CHAPTER 4

Music-Related Movement

First we move. Before we sing, we must be aware of our body. We take a deep breath, and the heart pumps faster; the blood flows to the extremities, the muscles flex and stretch, and we take a step forward.

Mark Ross Clark (2002, 3)

This chapter starts with an overview of various gesture definitions, and discusses why I have decided not to use this term in my research. There then follows an overview of various music-related movements and actions, and a taxonomy for describing such movements and actions.

4.1 Introduction

The previous chapter described one specific type of music-related movement: sound-producing actions. This chapter will give a general overview of different types of music-related movements, and suggest a terminology and a classification system that may be used to discuss such movements. Working on this project I have been struck by the lack of a common vocabulary, and how several of the main terms are used differently in various disciplines. In particular, I find the word gesture to be problematic, and particularly when it is used in the term musical gesture. The growing interest in “gesture research” in recent years is certainly fortunate, but I have found that the word gesture itself is becoming increasingly difficult to use. This chapter will therefore start out with a discussion of this term, before moving on to the presentation of various types of what I prefer to call music-related movement.
CHAPTER 4. MUSIC-RELATED MOVEMENT

4.2 Gesture Definitions

Several suggestions for categorising the broad range of gesture research have been offered. Zhao (2001, 6) suggests dividing the field into two tracks: the qualitative and conceptual frameworks developed in linguistics, psychology, neurology, choreography and therapy; and the quantitative and system oriented frameworks in computer vision, human-computer interaction, human motor control and computer animation. Another categorisation was suggested by McNeill (2000, 9), looking at the function that gestures play in various fields: human communication, cognitive psychology and modelling. Combining the categorisations by Zhao and McNeill, I suggest a slightly different tripartite division of gesture research and associated gesture definitions:

- **Communication**: using gestures to denote aspects of human communication, focusing on how they work as vehicles of social interaction. This is how the term is often used in linguistics, psychology, social anthropology, etc.

- **Control**: investigating gestures as a system, focusing on computational models and the control possibilities of gestures in interactive systems. This is typical of the fields of human-computer interaction (HCI), computer music, etc.

- **Mental Imagery**: studying gestures as mental processes, which may be the result of physical movement, sound, or other types of perception. This is common in cognitive science, psychology, musicology, etc.

The following section will present examples of gesture definitions following each of these three categories. The selection of definitions is not exhaustive, but rather centred on the ones that can shed light on my main interest: music-related movement.

4.2.1 Gesture as Communication

In everyday life, *gesture* is often used to denote bodily actions associated with speech, particularly hand movements and facial expressions. This is also the gesture definition most commonly used in linguistics, psychology and behavioural studies, in which Adam Kendon has defined gesture as "visible action as utterance" (Kendon, 2004, 7). In his first papers on the topic, Kendon used the term *body motion* (Kendon, 1972) and later moved on to use *gesticulation* (Kendon, 1980), before finally settling on the word *gesture* (Kendon, 1982).

Gesture has also been the preferred term used by David McNeill in his research into the co-existence of gesture and speech (McNeill, 1992, 2005). Through a series of observation studies of people’s storytelling, McNeill showed how hand movements and facial expressions are not just random movements accompanying speech, but are actually an integral part of the communication. Following this, he developed a taxonomy in McNeill (1992, 12-19) for different gestural functions based on the five types of nonverbal behaviour outlined by Ekman and Friesen (1969):
4.2. GESTURE DEFINITIONS

- **Iconics** represent a particular feature of an object, and can be described in terms of the shape and spatial extent of the gesture. Iconic gestures are often used to illustrate an action, for example imitating a knocking movement with a hand while saying "knocking on the door".

- **Metaphorics** are similar to iconics, but represent an abstract feature of an object. An example of a metaphoric gesture may be to say "something happened" while holding up the hands to refer to "something".

- **Beats** occur together with spoken gesture to highlight discontinuities and stress specific words. Beats are typically carried out as in/out or up/down movements, and may be seen as emphasising the most important words in a narrative.

- **Deictics** indicates a point in space, for example pointing in a specific direction while saying "over there".

- **Emblems** are stereotypical patterns with agreed meaning, such as the goodbye or OK sign.

McNeill’s theory of gesture is built on the idea that gestures coexist with speech. This is not to say that they have to co-occur, but rather that gestures and speech are co-expressive. Here, McNeill (2005, 15) adopts Damasio’s saying that “language is inseparable from imagery” and argues that mental imagery is embodied in the gestures that co-occur with speech. To explain the relationships between gesture and speech, McNeill (1992, 37) outlined what he calls the Kendon continuum, based on the typology of gestures suggested by Kendon (1982): gesticulation, emblems, pantomime and sign language. As shown in Figure 4.1, this continuum covers two extremes: gesticulation is used to denote the types of gestures that always co-occur with speech, and sign language the types of gestures that are linguistically self-contained.

![Figure 4.1: McNeill's (2005, 7) Kendon continuum of gestures, and how they relate to speech.](image)

Susan Goldin-Meadow has followed a similar line of thought in her work on how gestures help guide our thinking. The difference is that she uses the term gesture to denote only hand movement, and leaves out other types of body movement, including facial expression (Goldin-Meadow, 2003, 3). She, along with Kendon and McNeill, argue that gestures may not only support speech, but may also contradict speech. An example of this is how it is possible to spot when people are lying, since their facial expression and
body movements contradict what they are saying. McNeill (2005, 4) therefore argues that studying overt gestures may reveal interesting aspects of our covert mental imagery. This is an interesting idea, and one which we have explored in the observation studies of music-movement correspondences that will be presented in Chapter 5.

The definitions presented above all focus on the communicative aspects of gestures. As such, the term gesture does not refer to body movement or expression per se, but rather to the intended or perceived meaning of the movement or expression. This is similar to how Feyereisen and de Lannoy (1991, 3) use the term gesture, but they provide a slightly wider definition:

To some extent, any movement or change in position of a body segment may be considered a gesture. Accordingly, the very notion of gesture refers to a great variety of phenomena. In an extended sense, the term gesture encompasses technical gestures that are used in various professions and that often involve tool use. From such a perspective, gestures are mainly actions before becoming means of communication.

Here they open for using the term gesture not only in human-human communication, but also for describing the communication between humans and machines. This is probably why this definition also has been referred to in the human-computer interaction (HCI) literature, focusing on gesture for control.

### 4.2.2 Gesture for Control

An important topic in HCI is that of communication between humans and computers. Here, as for human-human communication, the point is what is communicated and not necessarily how. A difference between these fields, though, is that computers traditionally have had fairly limited sensing capabilities. This is probably the reason why several of the gesture definitions used in HCI are fairly restricted, for example a definition by Kurtenbach and Hulteen (1990, 310):

A gesture is a motion of the body that contains information. Waving goodbye is a gesture. Pressing a key on a keyboard is not a gesture because the motion of a finger on its way to hitting a key is neither observed nor significant. All that matters is which key was pressed.

This is a classic example of a computer-centric approach to interaction design, in which the constraints of the computer define the interaction. Here pressing the key is highlighted as the meaning-bearing component, while the rest of the movement of the person is considered irrelevant. Much has happened in the HCI community since Kurtenbach and Hulteen’s definition was written, and today the focus is much more on creating computer systems that can sense human communication. The challenge is now to develop sensor and computer vision solutions, and corresponding computational algorithms, for separating gestures (here used in the communication sense) from a continuous stream of movement. While humans have few problems with separating a hand gesture from other
4.2. GESTURE DEFINITIONS

types of movement (e.g. waving away a fly), this is much more problematic for computers. This is not only because of our capacity of visual scene analysis, as discussed in Chapter 2, but is also due to the fact that we may directly understand the intended meaning of the gesture based on our life-long experience of multimodal communication.

Rather than creating computer systems that can understand the meaning of gestures, some researchers are working on solutions for extracting the expressiveness of body movement. Here the term expressive gesture is introduced to denote aspects of body movement that convey information about affect and emotion:

It seems likely that expressiveness in gestures is conveyed by a set of temporal/spatial characteristics that operate more or less independent from the denotative meanings (if any) of those gestures. In that sense, gestures can be conceived as the vehicles which carry these expressive characteristics and it is likely that expressiveness as such subsumes certain universal patterns and general rules. (Camurri et al., 2001, 1)

Yet another type of gesture definitions is offered by researchers working on the control aspects of computer music:

If we call first of all, "gesture" all physical behaviour, besides vocal transmission, by which a human being informs or transforms his immediate environment, we may then say that there can be no music without gesture, for music is not exclusively vocal. (Cadoz, 1988, 65)

 Gesture is used in a broad sense to mean any human action used to generate sounds. The term refers to actions such as grasping, manipulation, and noncontact movements, as well as to general voluntary body movements. (Miranda and Wanderley, 2006, 5)

Both these definitions are broad in scope, and like the other HCI definitions they focus on gestures for controlling various systems. An important difference between these control definitions and the communication definitions presented in the previous section, is that of what types of body movements are being studied. The control definitions are mainly focusing on manipulative gestures (Quek et al., 2002, 172). Manipulative is here used to denote gestures that are based on physical contact, or what may also be called ergotic, haptic, or instrumental. As such, they are clearly different in nature from the empty-handed\footnote{Empty-handed gestures have also been called semaphoric, free, semiotic, or naked gestures (Miranda and Wanderley, 2006, 6).} gestures that are studied in the fields of human-human communication. It is therefore easy to imagine the potential problems that may arise when such definitions are mixed up, something I often experience in musical settings where people come from both types of backgrounds.
4.2.3 Gesture as Mental Imagery

A third group of gesture definitions focuses on gesture as mental imagery. While the two previous groups of definitions have both been using gesture in reference to some kind of physical body movement, there are also some definitions that use gesture in a metaphorical sense, for example:

[B]oth [physical and auditory gestures] present the ability to communicate musical intentions at a higher level than an audio wave form. The similarity of their level of abstraction motivated the author to label them both as Musical Gestures. (Métois, 1997, 16)

Here the term musical gesture is used to denote the combined sensations of physical movement and sound. This is along the lines of how several musicologists have used term musical gesture in recent decades. From a popular music perspective, Middleton (1993, 177), referring to Coker’s (1972) discussion of affections and emotions which could be associated with gestures, writes:

[How we feel and how we understand musical sounds is organised through processual shapes which seem to be analogous to physical gestures.

Middleton argues that the idea of gestures in music should be founded on the concept of rhythm. This seems similar to Todd’s (1995, 1941) idea of relationships between musical sound and the body. Todd claims, without actually using the word gesture, that musical movement is similar to, and imitates, motion in physical space.

A similar way of thinking about gestures, as a mental entity that can be evoked from musical sound, is suggested by Hatten (2004, 95), who argues that a musical gesture is “significant energetic shaping through time”. His theory of musical gesture is based on bodily action, or what he calls gestural competency. Such competency, he argues, arises from physical (i.e. biological and cognitive) and social (i.e. cultural and multi-stylistic) experience:

Musical gesture is biologically and culturally grounded in communicative human movement. Gesture draws upon the close interaction (and intermodality) of a range of human perceptual and motor systems to synthesize the energetic shaping of motion through time into significant events with unique expressive force. (Hatten, 2003)

François Delalande offers a gesture definition that may be seen as a combination of the definitions that focus on gesture as mental imagery evoked by sound, and the definitions based on meaning conveyed by visible body movement. In a study of pianist Glenn Gould, Delalande (1988) notes that the term musical gesture lies in the intersection between observable actions and mental representations. He further argues that musical gestures may be studied at various levels, ranging from the purely functional to
4.2. GESTURE DEFINITIONS

the purely symbolic: effective, accompanist and figurative gestures (Cadoz and Wanderley, 2000, 77-78). Here effective gesture is used to denote what I call sound-producing actions, while accompanist gestures are used for the movements that support the effective gestures in various ways. Delalande suggests the term figurative gesture to refer to a mental representation that is not directly related to any physical movement, but which may be conveyed through sound only.

A somehow analogous definition to that of Delalande and Hatten is suggested by Gritten and King (2006, xx):

[A] gesture is a movement or change in state that becomes marked as significant by an agent. This is to say that for movement or sound to become gesture, it must be taken intentionally by an interpreter, who may or may not be involved in the actual sound production of a performance, in such a manner as to donate it with the trappings of human significance.

This definition implies that there is a flow of communication between the performer and the perceiver, and movement "becomes" a gesture if it is understood as such by the perceiver, as illustrated in Figure 4.2.

![Figure 4.2: My illustration of how Gritten and King (2006, xx) suggests that a performer's movements may become gesture if perceived (and understood) as such by the perceiver (the interpreter).]

An interesting question then arises when it comes to consciousness: does an action have to be carried out consciously to be seen as a gesture? In human communication, Kendon has argued that gestures have to be carried out consciously since they are intentional (Kendon, 2004, 15). Hatten, on the other hand, argues that musical gestures may be performed unconsciously but still be valid as gestures if they are observed as significant by the perceiver (Gritten and King, 2006, 162). I would assume that there are also ambiguous cases where one person may perceive an action as intentional and another person may see it as unintentional. In that case it will have to be the subjective experience that will decide whether the action should be seen as a gesture or not.

4.2.4 Terminology

The gesture definitions presented above range from using gesture more or less as equivalent to body movement, to using gesture in a purely metaphorical sense. There are

\footnote{Accompanist gesture is the translation by Cadoz and Wanderley (2000) of the term geste accompagnateur used by Delalande (1988). It might be better to use the word accompanying in English, so as not to confuse such movements with those of an accompanist.}
certainly many other types of gesture definitions that have not been discussed, such as the concepts of *articulatory* and *phonological gesture* used in the motor theory of speech perception (Liberman and Mattingly, 1985). There are also several research fields focused on topics similar to the ones discussed, but which do not use the term gesture at all, such as *kinesiology* and *biomechanics*. The same can be found in some of the music performance literature, where terms like *motion/movement* (Shaffer, 1980; Gabrielsson, 1985; Clarke, 1993; Davidson, 1993) and *expressive movement* (Pierce and Pierce, 1989; Davidson, 1994) have been used. Yet another term is that of *corporeal articulation*, which Leman (2007) has used in the study of various types of music-related movement.

As I have witnessed at several conferences during the last years, the multitude of gesture definitions often results in much confusion and discussion. Particularly the rather imprecise use of gesture in parts of the HCI literature seems to cause confusion when contrasted with stricter definitions. Some have argued that it would help if gesture always was used in conjunction with another term, e.g. *instrumental gesture* (Cadoz, 1988) or *ancillary gesture* (Wanderley, 2001). My solution has been to avoid using the term gesture at all, and rather settle on the following terms:

- **Movement** is used to describe the act of changing the physical position of a body part or an object. This may be any type of displacement, whether it be carried out consciously or unconsciously.

- **Action** is used to denote a movement unit, or a chunk. This is a limited and goal-directed movement which is perceived as a holistic entity, or a manipulative action based on touch or force. For example, hitting a piano key with a finger may be seen as a displacement action, while holding the finger on the key may be seen as a manipulative action. As such, I use action to denote a cognitive entity, something which cannot be directly measured but rather inferred from movement.

- **Fidgeting** is used to denote movements that are not goal-directed and which may be unintentional and unconscious. Fidgeting can be thought of as "movement noise".

- **Interaction** is used to denote the reciprocal actions of objects (including body parts) that influence each other.

Figure 4.3 illustrates how I see the relationships between the three first concepts. Movement is shown as a continuous stream of displacement over time, while actions are separate units. The parts of a movement that are not categorised as an action are considered fidgeting. Note that actions can be nested, e.g. several actions that follow each other may be perceived as one coherent action. For example, playing a scale run on a piano may be seen as a series of separate actions if we focus on the finger movements, but can also be perceived as one coherent action if we look at the movement of the hand or the upper body. It seems as if we are able to perceive many such actions simultaneously, and that the actions mutually influence our perception, something which will be discussed in context of our observation studies presented in Chapter 5.
4.3 Music-Related Movement

Although there may be ambiguous cases, generally we can divide music-related movement into two main categories: the movement of performers, and the movement of perceivers. The movement of perceivers has received relatively little attention in the literature, and will be discussed more in Chapter 5. When it comes to the performers, I prefer to split this category into three subcategories, each having their own set of music-related movements:

- **Musicians**: the movements of musicians may be categorised as sound-producing, ancillary, sound-accompanying and communicative. These categories will be discussed more in the rest of this chapter.

- **Conductors**: the movement of conductors may be thought of as sound-coordinating. They are not sound-producing in themselves, but are still important for the sounding result (Nakra, 2000; Kolesnik and Wanderley, 2004; Gambetta, 2005), and as a specific type of theatrical movements (Small, 1998). Conductors’ movements fall outside the scope of this project, and will therefore not be discussed any further in this dissertation.

- **Dancers**: The movements of dancers may be thought of as sound-accompanying, since they often follow or contrast with the musical sound. Such movements will be discussed more in Chapter 5.3.

There are many approaches to the study of music-related movements movements. In his dissertation on *instrumental gestures* (what I call sound-producing actions), Ramstein (1991, 29) suggested that music-related movements can be studied on three analytical levels:
CHAPTER 4. MUSIC-RELATED MOVEMENT

- **Phenomenological:** this approach focuses on the descriptive aspects of the movement, such as describing the movement in terms of its cinematic (e.g., the speed), spatial (the size of space), and temporal dimensions (e.g., frequency range).

- **Intrinsic:** this approach deals with the conditions for movement production, for example that the hands are more suitable for fine motor control than the feet.

- **Functional:** this approach looks at the purpose of a movement or action in a certain context, e.g., whether it is sound-producing, sound-modifying, etc.

The rest of this chapter will focus on the functional aspects of the music-related movements of musicians. But first I shall start by defining some general properties of the performance environment and the performer’s relationship to the environment.

### 4.3.1 Performance Scene, Position and Space

To have a clear idea of the performance environment in which music-related movements are carried out, I suggest three concepts: scene, position and space, as summarised in Figure 4.4. First, the *performance scene* may be thought of as a physical space that both the performer and the perceiver recognise as one in which a performance is carried out. This is evident as both performers and perceivers tend to change their attention when the performer enters the performance scene. In a typical concert situation, the performance scene is clearly defined as a part of the stage, where everyone’s attention is naturally focused due to the seating and general expectation of what will come. But a performance scene may also refer to a social construct, and may thus be created anywhere. A typical example is how street musicians claim a part of the pavement as their performance scene, which people walking past will usually respect.

When it comes to the *performance positions*, we can define the *home-position* of a performer to be the resting position in which the performer sits or stands before starting to act (Sacks and Schegloff, 2002). In a musical context, and particularly in Western classical music, this can be understood as when a musician is standing or sitting at ease with the instrument before starting to perform. When in home position, the perceiver will usually know that the performance has not yet begun and will wait until the performer moves into *start position* before expecting any sound to be produced. Finally, the *performance position* is the one from which the performance action originates.

We may also refer to a set of *performance spaces*, or a *personal space*. First, we may use Laban’s term *kinesphere* to denote an imaginary box surrounding a person, which defines the maximum movement possibilities from a certain point in space (Laban, 1963). Laban argues that the kinesphere is a mental construct that we are always aware of in our interaction with the environment and with others. Within the kinesphere we may talk about different *performance spaces* or *action spaces*, i.e., imaginary “bounding” boxes for various types of music-related movements. For example, when playing the piano we have a well-defined sound-producing action space in the visual part of the keyboard, as indicated in Figure 4.5. This action space can usually be observed by both the performer...
4.3. MUSIC-RELATED MOVEMENT

**Figure 4.4:** The performance scene is the imagined area in which performance can happen. The home position is the position where the musician is sitting (or standing) at ease before starting to perform. The start position is where the performance starts from, and the performance position is the position(s) of the musician during performance.

and the perceiver, making it possible to identify where the sound-producing actions are carried out.

Figure 4.5 also indicates the performance spaces of other other types of music-related movements (as will be presented in the following sections). The idea of identifying these spaces is to illustrate that we have a clear understanding of where different types of movements and actions should be carried out in relation to an object (e.g. an instrument). This knowledge of performance spaces for various types of music-related movements also helps us set up expectations when perceiving a performance. This is why we may get surprised if a musician happen to perform outside of such conventional performance spaces, for example by playing with the fingers on the strings of the piano. Much musical experimentation happen due to such exploration of the boundaries of established performance spaces.

**Figure 4.5:** The action space can be seen as an imaginary box surrounding the space in which movements can be carried out. **Here the action spaces for various music-related movements are indicated, including sound-producing and sound-modifying actions, and ancillary, sound-accompanying and communicative movements.**
4.3.2 Action Units and Phrases

Let us now look more closely at the construction of an action. In Chapter 3, a sound-producing action was defined in terms of an excitation with a prefix and suffix. More generally, we can talk about an action unit, analogous to Kendon’s gesture unit, defined as a goal-directed movement excursion which starts and ends in the home position (Kendon, 2004, 111). As shown in Figure 4.6, Kendon suggests that such a unit may contain multiple phrases, each of which is built from a preparatory part, a nucleus and a recovery. The nucleus can be further split into a stroke and a post-stroke part. The stroke part is the goal-directed part of the movement excursion. In a sound-producing action this is typically the excitation, while for a communicative action the stroke is what is usually identified as the "gesture". The stroke may end in a recovery phase, or may be extended in a post-stroke hold prolonging the effect of the stroke. In music performance, this can often be seen in the performance of the final chord at the end of a piece, at which point the performer will hold onto the stroke position for much longer than is necessary for the sound-producing action itself. As such, the post-stroke hold can be seen as a type of movement embellishment prolonging the perception of the musical sound.

![Figure 4.6: The construction of an action unit, based on Kendon’s (2004, 111) gesture unit. The two phrases on the left and right of the middle phrase are compressed to save space in the illustration (N = nucleus, P = preparation, etc.)](image)

4.3.3 Functional Aspects of Musicians’ Movements

To understand more about the functions of various music-related movements, I suggest to divide music-related movement into four functional categories based on a combination of Cadoz’ (1988) taxonomy for instrumental gestures, Delalande’s (1988) typology, and Wanderley’s (2004) divisions:

- **Sound-producing actions** are the ones that are effective in producing sound. They can be further subdivided into actions of excitation and modification.

\(^3\)Sound-producing actions are called instrumental gestures by Cadoz (1988), and effective gestures by Delalande (1988).
4.3. MUSIC-RELATED MOVEMENT

- **Ancillary movements** support the sound-producing actions in various ways. As will be discussed and exemplified in a later section, such movements can be subdivided into support, phrasing and entrained movements. I refer to these as ancillary movements (and not actions) since they may not be of a goal-directed nature.

- **Sound-accompanying movements/actions** are not involved in the sound production itself, but follow the music. They can be sound-tracing, i.e. following the contour of sonic elements, or they can mimic the sound-producing action. Such sound-accompanying movements will be discussed in Chapter 5.

- **Communicative movements** are intended mainly for communication. As will be discussed later in this chapter such movements can be subdivided into endogenous, performer–performer or performer–perceiver types of communication.

Figure 4.7 shows an illustration of different types of music-related movements and actions in piano performance. Note that the different categories are not meant to be mutually exclusive, as several actions have multiple functions. For example, hitting a final chord followed by a theatrical lift can be seen as having both sound-producing, ancillary and communicative functions. This functional multiplicity is illustrated in the dimension spaces in Figure 4.8. Dimension spaces are commonly used to analyse interactive systems (Graham et al., 2000), and have also been used to analyse the functionality of digital musical instruments (Birnbaum et al., 2005). Here they are utilised to visualise how the movements of a musician and a dancer cover different music-related movement functions.

### 4.3.4 Sound-Producing Actions

Based on the typology presented by Cadoz (1988), we can divide the sound-producing actions into two categories: excitation and modification. As already discussed in Chapter 3.2.1, excitation actions may be subdivided into impulsive, sustained and iterative actions, each having distinct energy profiles. Excitation actions are either direct or indirect, depending on whether or not there is an object between the sound-producing element of the instrument and the object carrying out the excitation. For example, the actions of playing the harp or congas are direct since fingers and hands are directly in control of the resonating objects (strings and drum membrane). But there are also many indirect instrumental actions which involve one or more objects in the interaction, for example the bow in string instruments, the key mechanism on the piano, or sticks for drums.

---

4 Ancillary movements are called *accompanist gestures* by Delalande (1988), *non-obvious performer gestures* by Wanderley (1999), and *ancillary gestures* by Wanderley and Depalle (2004).

5 Communicative actions are called *semiotic gestures* by Cadoz and Wanderley (2000). Several of these can also be considered *gestures* in the way Kendon (2004) and McNeill (1992) use the term.

6 Cadoz uses the term *instrumental gesture* to denote what I call sound-producing actions. He further uses *sound-producing gestures* and *sound-modifying gestures* for the subcategories of *instrumental gesture*. I have chosen to use other terms to avoid conflict with the rest of my terminology.
CHAPTER 4. MUSIC-RELATED MOVEMENT

Figure 4.7: Examples of where different types of music-related movements (sound-producing, ancillary and communicative) may be found in piano performance.

Figure 4.8: Dimension spaces illustrating how the music-related movements of a musician (left) and a dancer (right) may be seen as having different functions. Here the musician’s movements have a high level of sound-producing and ancillary function, while the dancer’s movements have a high level of sound-accompanying and some communicative function.
4.3. MUSIC-RELATED MOVEMENT

Modification actions is the other subcategory of sound-producing actions. Such actions do not actually produce sounds themselves, but they modify the quality of the sound. Cadoz (1988) suggested to subdivide such modification actions as:

- **Parametric**: actions which continuously change a parameter, e.g. bow pressure in violin playing.
- **Structural**: actions which modify or change the structure of the object, e.g. opening or closing a key on a wind instrument.

Most musical instruments are played with both excitation and modification actions. In some instruments the two types are easily separable, such as in string instruments where the two hands play entirely different roles: the left hand is mainly modifying the sound (choosing the pitch) while the right hand is carrying out the excitation. Another example is that of wind instruments, where the excitation is often done in the mouth, and modification actions are carried out with the fingers. Wind instruments are also an example of how excitation and modification actions are coupled, since the mouth can also effectively modify the quality of the sound. As such, the aim of this typology is not to create an absolute classification system, but rather to point out some of the different functions that actions may play in sound production.

4.3.5 Ancillary Movement

Ancillary movement is used to cover three different types of music-related movements that are not directly involved in sound production, but still have an important impact on the resultant sound: support, phrasing and entrained movements. As briefly mentioned above, I refer to these as **movements** rather than **actions**, since they may not be goal-directed and chunk-based.

It does not make sense to talk about sound-producing actions without also referring to the other body movements that co-occur with the sound-producing actions. For example, hitting a piano key involves not only the active finger, but also the hand, arm, and upper body. Such movements are **support** movements of the sound-producing actions. In fact, it is the preparatory movements of this complex **multi-joint system** that determine the trajectory and velocity of the finger before and after it hits the key. Thus, such support movements play an important role in supporting the sound-producing actions, and they may even have audible components, as shown by Wanderley (1999) in a study of clarinet performance. Here the performer’s ancillary movements were seen in the movement of the clarinet bell, and this clarinet movement was shown to have an audible component due to the changing sound diffusion pattern of the instrument.

A different type of ancillary movement is what I prefer to call **phrasing** movements, since they are closely connected to musical phrasing. Wanderley (2002) has shown that the ancillary movements of clarinetists are an integral part of the instrumentalists’ performance and are stable and reproducible even after long periods of time. Many of these repeatable movements and movement patterns seem to be closely connected to the phrases
in the music being performed, and are often related to movement of the clarinet bell (Campbell et al., 2005; Quek et al., 2006).

Examples of support and phrasing movements are shown in Video 4.1, an excerpt from Beethoven’s Sonata Op.31 No.2 Tempest (III Allegretto) performed by François-René Duchable (2003). Figure 4.9 shows an image from the video where the rotating elbow movements support the hand rotation needed to carry out the passage. There is also an image showing a phrasing action when the performer is bending forwards to accentuate a salient point in the melody.

![Support and Phrasing Movements](image)

Figure 4.9: Two types of ancillary movements seen in the performance by pianist François-René Duchable in Video 4.1: circular elbow movements which can be seen as support movements for the the circular hand movements (left), and moving the head forwards as a phrasing movement which helps accentuate the musical passage (right).

A third type of sound-facilitating movements is what I call entrained movements. The concept of entrainment is based on the synchronisation of two or more independent rhythmic processes (Clayton et al., 2005), and can be said to have an ecological basis in biological, physiological and cultural rhythms (Aschoff, 1979; Hall, 1984; Strogatz and Stewart, 1993; Glass, 2001). Entrainment may happen as interpersonal synchrony, but here I am primarily interested in the synchronisation between the body, or body parts, and the music. Entrained movements are not directly linked to sound-production or the musical structure, but rather synchronise with a continuous underlying feature of the music, for example the characteristic rhythmic "feel" or the groove of the music.

Examples of entrained movements are tapping a foot, nodding the head or moving the whole upper body in synchrony with the music. Although such movements vary considerably between performers and performance styles, they may be thought of as important for the timing (or lack thereof) in a performance. As such, entrained movement can be a generator of rhythm and timing, in the same way as the rhythm and timing in music can be a generator of movements (Clarke, 1999). This was also observed in
4.3. MUSIC-RELATED MOVEMENT

the clarinet experiments by Wanderley et al. (2005), where the performers continued to move, albeit less, when asked to play “immobilised”.

An example of entrained movements is shown in Figure 4.10, a screenshot from Video 4.2 of the song We Work The Black Seam from the music movie Bring on the Night by Sting (1985). Here all the musicians show examples of entraining with the music: Branford Marsalis (tenor saxophone) is moving his right leg slightly, Darryl Jones (electric bass) is moving his right foot and the upper body, and Janice Pendarvis and Dolette McDonald (vocals) are moving in a choreographed manner, but are also swinging their arms more freely with the music. Sting has a very visible rhythmic movement starting in the left leg and extending through the body. I find this movement to be a bit too extreme to be only entrainment, and it can perhaps also be seen as a type of conductor movement, giving the pulse to the other musicians. As such, all the musicians show some type of entrained movements even though they are embodied differently.

Figure 4.10: An example of entrained (groove) movements in the song We Work The Black Seam from Sting’s (1985) music movie Bring on the Night (Video 4.2). The circles identify where I see examples of entrained movement.

Obviously, the three categories of support, ancillary and entrained movements are not always separable. Consider the excerpt of Rachelle Ferrel’s solo on Autumn Leaves in Video 4.3 from The Manhattan Project (1991). The images in Figure 4.11 show some of her rich movement repertoire, including hand and finger movements to accentuate the rhythmic pattern she is singing, various groove-based entrained movements in knees and the right arm, and phrasing movements to create musical accentuations. This type of bending movement also has an important sound-producing effect, since the flow of breath dramatically changes when she leans towards the microphone.

As mentioned previously, the main idea of developing this taxonomy of music-related movement is not to devise a strict categorisation. Rather, I am trying to create a vocabulary that can point out some of the different types of functions these movements have in
music performance. When it comes to the ancillary movements, it is important to stress that these originate from the performer’s needs, and should be separated from movements that are intended mainly for communication with the other performers and the audience. As such, ancillary movements are usually not carried out with a specific intention other than being the basis for, or result of, the sound-producing actions.

### 4.3.6 Sound-Accompanying Movements

A third type of music-related movements is what can be called sound-accompanying movements. These are neither part of, nor ancillary to, the sound-production, but rather intended to follow qualities in the sound or music. Such movements consist of tracing the melody of a song in the air, mimicking the sound-producing actions in "air instrument performance", or showing some other type of relationship to the musical sound. Sound-accompanying movements are carried out by performers (musicians, dancers, actors), but they are also observable in the movement of perceivers listening to music. Examples of such sound-accompanying movements will be shown in the context of the various types of observation studies presented in Chapter 5.

### 4.3.7 Communicative Movements

All performance movements can be considered a type of communication, but I find it useful to have a separate category for movements that are primarily intended to be communicative. These may be endogenous, performer–performer and performer–perceiver types of communication, and range from communication in a linguistic sense (emblems), to a more abstract form of communication.
4.3. MUSIC-RELATED MOVEMENT

An example of endogenous communicative movements can be seen in a performance by Glenn Gould in Video 4.4 and Figure 4.12 (Gould, 1974). It is impossible to know whether these movements were carried out for the sake of the camera or not, but, as Delalande (1988) suggests, they seem to be a type of communicative movement which involves Gould conducting himself. They may also be understood as a type of sound-accompanying or even ancillary phrasing movements.

![Figure 4.12: Examples of Glenn Gould’s hand movements as seen in Video 4.4 (Gould, 1974). These seem to be endogenous communicative movements and look like conducting movements.](image)

Several different types of performer–performer communicative movements can be seen in the images in Figure 4.13 taken from Video 4.2. Here Sting conducts the other musicians using eye contact and nodding. Notice also the passage during which Sting walks over to Branford Marsalis (tenor saxophone). The rhythmic swing Sting displays in his walk sets up expectations for the following contact improvisation, during which the two musicians keep focused on each other’s gaze and movements.

![Figure 4.13: Examples of performer–performer communicative movements seen in Video 4.2 (Sting, 1985). Sting conducts the other performers (left), indicates the groove while walking over to Branford Marsalis (middle), and keeps a close eye connection during Marsalis’ solo (right).](image)
Examples of performer–perceiver communicative movements may be seen in the performance by Nigel Kennedy in Video 4.5 from the Spirits of Music DVD (McFerrin and Kennedy, 2005). The first image in Figure 4.14 shows a snapshot of how Kennedy turns and looks at one of the other musicians creating a sense of unity between the musicians on stage, or what could be called a regulator in the terminology used by Ekman and Friesen (1969). An example of what Ekman and Friesen called an affect display can be seen in the second picture in which Kennedy closes his eyes and mouth to enhance the mellow musical passage. Another affect display can be seen in the last image in Figure 4.14, in which Kennedy surprisingly outbursts an “ah” sound in the middle of the performance. All of these examples show various types of communicative movements that enhance the music performance, yet have little direct sound-producing function.

Figure 4.14: Three types of communicative movement seen in Video 4.5 (McFerrin and Kennedy, 2005): contact movements through a turn and gaze (left), showing affect and emotion while playing (middle), and a surprised “ah” sound and facial expression (right).

Several of the movements in Nigel Kennedy’s performance in Video 4.5 can also be seen as having strong, theatrical components. Figure 4.15 is a picture summary of how Kennedy starts walking to the right side of the stage, turning slightly to be sure that everyone is following his movements. Then he punches into the air, and returns to continue playing with a smile on his face. These movements are clearly intended for communication, but may also serve to build musical expectation. The apparent expectation is further prolonged by the rubato playing style before they finally return to the melody of the piece.

4.3.8 Movement Repertoire

One of the things I have noticed while watching a number of music performance DVDs, is how many musicians seem to develop a rather consistent movement repertoire. This is particularly evident in many artists/musicians in different kinds of popular music. Figure 4.16 shows three images from Video 4.6 (Hendrix, 1973), where Jimi Hendrix performs a “swinging arm” movement. This swinging arm movement consistently co-occurs
with a specific "screaming" guitar sound in the video example, and can also be seen in several of his other performances.

It is difficult to say whether this swinging arm movement is a sound-accompanying movement following the "upwards" movement in the sound, or whether it is an ancillary movement that supports the sound-producing action to actually help produce the sound. Perhaps he started using the arm movement for theatrical purposes, but that it has later become internalised as an integral part of his sound-production. Whatever the function, such a swinging arm movement can be seen throughout his career and can also be seen in the performances by several other rock guitarists. I have only observed this phenomenon informally, but it seems as if this action-sound relationship has become part of a rock guitarist’s movement repertoire.

In the same way as musical phrasings and "licks" are often picked up by musicians playing together, I have seen that also the movement repertoire of a musician can be copied by others. An example of this can be seen in Videos 4.7 and 4.8, and Figure 4.17, where Eric Clapton and Tim Carmon play solos after each other in the song Old Love on the CrossRoads DVD (Clapton, 1999). Not only does Tim Carmon pick up many melodic, harmonic and timbral features from Clapton’s solo, but he also adopts his movement style. This includes how they both move the torso and bend backwards with closed eyes to emphasise salient points in the melody.

I shall be careful about drawing extensive conclusions based on my brief observations.
CHAPTER 4. MUSIC-RELATED MOVEMENT

Figure 4.16: Three images from Video 4.6 showing how Jimi Hendrix repeatedly performs a "swinging arm" movement with long sustained sounds in his solo, taken from Hendrix (1973). He used this action-sound relationship throughout his career, and also seems to have influenced other rock guitarists.

Figure 4.17: Examples from Videos 4.7 and 4.8 of how music-related movements may be transferable between musicians (Clapton, 1999). Notice how similar Eric Clapton and Tim Carmon move in their solos, in these images a backwards bending movement with closed eyes occurring at a salient point in the melody line.
of movement repertoires. However, it would be interesting to see more detailed studies of this, and with an ever-growing catalogue of commercial music DVDs it should be easy to find material for comparative studies. Such studies could focus on the development of performance styles over time for individual musicians, and look at how the movement repertoire of famous musicians have influenced the movements of other musicians.

### 4.3.9 Link to Sound

The four different types of music-related performance movements may be seen as representing a continuum when it comes to their connection to the musical sound. Figure 4.18 illustrates this continuum, showing that the sound-producing actions are, by necessity, very closely linked to the sound. Of the ancillary movement types, the support movements are often closely linked to the sound, while the phrasing and entrained movements tend to have a somewhat looser relationship. Similarly, sound-accompanying movements may have either a close or loose link to the sound. For example, "air instrument performance" may mimic closely the sound-producing actions, as will be discussed in more detail in Chapter 5.2. Free dance movements, on the other hand, often have a more loose link to the sound as we will see in Chapter 5.3. When it comes to communicative movements, they are often very loosely (if at all) connected to the musical sound.

![Relationship between the four different music-related movement types and their connection to sound.](image)

**Figure 4.18: Relationship between the four different music-related movement types and their connection to sound.** Sound-producing actions are necessarily closely linked to sound, while communicative movements are often only loosely (if at all) connected to the sound. The others may vary within this continuum.

### 4.4 Summary

The chapter started with a presentation of different types of *gesture* definitions, categorised in three groups: *communication*, *control* and *mental imagery*. The definitions all have in common that they focus on body movement in various ways. However, there are some important differences between these definitions that can potentially lead to confusion, particularly when we speak about intention and meaning. For this reason I have decided not to use the term *gesture* at all, but rather use *movement* to describe physical displacement, and *action* for goal-directed movements and manipulation. The rest of the chapter focused on the body and music-related movement, and particularly on the various functions music-related movements and actions of musicians play in a musical context.
Throughout the chapter examples from commercial music DVDs have been used to illustrate the various types of music-related movement. This is a deliberate choice, since I am interested in studying material of real performances. As Caroline Palmer (1997) argues, much of the early empirical studies of music performance focused on laboratory experiments, and particularly on piano performances of the Western classical repertoire. The reason for this is probably because the piano is an instrument from which a digital representation is readily available using the MIDI output of a digital piano. The many problems related to MIDI will be discussed in Chapter 6.4.6, but one of the main drawbacks is that MIDI is essentially centred around describing attacks of a sound-producing action. Analyses based on MIDI data will therefore inevitably result in a focus on sound-producing actions, omitting the other types of music-related movements.

More recent performance studies, on the other hand, are often based on motion capture recordings which reveal more of the full-body movement of the subjects. However, since most of these studies are confined to a laboratory space and setting, I find that many of the communicative movements found in stage performance are absent from such studies. There is a big difference between performing in a laboratory in front of a few researchers, and performing on stage in front of an audience. The DVD examples presented in this chapter show some of the richness of music-related movement as found in stage performances, and it would be interesting to carry out more controlled motion capture experiments on stage to study some of these movements.

This chapter has focused on the movements of performers and particularly musicians, but there are also many music-related movements carried out by perceivers. There have been few studies of such movements, so in the Musical Gestures project we decided to carry out a series of observation studies of people moving to music. These studies will be presented in the next chapter.