that emerge throughout the course of the prelude. (p. 190)

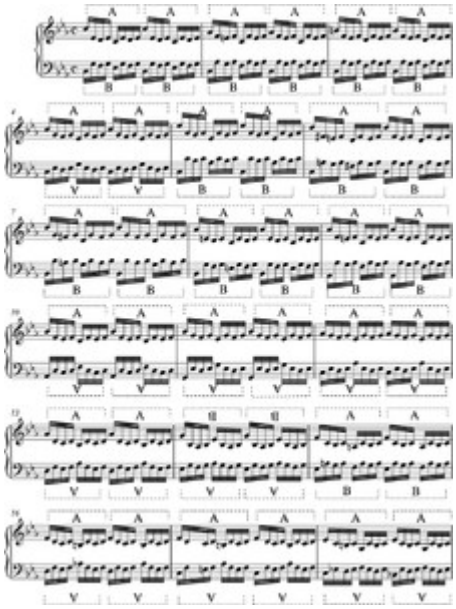

Figure 10.5 The succession of hand shapes through the first page of BWV 847.

(p. 191) Conclusion

This chapter has introduced and outlined three distinct, though surely related, concepts of entrainment. These concepts bring with them particular implications for musical embodiment, implications that suggest the relationship between music and body is complex and multifaceted. By way of a short discussion of embodiment in the experience of playing and listening to Bach's Prelude in C minor, this chapter suggests some of the ways in which scholarly approaches that include entrainment may be useful in studying the multiple ways in which the human body creates and uses music.

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Notes:

(1.) OED Online, “Zeitgeber, n.,” accessed June 13, 2016, http://www.oed.com/view/Entry/232755?redirectedFrom=zeitgeber.

(2.) In this neutrality it adheres to the classical tradition of measuring rhythmic effects in psychological terms through experiments that involve standard or default movements such as tapping. In such studies, tapping is taken to stand for any type of movement: it becomes the default way to demonstrate the human psychological capacity to perceive rhythmic patterns.

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