Choreographing surprise

The relation between dance, music and expectation

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1 Introduction

1.1 Introduction

This thesis forms the end of my master studies, in which all of my research and writing skills are combined. My thesis is written from two different perspectives: music and dance. I studied musicology at the University of Amsterdam for three years. After my Bachelor's degree, I switched to theatre studies at the Utrecht University. During my entire studies I looked for ways to combine these two fields of interest within my research topics. Furthermore, during the second half of my studies, I became more and more interested in the perception of music and dance, especially with regard to physical and emotional responses to both art forms.

During my last year, I wrote an essay about an article by Susan Foster (Foster 2003), in which she mentioned the influence of expectation in spectators' responses to dance. This topic relates to a theory that was discussed extensively in one of my courses at musicology: the ImaginationTensionPredictionReactionAppraisal theory (further referred to as 'ITPRA theory') by David Huron. This theory explains how various characteristics of music evoke emotional and physical responses through expectation. I immediately wondered if the ITPRA theory would be applicable to dance as well. This appeared to be the case, since expectations are created about the occurrence of visual stimuli, such as moving bodies, as well. However, a number of characteristics of dance required a slightly different approach to the application of the theory to dance, as my essay pointed out. This idea provided the basis of my thesis.

1.2 Subject

The subject of this thesis is twofold: *the role of expectation in emotional and physical responses to dance* on the one hand and *the influence of music on this expectation* on the other hand. These two topics cross three fields of study: musicology, dance theory and neuropsychology. Although my main interest is in music and dance, neuropsychology relates to exactly those topics within musicology and dance theory that I find most interesting. Moreover, the two art forms are connected through (neuro)psychological concepts such as expectation. This means that t*he role of expectation in emotional and*

physical responses to dance and *the influence of music on this expectation* evoke an interesting and, to my opinion, quite new approach to the relation between dance and music.

1.2.1 Goals

The first goal of this thesis is to explain how the ITPRA theory by David Huron can be applied to analyse the role of expectation in spectators' emotional and physical responses to dance and to the combination of dance and music. By doing this, it aims to provide information as to how expectation influences spectators' responses. The second goal of this thesis is to provide suggestions for experimental research to detect and measure the correlation between spectators' expectations and responses to dance and music. In short, the thesis aims to combine musicology, dance theory and neuropsychology in one topic.

1.2.2 Theoretical framework

Although this thesis touches upon three fields of study, it focuses on only one topic within those fields: expectation. The demarcation of my research is based on this topic, consequently only publications focusing on music and/or dance in relation to expectation are used. Moreover, the ITPRA theory by David Huron is the main theoretical framework on which this thesis is based. All other theoretical insights that are presented in this thesis are linked to this theory.

1.2.3 Justification of thesis

Expectation is not an entirely new topic in either musicology or dance theory. However, the topic has not often been linked to the combination of music and dance often before. On the other hand, the relation between dance and music has been discussed extensively, but not often from a neuropsychological point of view. Expectation provides a new approach to studies focusing on the combination of music and dance. Therefore, my thesis presents an innovative perspective on the relation between music and dance, which results in new interesting insights. My thesis thus brings together three fields of study and enables each type to benefit from new theoretical standpoints.

Moreover, this thesis brings a new theory to dance studies that can be used to analyse the role of expectation in spectators' emotional and physical responses to dance. With this theory, dance theory may develop new perspectives in the way dance evokes emotional and physical responses. Moreover, the thesis presents a number of research experiments that can provide statistical evidence for claims that are based on the ITPRA theory. My thesis therefore opens up the possibilities for future research on emotional and physical responses to dance.

1.2.4 Research questions

This section presents the main research question on which my research is based, as well as four sub-questions that are used in answering the main question. The twofold subject of this thesis leads a twofold research question: H*ow can the ITPRA theory be used to a) analyse the role of expectation in spectators' emotional and physical responses to dance and b) the influence of music on this expectation?*

In order to be able to answer this question, the following sub-questions are relevant:

1. Is the ITPRA theory applicable to research in spectators' responses to dance?
2. What choreographic conventions form the basis on which expectations are created?
3. Is musical expectation similar to choreographic expectation?
4. How does music influence the expectation of dance?

1.3 Research method

This thesis is based on literature research. The starting point for my research is the work of music psychologist David Huron, who created the ITPRA theory (Huron 2007). This theory, which explains how music evokes emotional and physical responses through expectation, is applied to dance. In addition to the theory by David Huron, several other authors' claims and theories are included in the discussion. These theories either focus on the relation between music and dance, the relation between music and emotion or expectation or the relation between dance and emotion or expectation. One of the most important authors used in this thesis is choreographer and dance theorist Ivar Hagendoorn (Hagendoorn 2004a, 2004b, 2005), who has carried out research on the relation between dance and expectation. His hypotheses have a lot in common with Huron's claims about

the relation between music and expectation. Since the amount of statistical evidence for the role of expectation in spectators' responses to dance is relatively low, a significant part of my thesis is based on my own theoretical argumentation.

1.4 Structure

Chapter 2 explores the theoretical discussion regarding emotional and physical responses to music and dance among both musicologists and dance theorists. These discussions form the theoretical background of the ITPRA theory. Chapter 3 explains the ITPRA theory by David Huron, focusing mainly on the five phases through which one experiences emotional and physical responses to an event. The fourth and fifth chapter each link the ITPRA theory to one of the two art forms. Chapter 4 elaborates on musical conventions on which listeners' expectations are based, such as tonality/harmony, rhythm and timing, genre and style. Chapter 5 presents choreographic conventions on which spectators' expectations are based, such as natural laws of the body, genre and style, space and time. Chapter 6 explores the interaction between music and dance in relation to expectation. In order to do this, it presents various ways of interaction between musical expectations and choreographic expectations. Finally, chapter 7 presents suggestions for experimental research on spectators' emotional and physical responses to dance and the combination between music and dance.

Chapter 2 Theoretical discussions on music, dance, expectation and emotion

2.1 Introduction

The ITPRA theory is rooted in century-long theoretical and philosophical discussions about the way music evoke emotions. This chapter presents short discussions of several theories about the relation between emotional and physical responses to music and dance. The first section focuses on music theories while the second section presents dance theories. Special attention is paid to music theorist Leonard Meyer in the first section, because the ITPRA theory of David Huron is based mainly on Meyer's theoretical ideas (Huron 2007). The second section focuses on Ivar Hagendoorn (Hagendoorn 2004a, 2004b, 2005), because his work is among the most recent addition to the theoretical discussion about the relation between dance and expectation.

2.2 Music theory: the relation between music and emotion

There are numerous different theories about the relation between music and emotion. Consequently, there is still no consensus on which theory explains best how music evokes emotion. During the previous decades, the common view was that the primary value of music lies in the way it communicates the composer's emotions to the listener. This idea has lost terrain in favour of theories that take the independency of listener's emotions from composers' aimed emotions into consideratin. Nobody experiences exactly the same emotions when hearing a song.

Musicologist Malcolm Budd (1992) discerns two opposing interpretations of music that relate to its value and meaning. The first interpretation says that the value and meaning of music lie within the music itself and that they do not refer to anything outside music. This interpretation suggests that the kind of emotions evoked by music is inherent to music and differs from emotions evoked by external factors. The second interpretation is that the value and meaning of music are related to outside factors. According to this interpretation, emotion are external factors.

Nowadays musicologists also pay a lot of attention to the relation between music and physiological changes in one's body. They concur to the idea that music affects our

body through physiological changes. However, there is no consensus yet about the role of these physiological changes in emotional responses to music. According to Budd, some say that physiological changes result in emotional responses to music, while others say that emotional experiences of music result in physiological changes and yet another group of musicologists finds both forms of physiological change as equally important (Budd 1992). There is not yet enough experimental evidence yet to support nay of these claims.

Another type of theory is rooted in symbolism: it states that music is a symbol that represents emotion. Philosopher Susanne Langer, for instance, claims that music as a symbol represents the development of emotions in time (Langer 1951). The main problem with this type of theory is that it reduces music to a mere instrument to accomplish emotional responses. There are also numerous theories based on the so-called 'doggy theory'. This theory claims that the face of a St. Bernard's dog evokes the emotion 'sadness' through its resemblance of a sad face. Doggy theory-based theories claim to some extent that one experiences emotion by imitating the emotions recognized in music. This means that a musical phrase that one recognizes as sad, evokes the feeling of sadness within that person through his imitation of the musical emotion. A theory by music psychologist Patrik Juslin goes even further by stating that music evokes emotion through contagion, which means it occurs involuntarily. According to Juslin, musical emotion is as contagious as laughter.

The influence of expectation in relation to emotional responses to music was explored first by music philosopher Leonard Meyer in the 1950s. Many theorists, such as musicologist Carol Krumhansl and Huron, have taken up his theory and provided evidence for its claims. Meyer argued that music evokes emotions through an increase in tension that accompanies listeners' expectations about the music. Expectations, according to Meyer, occur when a certain event takes place and focus on an interrelated event or a succeeding event. The advent of dark clouds, for instance, creates the expectation that it is going to rain. Musical events create expectations for succeeding musical events. These expectations are related to genre and exposure. For example, a Western music listener may be able to create accurate expectations regarding a Western melody or rhythm, while he may be clueless about the melodic and rhythmic development of non-Western music.

The amount of exposure to a musical culture or genre determines the amount of certainty with which expectations are created. Meyer makes extensive use of information theory to explain how the amount of certainty correlates with the amount of tension of a listener.

David Huron based his theory on the relation between expectation and emotion in music almost entirely on Meyers' theoretical claims (Huron 2007). Chapter 3 discusses Huron's theory in detail, since this theory forms the base of this thesis.

2.3 Dance theory: the relation between dance, kinaesthesia and expectancy

Not only music theory, but also dance theory has dealt with the issue of emotion for a long time. This is related to the idea that dance does not necessarily convey meaning through storylines, mime or virtuosity, but also through a type of physical sensation called kinaesthesia. Dance theorist Susan Leigh Foster defines kinaesthesia as 'the sense of the body's movements' and traces its use back to eighteenth-century philosophy and aesthetics (Foster 2008, p. 47). Various interpretations of the term have evolved since the eighteenth century, a few of which are discussed below.

Already in the early 1900s, dance theorist Theodor Lipps proposed the term *Einfühlung* ('in-feeling' or 'feeling into'), which states that when watching visual objects in motion, one feels a tendency to imitate the movements of the object. One does not actually perform these movements, but one experiences the tendency or the intention to imitate the movements. This tendency creates kinaesthetic sensations, which are linked to emotions that have previously accompanied the same kinaesthetic sensations (Lipps 1906, p. 27).[1] Dance theorist John Martin explored the term slightly differently by arguing that the physical (or kinaesthetic) impact of dance occurs through so-called inner mimicry, as explained by Foster (Foster 2008). Contagion of movements occurs in everyday life, when people yawn or laugh, for instance, but it also occurs in dance. According to Martin, spectators of a dance performance imitate a dancer's movements, which results in an experience of the same emotions as the dancer. A problem with this statement is that dancers do not actually feel the emotion they present with their body, which suggests that spectators' emotions are self-imposed.

[1] Referred to in: Wildschut (2003), p. 39.

In the first half of the twentieth century, expectation was quite an underestimated phenomenon in dance theory. This changed in the latter half of the twentieth century. Neuropsychological research produced evidence that confirmed the influence of expectation in emotional and physical responses to dance. This research was mainly based on the discovery of mirror neurons in the 1990s (Hagendoorn, 2004a). Mirror neurons are activated during both the perception and performance of a movement, which means that perception and action have the same biological roots (Hagendoorn 2004a). The discovery of these mirror neurons promotes the idea that spectators of a dance performance literally move along with the dancers. They imagine various scenarios of how a movement sequence will develop and perform these scenarios physically within their own body.

Both neuropsychologist Alain Berthoz, choreographer and dance theorist Ivar Hagendoorn and neurocognitive scientist Corinne Jola have extensively explored the relation between movement and expectation. Moreover, film theorist Ed Tan explored the relation between film and emotion. In the 1990s, Berthoz changed the interpretation of the term kinaesthesia. He defines the term as a form of simulation and gives the sight of a chair as an example: "[…] as one is looking at an armchair, one is already simulating the motions associated with seating oneself on it" (Foster 2008, p. 53).[2] Human beings do not perceive all objects or events in the same way. How and what a person exactly perceives is dependent on his thoughts and feelings. Ed Tan's theory is based on the work of Nico Frijda, who defines emotion as a change in action readiness (Frijda 1988).[3] Action preparedness occurs only when it has been activated by a stimulus (in the form of a thought or a situation). Tan argues that action readiness occurs through stimuli, such as twist in a film plot, that lead a person to want to find out what is going on. This curiosity results in increased attention and interest. Tan argues that one's expectations for a positive result determine the amount of action readiness and interest (Tan 1991). This suggests that expectation influences action readiness to a great extent. For instance, when one expects highly positive stimuli to occur, the amount of action readiness may be rather high while negative expectations may cause low action readiness and disinterest.

[2] This citation is quoted from Foster's article, since the original book by Alain Berthoz was not at my availability.
[3] Referred to in: Wildschut (2003).

Ivar Hagendoorn's research focuses explicitly on the role of expectation in the perception of dance. Hagendoorn proposes two hypotheses regarding the physiological and emotional effect of dance on spectators. The first hypothesis is based on two motor control systems: a forward system and an inverse system. "An *inverse* model provides the motor commands necessary to perform a movement. A *forward* model captures the forward or causal relationship between the input to a system and its output, by predicting the next state of the system, given its current state. Thus the *forward* model predicts how the pointer will move if the mouse is moved. The *inverse* model estimates how the mouse should be moved so that the pointer moves in the desired direction" (Hagendoorn 2004a, p. 93).

In the case of dance, the forward system of the spectator predicts the dancers' movements in order for the inverse system to keep up with the movement and register it by turning one's eyes and head towards the movement (Hagendoorn 2004a). Since dance movements and directions change all the time, this requires a lot of attention. Increased attention produces dopamine neurons which in turn cause arousal. However, this is not the only way dance evokes emotional responses, according to Hagendoorn. The difference between predicted movements and actual movements accounts for a so-called prediction error effect. When the difference is zero (which means a spectator correctly predicted the movement), a reward is produced in the form of a positive feeling. When the difference is significant, a small punishment in the form of a negative feeling is the result. These feelings relate only to the prediction of the movement and not to the movement itself, thus they form only a part of the overall emotional reaction to a movement.

The second hypothesis is based on Immanuel Kant's distinction between the Beautiful and the Sublime. According to Hagendoorn, beauty is the feeling we experience and attribute to an object when we discover harmony in it (Hagendoorn 2004a). Harmony appeals to our strive for order and therefore evokes a positive emotion. The sublime differs from the beauty in that it is embedded in disharmony and internal conflict. This is the case for objects that are too big to perceive in their entirety. Magnificent buildings or extreme phenomena such as hurricanes create a sublime experience. The internal conflict that arises consequently is one between the rational part of our brain that wants to

understand and therefore perceive the object or phenomenon in its totality and the imaginative part of our brain that does not need this. The resolution of this conflict lies in one's realisation that one experiences something that goes beyond representation. The intense awareness of the experience as such is accompanied by a sublime feeling (Hagendoorn 2004a).

Neurocognitive scientist Corinne Jola focuses on the combination of neurocognitive research and dance science. Her research is focused mainly on the relation between dance and cognition as well as the relation between dance, music and cognition. She works together with Dutch dance company EG|PC in a research project investigating the perception of dance in combination with different types of music and silence. Moreover, she published several articles about the relation between dance and neurocognitive science.[4]

2.4 Summary and conclusion of this chapter

In music theory, there are numerous explanations as to how music evokes emotions. These include imitation, contagion and expectation. Theories based on the so-called "doggy-theory" claim that listeners experience emotions by imitating emotions presented by the music. A variant of this theory, proposed by Patrik Juslin, suggests that musical emotion is as contagious as laughter. A problem with these theories is that they suggest that all listeners experience similar emotions. Leonard Meyer was the first musicologist to write extensively about the influence of expectation in the experience of musically evoked emotions. According to Meyer, the advent of musical events creates expectations regarding succeeding musical events in a similar way as, for instance, the advent of dark clouds, which creates expectations about certain changes in the weather. The ITPRA theory of David Huron is rooted in the work of Leonard Meyer to a great extent.

In dance theory, numerous theories have been proposed about the emotional and physical impact of dance on spectators. Slightly more attention has been paid to physical responses of spectators to dance, since dance is ultimately a physical form of art. The

[4] See: [http:// insidemovementknowledge.net/context/background/capturing-intention] for more information regarding the research project. Jola's articles on dance, music and neurocognitive science were not at my availability. See [http://www.psy.gla.ac.uk/staff/index.php?id=CJ001&pbl=full] for a list of publications by Jola.

term kinaesthesia has been put forward to explain these physical responses. Several interpretations of the term have been discussed in this chapter, such as imitation, tendency to act or action readiness and expectation. Theodor Lipps added the term *Einfühlung* to kinaesthesia in order to explain how spectators imitate physical changes of the dancers' bodies, the kinaesthetic sensations of which are accompanied by emotions. John Martin interpreted the term slightly differently, by pointing to the contagious effect of emotions presented by dancers. Ed Tan used Nico Frijda's definition of the term kinaesthesia as action readiness to argue that action readines occurs through stimuli that lead a person to want to find out what is going on. Ivar Hagendoorn explicitly relates kinaesthesia to expectation, basing his theoretical claims on several neuropsychological experiments by Alain Berthoz and others regarding the perception of motion. According to Hagendoorn, a constant change of visual stimuli produced by dance movements, results in heightened attention, which in turn causes arousal of emotions.

From this, one may conclude that expectation is not the only factor that determines listeners' and spectators' responses to music and dance. However, its influence in these responses has been noticed in both art forms. For example, Ivar Hagendoorn's articles provide useful information about the relation between expectation and dance. In music theory, the ITPRA theory by David Huron is the most recent theoretical work on expectation in relation to music. Most other theories simply state that emotions are evoked through some process and fail to explain how this occurs exactly. Moreover, they do not explain how different musical characteristics evoke different responses with different listeners. Expectation-related theories do explain exactly how all these processes take place. The ITPRA theory is one of the most recent and best-received elaborations on Meyer's theory and therefore, to my opinion, the best choice to use in relation to dance in extension to music. Since there is no such theory in dance yet, the ITPRA theory may prove to be a highly useful addition to the field of dance theory in this respect. The ITPRA theory is explained in detail in the following chapter.

Chapter 3 The ITPRA theory

3.1 Introduction

This chapter aims to explore the ITPRA theory in depth before discussing it in relation to dance and music. Although the author, music psychologist David Huron, developed his theory with regard to emotional responses to music, his arguments draw on studies of general psychology and evolutionary biology. Firstly, the main reasons are given for choosing the ITPRA theory in favour of other theories such as those discussed in chapter two. Secondly, the main aspect of the theory; expectation, is explored from a biological point of view. Lastly, the five terms that together make up the title of the theory are explained and discussed in relation to emotion, memory and perception.

3.2 Choice of the ITPRA theory

The ITPRA theory is developed not as an exclusively musical theory, but also as a tool to analyse and understand the phenomenon of expectation in general. As David Huron points out, expectation is a biological survival mechanism that is put into action whenever any of our senses are stimulated by our direct environment. This means that it can also be used to analyse the perception of motion. This has been suggested by theorists such as Alain Berthoz (2000). To my opinion, the ITPRA theory is able to unravel some of the mysteries that surround the perception and emotional impact of dance on spectators. Moreover, it will provide us with a better opportunity to analyse the influence of music on the perception of dance.

3.3 Biological use of expectation

Expectation is explained by Huron (Huron 2007) as a biological mechanism that humans and animals use for their survival, because it allows our body to prepare for imminent danger. It makes sure that we are ready to react quickly and appropriately when a dangerous event takes place by creating numerous physiological and mental changes. Examples of these changes are rapid breathing, increased heart rate, immediate focus of the eyes and ears and the suppressing of distracting thoughts. These physiological and mental changes demand a lot of energy, which means we cannot remain in this state of

heightened attention forever. Our body has to regain energy by loosening tension and focus. In a safe and static environment, our minds will grow bored and our bodies grow limp. In fact, they are working towards an ultimately energy-conserving state of rest: sleep. The role of expectation is therefore not only confined to preparing a body for imminent danger, but it is also used to make sure no energy is lost in vain by reacting to an event too soon. Ideally, a body reacts to a dangerous event only moments before the event takes place. This means, for example, lifting our arms only seconds before a ball is thrown into our direction. This way an even balance is kept between action and relaxation.

3.4 Five responses: imagination, tension, prediction, reaction and appraisal

The letters that make up the word ITPRA are based on the various responses that take place before, during and after the onset of an event. The term *event* refers to anything that enters the world of a subject through sensual perception. The touch of a rose-thorn, the sight of an approaching car and the sound of a slammed door could all be described as events. Figure 3.1 shows the chronological order in which the five responses take place as well as their duration.

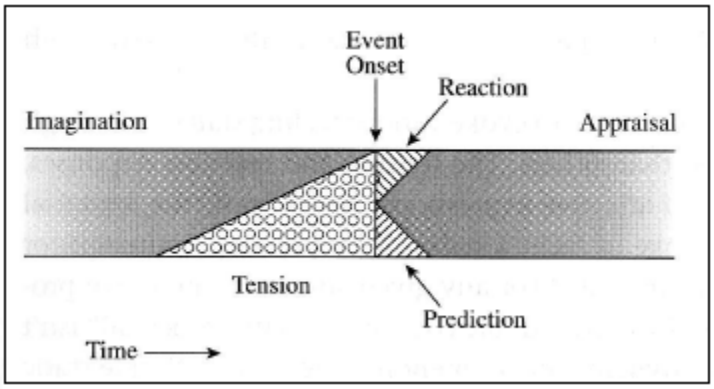

Fig. 3.1 David Huron's five responses to an event (Huron 2007, p. 17).

The imagination response takes place from a few seconds up to years before the event. During this phase, one imagines how and when an event will occur and what the outcome of that event will be. Moreover, one already feels a muted version of the feeling this outcome will evoke. For example, a groom may already feel excitement imagining the

moment he will officially be declared married to the love of his life months before the wedding.

The tension response takes place right before the onset of the event and it produces all of the previously mentioned mental and physiological changes in our bodies. It is the actual preparation phase, which ideally takes place only seconds before the event. The amount of uncertainty about when the event will take place exactly and what it will be like determines the amount of stress. Uncertainty usually provokes more stress than certainty. The emotions experienced during this phase are the result of physiological changes in our body. Experiments by Fritz Strack and others[5] underline this claim by showing that smiling results in feeling pleasure.

The prediction response takes place immediately after the onset of an event and it is related to the expectation of the event. It manifests itself as a sort of evaluation system where correct expectations (i.e. expectations that have been met) are rewarded with a positive feeling and incorrect expectations (i.e. expectations that have not been met) are punished with a negative feeling. This way, one is stimulated to create expectations that are more accurate when a similar event unfolds in order to prepare oneself better for the event. A negative prediction response does not automatically result in an overall negative response, since the latter is a combination of the prediction, reaction and appraisal response.

The reaction and appraisal responses are both related to the outcome of the event. The first is a quick and unconscious response to this outcome. A reflex is an example of a reaction response. A reflex is innate, but certain reaction responses are learnt through exposure. An example of a learnt reaction response is the mild surprise evoked by a violation of grammar. Since grammar is learnt, the surprise reaction is also learnt.

The appraisal response is a conscious assessment of the outcome of an event. It starts the moment one realises what just happened and how that will affect one. It is possible for the appraisal response to oppose the reaction response. In the case of a surprise party held by a number of people for one's birthday, the initial reaction of shock at the moment everybody shouts "SURPRISE!" is usually followed by a smile or even

[5] Strack (2003) referred to in: Huron (2007), pp. 11-12. See also: James (1884), Lange and James (1922).

laughter. One realises that the event, which at first seemed dangerous, turns out to be harmless after all.

3.5 Prediction effect and contrastive valence

Through these five responses, human beings anticipate, prepare for and react to events in their direct environment. There are four kinds of expectation: expectations regarding *what*, *when*, *where* and *why*. Huron only discusses the *what* and *when* type of expectations because those are most relevant in relation to music. The *what* type of expectation is mostly related to pitch whereas the *when* type of expectation deals primarily with rhythmical aspects of music.

Having discussed the biological use of the ITPRA theory, Huron states that human beings (and animals) in general like familiarity better than unfamiliarity. After all, familiar events are easier to expect and prepare for. Research has shown that familiar faces, drawings, sounds and words are judged more positively than unfamiliar ones. This phenomenon is called the *exposure effect*, a term posed by Robert Zajonc and further investigated by Robert Bornstein (as mentioned in Huron 2007). Huron renamed this term the *prediction effect*, arguing that exposure indeed plays an important role in the evaluation of events, but the actual evaluation occurs through expectation. Regular exposure to an event results in recurring expectations for that event. Therefore, a recurring event is easier to expect than a newly occurring event. Better expectation results in a positive prediction response.

The prediction effect does not suggest that unpredicted events always result in negative emotional responses. After all, the prediction response is not the only response that influences one's overall response to an event. In the case of the birthday party, the appraisal response overrules the prediction response and forces an overall positive feeling. Research has investigated this phenomenon, called *contrastive valence* by Huron (Huron 2007, p. 23). The emotional impact on an event is much bigger when it has not been predicted correctly. This is due to the contrast between the quick prediction response and slow appraisal response. The emotional impact is not only bigger when the outcome of the event is negative, but also when it is positive. This means that an unexpected positive event creates a greater positive feeling than an expected positive

event. For example, one usually reacts with extreme pleasure to an unexpected surprise party, while the pleasure is less high (or even fake) when it was expected. This means that, although from a biological perspective surprises can never be positive, due to the failed (or lack of) preparation contrastive valence changes an initially negative response to a positive surprise into an extremely positive response.

3.6 Misattribution

When one experiences an emotion, one is inclined to attribute that emotion to an object or event. This is because emotion always occurs in relation to something and not by itself. From a biological point of view, one has to find out what caused the emotion in order to be prepared for the next time one comes across that cause. However, sometimes an emotion is attributed to the wrong object or event. Research by Donald Dutton and Arthur Aron has shown how male students who carried out a nerve-wrecking task were inclined to attribute their emotions to the presence of an attractive female (Dutton and Aron 1974).[6] Huron argues that misattribution is the result of our natural eagerness to draw many conclusions from small amounts of information in order not to miss the correct conclusion.

Misattribution goes hand in hand with the prediction response. When a particular event occurs, positive emotions evoked by correct expectation are attributed to any 'convenient bystander', as Huron calls them. These bystanders are usually those stimuli that cause an emotional response. In the case of music, these are particular notes and beats. These notes and beats are not able to arouse emotion by themselves, but cause us to experience a particular emotion through the musical context. One attributes that emotion to the note itself though. For example, one may believe a particular note or set of notes to be sad, while in reality they just make one feel sad. Jenefer Robinson has used the term misattribution in a similar way to describe the way emotions cloud our perception of the world (Robinson 2005, p. 402). When we look at an object while under the influence of an emotion, we are inclined to attribute this emotion to the object itself. This way, we attribute musically aroused emotion to the music itself.

[6] Referred to in: Huron (2007), pp. 135-136.

3.7 Memory

As we have seen in section 3.5, exposure influences expectation. One is usually better prepared for an event one has experienced before, provided one has collected the previous experience of that event in our long-term memory. This means that expectation is determined by memory, which in turn is determined by exposure (see Fig. 3.2). There are two types of long-term memory: episodic and semantic memory. The episodic memory collects personal experiences. The semantic memory collects general information, such as language, norms and values. In the case of music, general musical conventions such as a simple straight meter (for example 2/4) or a major tone scale are collected in the semantic memory. The episodic memory collects personal musical experiences of previously heard songs. Some of that information is lost over time, which is the reason why most of us can remember a particular song without recollecting the first time we heard that song.

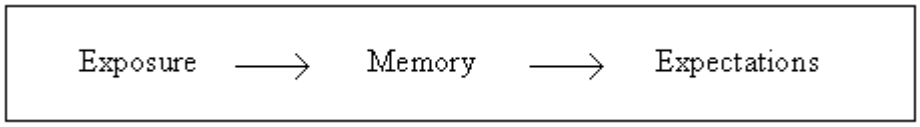

Fig. 3.2 How expectation patterns are formed

These two types of memory result in two different kinds of expectation: veridical expectations (based on the episodic memory) and schematic expectations (based on the semantic memory). To these two types of expectation, Huron adds a third: dynamic expectations. Dynamic expectations arise as the music progresses (even if one has never heard it before) and they are based on preceded musical characteristics. The three different kinds of expectation explain to a great extend why already familiar music is still able to surprise us and unfamiliar music may still sound familiar. For example, a familiar set of notes may not surprise our veridical system because it has been collected in our episodic memory, but may still surprise our schematic system since it includes syncopated notes (notes at unconventional beats) and notes that are out of key. Moreover, an unfamiliar set of notes may not surprise us because it keeps a steady pulse and includes many repetitions.

3.8 Summary and conclusion of this chapter

The ITPRA theory by David Huron provides useful information as to how and why exactly one experiences emotions from listening to music. The ITPRA theory is rooted in evolutionary biology largely, claiming that emotions are rooted in our biological defence mechanism. The occurrence of a dangerous event causes sudden physical and mental changes in our body in order for us to be able to react to the event quickly and appropriately. Through expectation, one is able to control the amount of energy that is needed for these changes to be activated on the one hand and to prepare for dangerous events on the other hand.

One's reaction towards events occurs through five different responses: the imagination, tension, prediction, reaction and appraisal response. During the imagination and tension response, one creates expectations of an event and one's body prepares to the event accordingly. The prediction response is an evaluation of these expectations and preparations, while the reaction and appraisal response relate to the outcome of the event itself. Responses to the expectation of the event may contradict responses to the outcome of the event, for example in the case of a positive surprise. Although the positive outcome of the surprise may evoke positive emotions, the fact that the surprise was not expected and prepared for accurately, initially causes a negative response (in the form of initial shock).

Expectation is based on memory. Huron discerns two types of memory, which result in two types of expectation. The semantic memory collects general information, such as language, while the episodic memory collects personal experiences. The semantic memory causes schematic expectations and the episodic memory results in veridical expectations. These two types of expectation are discussed in relation to music in the following chapter, which discusses the ITPRA theory in relation to music.

As a conclusion, the only thing left to say is that the ITPRA theory explains to a great extent why one reacts to certain stimuli the way one reacts. Moreover, it is applicable to all kinds of stimuli, but especially interesting to two art forms that manifest themselves explicitly as aural and visual stimuli: music and dance. In the next chapter, the relation between music and expectation is discussed.

Chapter 4 The ITPRA theory and music

4.1 Introduction

This chapter aims to further explore the relation between expectation and music. Through this exploration, it will become clear that although the ITPRA theory describes how human beings respond emotionally to all kinds of events in general, it is suited to shed light on emotional responses to music. This chapter starts with a discussion of musical exposure and memory, followed by an elaboration on the various conventions in music that influence our expectations of it. These are related to tonality and harmony, rhythm, phrasing, genre and style. Finally, a number of emotional responses to expected and unexpected music are discussed. All discussions are based on David Huron's book (Huron 2007).

4.2 Musical exposure and memory

Music exists throughout the entire world. There is no culture or society that does not engage with music in one way or another. This implies that music is innate to human nature. However, every culture or society has its own distinctive kind of music. Tonality, for example, is a typically Western musical principle that is unknown in various parts of the world (mostly indigenous tribes that have not been influenced by Western popular culture). Moreover, many common rhythms in African music sound uncommon, irregular and rare to European ears. This means that although every human being is somehow exposed to music, the kind of music they are exposed to varies enormously.

As we have seen in the previous chapter, music is memorised through two types of memory: the episodic and semantic memory. The musical culture in which one is brought up, determines to a great extent the musical characteristics that are preserved in one's semantic memory. For example, the semantic memory of an Indian person holds Indian *ragas* (tonal scales) and *talas* (rhythmical scales) as well as the Indian language and Indian norms and values. The musical taste and expectation patterns of an Indian person are based on this extensive knowledge. He/she might therefore find characteristics of Indian music self-evident and easy to predict, while he/she finds certain Western classical music characteristics uncommon and difficult to predict accurately.

Moreover, a person from Europe or North America may find Western classical music very common and predictable while having difficulties anticipating melodic and rhythmical characteristics of Indian music. However, if any one of these two persons has been exposed regularly to the other musical culture, he/she may well be capable of predicting characteristics of both musical genres. This means that through regular exposure to a particular musical genre or culture, the characteristics of that music are preserved in the semantic memory. Huron argues that characteristics of different musical genres are preserved separately in the semantic memory, in the form of musical schemas. Our memory can hold many different musical schemas at the same time. One only needs to tap into the right schema to be able to make accurate expectations about the music. This suggests that one is able to learn to like any type of music by exposing oneself to it regularly.

The fact that different musical cultures exist that each create their own musical schemas in our memory implies that our perception of music is not based on natural laws. Instead, musical expectancy is rooted in convention. In this chapter, only a number of musical conventions of Western music are discussed. It is out of the scope and aim of this thesis to explore the conventions of more than one musical culture. The most important conventions in Western music relate to tonality, harmony, rhythm, phrasing, genre and style.

4.3 Tonality and harmony

Tonality is usually described as a system of principles that determine how each note in a scale is related to the basic pitch of that scale (called the tonic). Some Western music theorists, composers and musicians restrict tonality to the characteristics of the major/minor scale system. Others share a wider view on the concept of tonality. This thesis uses the first definition of the term, since it focuses mainly on the relations between various scale degrees. Western scales are based on a range of twelve pitches within an octave (i.e. distance between one pitch and another pitch with half or double its frequency). Each of the twelve pitches can function as the basis of a scale (i.e. the tonic). There are numerous sorts of scales, but most Western music makes use of heptatonic tone scales (i.e. scales consisting of seven notes) in either major or minor scale. Major is even

more common than minor, because it is more frequently used in Western music. This means that Western listeners are exposed to major scales more often than to minor scales. As a result, Western listeners tend to prefer major scales when asked to imagine a scale without hearing one (Huron 2007, p. 209).

Various studies have determined the number of occurrences of each note in a scale (called scale degree) in Western music. Figure 4.1 shows the number of occurrences of scale degrees in major and minor scales. The horizontal bar shows all scale degrees within an octave and the vertical bar shows the number of occurrences of each scale degree.

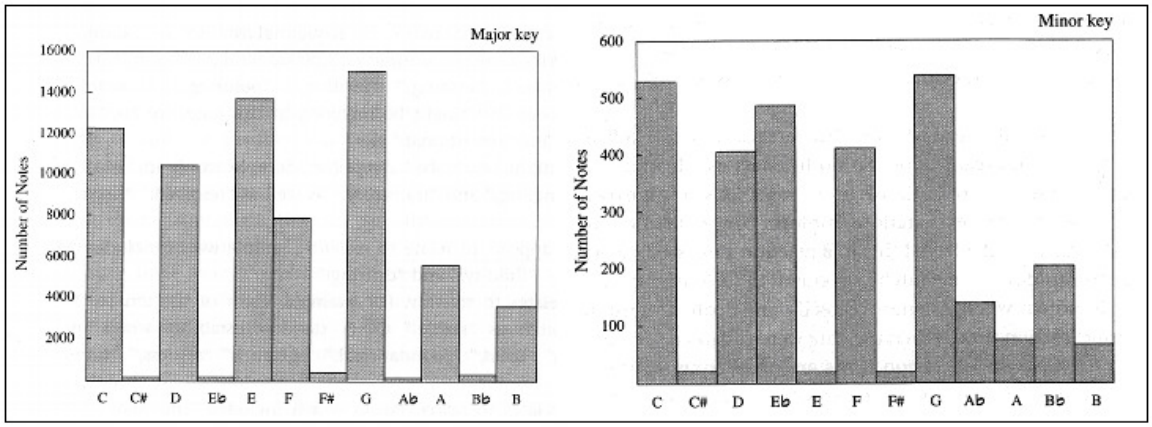

Fig. 4.1 Number of occurrences of scale degrees for a large sample of melodies in major and minor key (Huron 2007, p. 148 and 149)

In both types of scales, the tonic is used most often, followed by the fifth scale degree (in major scales) or the lower third scale degree (in minor scales). These scale degrees occur most often and might therefore be expected more than other scale degrees. However, in a melody, the number of occurrences of scale degrees is not the only factor that determines their predictability. Every scale degree has a particular function in relation to the tonic and other notes. This relation is based on tendency.

Figure 4.2 shows the tendency of every scale degree to move into the direction of another scale degree. All scale degrees are given a number. For example, number one is the tonic and number five is the dominant. The musical symbol for rest presents the end of a melody or phrase. The thickness of each arrow presents the strength of tendency between two scale degrees.

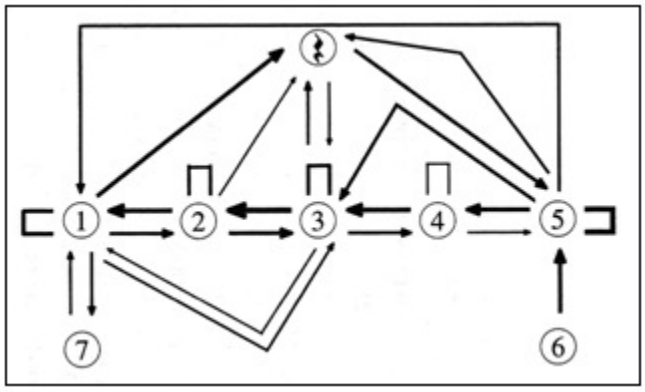

Fig. 4.2 Tendency of scale degrees (Huron 2007, p. 160). [figure is turned 90°]

As can be seen clearly, a downwards movement from one scale degree to its neighbour is highly common in Western music. Moreover, the tonic tends to be followed by a rest, most likely because the tonic usually functions as the final note in a melody. These two findings imply that Western listeners are best able to predict downwards movements towards the tonic. Experiments with participants who had to judge the goodness of fit of a probe tone following the interruption of a melody have shown that listeners are highly sensitive to closure. The subjects in question judged probe tones that ended a melody better than any other probe tone (Huron 2007, p. 151 and further).

All these findings suggest that listeners tend to create predictions about melodic development according to their experience with Western music. Music that follows the tendencies of each note is therefore usually more predictive than music that goes against these tendencies. This goes for melody as well as for harmony, in which case not individual notes but accords succeed one another according to a system of tendencies. For example, the fifth accord (the dominant) tends to be followed by the tonic accord, which ends a harmonic progression.

4.4 Rhythm and timing

Rhythmical expectancy accounts for *when*-types of expectation. Research has shown that by far most Western music is played in a simple duple (2/4) or triple (3/4) meter, while compound meters such as 6/8 or 9/8 and irregular meters, such as 7/8 or 4/5, are barely used in Western music (Huron 2007, p. 195). This implies that Western listeners are better able to predict simple meters. Moreover, particular rhythmic positions are more commonly used than others. Figure 4.3 shows the number of note onsets on all rhythmical positions of a Western classical music composition. The horizontal bar shows the metric positions in numbers. For example, one is the first beat (i.e. the downbeat). The vertical bar shows the number of notes that are played on these metrical positions.

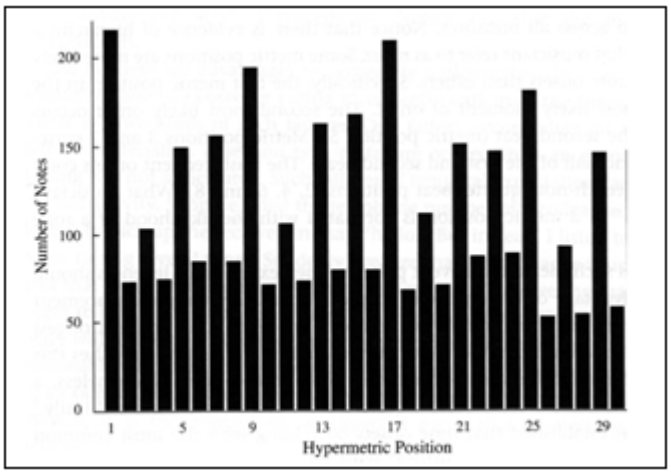

Fig. 4.3 Rhythmical organisation of Joseph Haydn's String Quartet, op. 54, no. 1, fourth movement (Huron 2007, p. 180).

The downbeat, which is the first beat, usually has the strongest accentuation, followed by other evenly spread out accents. These are for example the third beat in a 4/4 rhythm (i.e. **1** 2 **3** 4) or the fourth beat in a 6/8 rhythm (i.e. **1** 2 3 **4** 5 6). Listeners' attention fluctuates throughout a music composition, but it is usually highest during accented beats, because those beats are highly expected. Leaving out accented beats creates a bigger surprise on the part of listeners than leaving out unaccented beats. Syncopation is a musical technique in which a rest is played where a note is expected or a note is played where a rest is expected. Syncopated notes go against our schematic expectations (based on the semantic memory), which means that they are able to surprise us over and over again.

Timing is an essential aspect of music and plays an important part in musical expectancy. Expressive timing is inherent to musical performance. Predictable rhythms become less predictable and make a musical performance less static when they are not strictly performed. Expressive timing relates to rhythm as well as speed. Slowing down or speeding up the music has consequences for listeners' expectations, as it suddenly gives listeners more or less time to form expectations about succeeding musical events. Finally, phrasing is an important aspect of music. As we have seen, closure influences musical expectations to a great extent. Listeners expect music to develop itself similarly to language, in which smaller units form groups of sentences or phrases, which together make up a text or composition. Research has shown that listeners expect the second half of a phrase to involve a downwards movement towards the tonic (Huron 2007, p. 180). This is in line with the average arch shape of Western musical phrases. With respect to timing, they expect phrases to obey to the rhythmical structure of the music. This means that expressive timing in relation to phrasing adds to the unpredictability of music. Completely unconventional phrasing (i.e. ending and starting phrases at unconventional rhythmical and/or melodic positions in a melody) goes against all expectations and usually creates high uncertainty on the part of listeners.

4.5 Genre and style

It has been said that we are able to learn and preserve different musical schemas at the same time. Once one has been introduced and exposed regularly to a particular musical culture, one preserves the musical characteristics of that culture. This goes for different musical genres and styles as well. A Western listener may, for example, possess different schema for classical music, pop, jazz, rock, latin, R&B and various types of folk music. These types of music are mainly broadcasted on Western radio and television, performed by Western bands and learnt in music class. When hearing music, one is able to switche extremely quickly to the required musical schema.

Numerous composers and artists mix two or more musical genres or styles within one composition or performance. For example, a pop song might be performed in a reggae rhythm (in which case the accents are placed on the second and fourth beat) or a classical composition might be performed on a fiddle (which is a regular violin played in

a traditional folk style). Listeners are capable of using two different musical schemas at the same time when listening to this type of crossover music, which means their expectations are not necessarily crossed.

4.6 Predictability and unpredictability

The previous sections have focused mainly on musical techniques and characteristics that reject or give in to listeners' expectations. It has thus been made clear that musical expectancy is very much based on conventions. In order for music to catch and keep listeners' attention, a good balance between predictable and unpredictable characteristics of the music is required. Although we may prefer familiarity and predictability from a biological perspective, music that is utterly predictable will lead listeners to become bored. After all, predictable events do not require much attention. According to dance dramaturge Ghislaine van Schijndel, curiosity is the necessary means to draw and keep one's attention and deepen one's emotional experience (Van Schijndel 2008). On the other hand, too much surprise causes irritation on the part of listeners, since they are refrained from relaxing and loosening tension.

Numerous musical genres aim to disrupt the balance between predictability and unpredictability. Two examples of genres that aim for the loss of attention on the part of listeners, are new age (or ambient) music and minimal music. The former puts great emphasis on a slow pace and on simple melodic and rhythmical development, while the latter mainly focuses on repetition and scarcity of musical data. Both musical genres are a-dialectical[7], which means they avoid any kind of narrative structure (including climaxes). Other types of music, such as experimental avant-garde music, intentionally disrupt any possibility of making expectations by avoiding musical conventions, such as tonality or rhythmical structure. Many of these types of so-called avant-garde music are eventually integrated in mainstream musical genres, as mainstream artists copy their techniques and conventions change.

[7] This is a term used by Wim Mertens (1980), a Dutch minimal music composer and theorist.

4.7 Summary and conclusion of this chapter

In this chapter, the ITPRA theory has been discussed in relation to music. Exposure to a type of music creates expectations about that music. This means that, for example, a Western listener is able to create accurate predictions about Western music, while not being able to predict developments in Indian music accurately. This results in different responses to both kinds of music. *When* and *why* types of expectations are created about several characteristics of music. These are: tonality and harmony, rhythm and timing, genre and style.

A lot of research has been carried out regarding listeners' expectations of melodic and harmonic development in music. It has been found that according to certain relations between scale degrees, particular successions of tones are highly expected by listeners. In the case of rhythm, certain beats are expected more than other beats. Composers may therefore evoke particular emotional responses to their music by either meeting listeners' expectations or surpassing them. A good balance between expected and unexpected musical events is required for listeners' not to get bored or irritated. Lastly, genre determines to a great extent several characteristics of the music as well as its style of performance. Since listeners are able to form more than one schema of expectations and switch between those different schemas while listening to music, composers and musicians may combine genres and styles without crossing listeners' expectations too much.

From this chapter, it may be concluded that expectation plays a highly important role in listeners' emotional and physical responses to music. Numerous experimental tests have confirmed claims, put forward through the ITPRA theory, about the relation between music and expectation. The interaction of different types of memory, different responses and different stimuli results in complicated overall responses to music. Although dance is a different art form, that is based on a different type of perception, it makes use of expectation similarly to music. The relation between expectation and dance is discussed in the following chapter.

Chapter 5 The ITPRA theory and dance

5.1 Introduction

This chapter starts with a short comparison between music and dance in relation to expectancy in order to find out what aspects of dance the ITPRA theory covers and what aspects it does not cover. As the theory was initially designed as a tool to analyse musical expectancy, it might not be relevant to all aspects of expectation about dance. The structure of the following sections is similar to the structure of the previous chapter, as each section explores a different convention in dance that influences our expectations of it. These conventions are related to the natural laws of the body, time and space.

5.2 Comparison of music and dance in relation to expectancy

It has become clear that both music theory and dance theory have recognised the influence of expectancy in emotional and physical responses to dance and music. This implies that the ITPRA theory could be as relevant and important to dance theory as it is to music theory. This chapter discusses a number of comparisons between music and dance with regard to expectation in order to determine how the ITPRA can be applied to dance theory.

Firstly, there is a difference between music and dance in relation to the four kinds of expectations mentioned by Huron: expectations regarding *what*, *when*, *where* and *why* (Huron 2007, p. 6). Huron focuses on *what* and *when* types of expectations only, because only these two types relate to music. Moreover, according to Huron, the *why* type of expectation is too complicated to discuss. Huron does not explain what makes this type of expectation complicated. Since direction and space are two essential aspects of dance, the perception of dance relates to *where* types of expectation in addition to *what* and *when* types of expectation. This means that the expectations of people watching a dance performance are slightly more complicated than those of people listening to music.

Secondly, the nature of music is different from the nature of dance. Music has a so-called vocabulary of twelve notes that can be organised in a variety of ways, while dance does not have such a distinct vocabulary. Especially in modern and contemporary dance, all kinds of movements are eligible, including every-day movements such as

walking or sitting. Moreover, dance movements are not as clearly defined as musical notes. No matter however a note is played, it is still that particular note. And irrespective of how smoothly a melody is played, there is always a distinct line between that note and the next one.[8] Dance movements usually occur in a more or less continuous flow of movement, which means that there is no such distinct separation between one movement and the next. Furthermore, a change in direction, effort or initiation of a movement inherently changes the entire movement while a musical note – however it is performed or embellished – remains the same note.

These differences between music and dance require a different approach to expectation in relation to dance. To my opinion, spectators of a dance performance create expectations not so much about particular dance movements, but about the characteristics of these movements. This opinion is based on the observation that it is impossible to predict movements themselves, since there are too many. This means that one makes expectations about *how* a movement is performed rather than about *what* movement. These characteristics include direction, intensity, flow, phrasing and timing: these are discussed in the following sections. Moreover, it is almost impossible to produce statistical evidence for dance in relation to exposure. Music theorists can calculate the exact amount of times a particular note is played in a song, while in dance the lack of a distinctive vocabulary of movements and the inability to separate movements within a dance sequence make it almost impossible to categorise movements. Therefore, any discussion of dance in relation to the ITPRA theory has to rely on observations and common knowledge about dance.

Dance is the organisation of particular movements in space and time.[9] Dance is always rooted in convention. Some forms of dance require exact precision in the way movements are performed, such as the Indian Kathak tradition.[10] Other forms of dance

[8] One exception is a musical phenomenon called *glissando*. Glissando is a continuous upwards or downwards slide in pitch. Perfect glissando is achievable on only three types of instrument: trombones, string instruments and the human voice.

[9] This thesis uses a straight-forward definition of dance presented by Luuk Utrecht (Utrecht: 1988). Other interpretations of the term 'dance' include "formalist human behaviour" by Jany Dudley, "a constellation of motor behaviours by Jaonn W. Kealiinohomoku and "movements guided by certain principles" by Louis Horst. See Preston -Dunlop (1995).

[10] *Kathak* is an Indian dance style in which the movements are prescribed down to every detail. Online videos of kathak performances can be found on [www.youtube.com] typing the terms 'kathak dance'.

are not based on rules and principles, such as dance improvisation and some types of avant-garde dance. However inventive these types of dance are, they usually still obey to a number of conventions. I have divided these conventions in four main categories: natural laws of the body, genre and style, conventions relating to space and to time.

5.3 Natural laws of the body

The natural laws of the body are in fact not conventions in terms of man-made cultural traditions or genres that each convey their own rules. They do however influence spectators' expectations in the same way as conventions. A difference between man-made conventions and natural laws is that the former are open to change while the latter cannot be surpassed. Of course, the possibilities of the body are always explored by dancers, acrobats and other talented artists, but there are certain limits to this. Therefore, the amount of certainty with which expectations are created in relation to natural laws is significantly higher than the amount of certainty of expectations in relation to man-made conventions.

One very important natural law is that of gravity. We are quite well-equipped to predict events in which gravity dominates movement. For example, one is able to make an accurate estimation of the precise location and moment a ball comes down and reaches the ground after being thrown up into the air. This also goes for dancers and props in a dance performance. The amount of certainty with which spectators anticipate a jumping dancer to reach the ground, is quite high. This anticipation causes a lot of tension. The moment a dancer reaches the ground evokes a feeling of pleasure. This feeling of pleasure is actually the result of a positive prediction response and it is misattributed to the movement itself.

Gravity does not only influence the speed at which a jumping dancer reaches the ground, but also controls upwards and downwards movements. Especially in modern dance, movements are dominated by gravity. This aids spectators in predicting the speed and force with which a dancer is able to carry out movements. For example, moving heavy limbs, such as one's legs or the torso, requires much more energy and force than moving lighter limbs, such as the arms or hands. Choreographers can surprise spectators by choreographing seemingly heavy and slow movements for the arms and quick, light

movements for the legs. This goes against the expectations of spectators as they are used to watch light movements performed by the arms and heavy movements performed by the legs. In his choreography *Self Unfinished*, choreographer Xavier le Roy performs part of his choreography while standing upside down. As a result, his arms produce heavy movements while his legs move seemingly light into the air. Not only does it cross spectators' expectations, the unexpected ease with which spectators recognize imaginative forms in le Roy's body creates perceptual confusion.

Apart from gravity, there are a couple of other natural laws of the body, one of which is balance. Imagine a dancer doing three pirouettes in a clockwise direction. The dancer is not very likely to change his/her direction and suddenly turn anti-clockwise without first ending the pirouettes. This also goes for running or leaning into a certain direction. Dancers must first finish their initial movement and regain balance before they can move into another direction. Spectators are aware of these limitations to bodily movement and are therefore well able to create predictions about when and how dancers regain balance before moving into another direction or position. Choreographers can surpass these expectations by creating counter movements, such as throwing an arm, a leg or even turning one's head into the opposite direction of the rest of the body. This suggests that the natural law of balance is surpassed and creates the illusion that an impossible movement is performed.

This last comment moves the discussion to the issue of seemingly impossible movements. Choreographer and dance theorist Ivar Hagendoorn argues that movements beyond our understanding are perceived as sublime. An impossible movement seems to go beyond one's ability to perceive it in its totality. One cannot perceive it as such, because one fails to understand the movement. It seems to surpass all natural laws of the body and therefore goes against one's expectations. Hagendoorn argues that such a seemingly impossible movement creates awe on the part of spectators. This feeling of awe is even stronger because of the contrastive valence effect of the highly unexpected movement. Figure 5.1 (on the next page) shows an example of a movement or position that is seemingly impossible.

Fig. 5.1 Jirí Kylián, *Dreamtime* (1983). (Hagendoorn 2004a.)

5.4 Genre and style

The discussion about musical genre and style in chapter 4 makes it clear that one is able to form expectation schemas for more than one music genre or performance style. This also goes for genres and styles in dance. In Europe and North America, for example, well known dance genres include classical ballet, modern dance, hip hop, jazz or musical dance and various folk dances such as belly dancing, salsa and Irish dancing. Those dance genres are shown most often on television, in films and on the internet. Although not every person from the West might be familiar with all those dance genres, they have at least an idea about what they look like.

The amount of exposure to a dance genre determines how well one is able to create accurate predictions about it. The history of dance has a great influence on this. Western dance, as performed in the theatre, has gone through a couple of significant changes during the twentieth century. For a long time, classical ballet dominated the entire Western dance world. Classical ballet is a highly stylized ballet form and is determined by a specific set of rules and techniques. An example is the set of five specific positions for the feet and arms that was established in the fourteenth century (Utrecht 1988). Knowledge of these principles helps spectators to create accurate predictions about classical ballet performances. Moreover, classical ballet has a distinctive vocabulary of movements. Examples are the arabesque, the fouetté or de pas de chat. These movements – as well as other ballets techniques – occur in ballet performances frequently and are therefore preserved in one's semantic memory, provided one watches ballet regularly. Expectations about classical ballet are therefore mainly based on the semantic memory. Well known choreographies that are still regularly

performed, such as Swan Lake and the Nutcracker, are preserved in one's episodic memory. This means that a quite unfamiliar movement may still be perceived as familiar, because it was remembered as a part of (one of) these choreographies.

With the advent of modern dance, old techniques and principles were set aside and new movements emerged. Suddenly, spectators could not rely on their knowledge of movements and techniques anymore. As a result, they could not form accurate predictions about this new dance form and became overwhelmed with completely unexpected ways of moving. It could be said that this is one of the reasons that modern dance was initially criticised by audiences worldwide. Nowadays, modern dance has evolved into a more or less stylised dance style and dance spectators have become familiar with its techniques and movements.

Contemporary dance genres, such as avant-garde and experimental dance, have rejected systems of techniques and clear movement vocabularies altogether. These dance genres are open to all kinds of movement, including walking, sitting and running. Moreover, an experimental dance performance might exclude any kind of movement apart from walking and sitting. This means that there are no rules of principles for these dance genres to be preserved in the semantic memory. Spectators are sometimes completely prevented from relying on their knowledge of dance. This makes predicting movements of experimental dance performances extremely difficult. It has commonly been said that these types of avant-garde and experimental dance are sometimes hard to watch.

5.5 Conventions relating to space and direction

In section 5.2 it has been mentioned that dance evokes not only *what* and *when* types of expectation, but also with regard to *where* types of expectation. *Where* types of expectation relate to spatial aspects of dance. These include the space in which dance is performed, direction of movements and visual forms.

The space in which dance takes place evokes numerous expectations about the performance itself. Many forms of dance, especially classical ballet, jazz dance, modern and contemporary dance, take place in conventional theatres. This means that the performance usually takes place on a stage while the audience is seated in a darkened

auditorium and that there is no direct contact between dancers and spectators. These theatre conventions influence spectators' expectations about where the dance is performed and how spectators and dancers relate to each other during a performance. Performances that take place in unconventional spaces, such as business institutions or on the streets, often reject these conventions. Often there is no clear division between dancers and spectators and the latter are sometimes even invited to join the performance. This might feel uncomfortable to spectators who are used to conventional theatre performances, because they cannot rely on those conventions and they might not know how to act.

As for spatial aspects of movements, various dance genres have established their own conventions regarding forms and direction. Choreographer Doris Humphrey detected weak and strong spots in a performance space (Humphrey 1959). Strong spots include the centre and four corners of the performance space and the lines in between those spots. The strongest spots attract the most attention. Most dance genres make extensive use of this by focusing the dancers' positions at or around these spots. Moreover, certain figures and forms such as straight or diagonal lines, circles and squares are used quite frequently in dance performances, especially in classical ballet and modern dance. As a result, spectators who frequently watch dance performances are exposed to these forms, figures and strong spots in the performance space regularly. These experiences are at first preserved in one's episodic memory and eventually in one's semantic memory. When a group of dancers runs on stage, spectators expect them to form a clear figure in the space. They make use of their semantic memory to create accurate predictions about what spots will be used by dancers and what possible figures they will form. Once spectators recognise a particular figure and this figure was expected, the prediction response usually evokes a positive feeling.

Choreographers can surpass spectators' expectations by putting dancers on weak spots in the performance space or by rejecting any distinctive figure. Spatial chaos might irritate spectators, because their expectations are not met. It might also evoke a sublime feeling in case it involves a great number of dancers, because of the spectators' inability to perceive the choreography in its entirety. Moreover, spectators might be positively surprised by the skill with which the dancers are able to avoid bumping into each other.

Dance movements are usually not performed separately, but within a movement phrase or flow of movement. This means that expectations regarding the direction of movement relate to the flow of movement as a whole. For example, when the first movements within a flow of movement are performed to the right, spectators might expect the rest of the movements to follow into the same direction. An abrupt halt in the flow of movement or change into the opposite direction may therefore come as a surprise and evoke emotions accordingly. Moreover, the point of focus on dancers' faces often provides clues as to what direction their movements will go into. Juxtaposing dancers' point of view with their actual movements in terms of direction might create surprise as well. For example, a dancer that ends his/her pirouette into a left direction and looks to the left may be expected to continue his/her flow of movement into that direction. Moving to the right instead may cross spectators' expectations. Finally, a juxtaposition of movement directions may also occur between different parts of the body. This occurs often in choreographies by dance company LeineRoebana. In this case, two or more parts of the body seem to move independently from each other, which means spectators cannot rely on the movements of the one part of the body to create accurate predictions about the other part of the body. LeineRoebana calls this type of movement *bodily schizophrenia*.

5.6 Dramatic structure

Some choreographies are structured according to a narrative or dramatic development. In this case, various characters in the story convey their emotions through facial gestures and differences in quality of movement. For example, anger is usually portrayed through wild, intense and powerful movements while joy is often displayed through quick and light movements. The dramatic structure of a choreography evokes emotions in numerous ways. Firstly, a portrayed emotion may cause spectators to experience that emotion in two ways. Musicologist R.K. Elliot points to the difference between experiencing musical emotion from within and from without. In the former case, listeners experience the same emotion as the main voice or character in the music while in the latter case, they experience a form of sympathy with that main voice or character. This means that the emotion sadness by the main voice in the music may cause spectators to either experience

sadness or pity. I propose that choreography evokes emotions in a similar way. Spectators that watch a dancer portray sadness, may experience the emotions sadness or pity.

Another way in which the dramatic structure of choreography evokes emotion is through expectation. Spectators usually create expectations about the development of the choreographic narrative. Abrupt changes in this dramatic structure may create surprise and confusion on the part of spectators. Moreover, spectators may expect the choreographic narrative to develop into some sort of climax and solution of the characters' main problems eventually. Surprise may be created by rejecting this conventional dramatic structure.

5.7 Conventions relating to time

Earlier in this chapter, dance was defined as movement organised in space and time. Time is an essential aspect of dance. As with space, there are certain conventions in dance relating to time. These conventions have to do mainly with speed, phrasing and music. These conventions are not discussed in this chapter, since they are all part of a discussion on the relation between music and dance. The following chapter explores this topic in more detail, since it is one of the focuses of this thesis.

5.8 Summary of this chapter [11]

In this chapter, the ITPRA theory has been discussed in relation to dance. A short comparison between music and dance makes clear that choreographic expectations are roughly similar to musical expectations. However, the nature of choreographic expectations is slightly different than that of musical expectations. Instead of predicting exactly what movements will succeed a current movement, predictions are made regarding several aspects of movement. These aspects are: natural laws of the body, genre and style, space and direction, dramatic structure and time. Natural laws of the body include gravity and balance. Spectators know the limitations of a human body and are able to use this information in creating expectations about movements. Moreover, different dance genres and styles produce different expectations in a similar way to

[11] Conclusions about this chapter are discussed in combination with conclusions from chapter 6 at the end of chapter 6, since these conclusions bear upon both chapters.

musical genres. Space and direction play an important role in spectators' expectations. Not only the space in which dance is performed, but also the direction of the entire flow of movement and the dancers' point of focus convey useful information for spectators in order to create accurate expectations. Another characteristic that influences spectators' expectations, put forward by Doris Humphrey, is the dramatic structure of choreography. Sudden and unconventional changes in a narrative structure cause as much surprise on the part of spectators as sudden changes in direction.

Finally, timing plays an important role in spectators' expectations about dance. However, this aspect will be discussed extensively in the next chapter. Chapter 6 relates expectation to the combination of music and dance. Through the combination of both art forms, the temporal aspects of dance are discussed in relation to expectation.

Chapter 6 The interaction between dance, music and expectation

6.1 Introduction

This chapter focuses on the combination of dance and music in relation to expectation. Since dance and music complement each other in terms of perception, expectations about dance movements are highly influenced by music and vice versa. Before discussing how various elements of music and dance relate to expectation, it is important to focus on the relation between music and dance as such. Therefore, this chapter starts with an exploration of how aural and visual perceptions influence one another. The next section discusses three ways in which dance and music interact according to dance pianist and theorist Elizabeth Sawyer. The following sections focus on various combined elements of music and dance in relation to expectation. The first of these is rhythm and is discussed in section 6.4. This section followed by sections on tonality, direction and natural laws of the body, on exposure, genre and style and eventually on dramatic structure.

6.2 Aural versus visual perception

Music and dance are often seen as inseparable, because they complement each other in terms of perception. According to psychologist and philosopher John Dewey, the eye and the ear complement each other and together create an illusion of oneness. However, there are distinctive differences between visual and aural perception. Dewey claims that visual perception is directed outwards: "The eye is the sense of distance […]. Vision gives the spread out scene – that *in* and *on* which … change takes place." (Dewey 1958, p. 236) In opposition to this, aural perception is an inwards-directed form of perception. Although sounds come from outside the body, they manifest themselves inside our body. When sound vibrations reach our ears, they set in motion vibrations in several parts of our body, such as the eardrums and body liquids. When, for example, we feel as if the sound of a very loud bass at a rock concert makes us tremble inside, our body liquid in fact trembles.

There is no consensus about which kind of perception is processed quicker. However, music is commonly thought of as more directly appealing to our emotions than any other art form. This might be so because spectators are inclined to seek out gestures in dance movements, which they can relate to a narrative structure. Therefore, they

consciously project musically evoked emotions on these perceived gestures. The essential problem with this point of view is that it ignores the physical responses that dance movements evoke in spectators' bodies, which could be said to be equal to the physical responses evoked by music through sound vibrations. If dance and music evoke physical responses in spectators' bodies in a similar way, they may also evoke emotions in spectators similarly.

However, the point about gestures in dance movements cannot be ignored, because spectators are indeed able to recognise certain emotions in movements on many occasions. Since dance requires movement by human bodies, it automatically has to deal with human issues such as gender, physicality and emotion or mood. Music does not require this amount of embodiment. Therefore, dance can never become as abstract an art form as music.

To my opinion, dance evokes emotions through two different types of perception, one based on recognition of emotional gestures and the other based on expectation. The first type of perception involves conscious thought and therefore occurs more slowly than the second type of perception. This means that emotional gestures are influenced by music and physical responses to dance, since these manifest themselves quicker through the tension and prediction response. For example, when one watches dancers that act being sad through their movements, one might experience sadness. However, when this visual image is combined with joyful music, the movements become suspicious. One might wonder whether the dancers are truly sad, while others might even start laughing at the strange sight. Actually, in the latter case, the contradiction between musical and choreographic emotions actually surprises. This creates different emotions from sadness altogether.

6.3 Three ways of interaction between dance and music

According to dance pianist and music theorist Elizabeth Sawyer (Sawyer 1985), music and dance interact in three ways: through synchronisation, opposition or assimilation. In the case of synchronisation, the dancers' movements correspond with the music in terms of meter, rhythm, structure and development. Many conventional dance performances are dominated by synchronisation between dance and music. In the case of opposition, the

dancers' movements contradict the music in terms of tempo, quality, accentuation, texture and stylistic organisation. Opposition occurs less often than synchronisation. The last way in which music and dance interact – assimilation – is a combination of synchronisation and opposition. In this case, the dance movements closely follow some aspects of music while other movements juxtapose the music. For example, the dance and music may be in correspondence with each other in terms of style and quality but completely independent from each other in terms of tempo, phrasing and accentuation. In the case of live music and improvisation, in which there is a live interaction of musicians and dancers, assimilation is usually the main form of interaction.

These three types of interaction between dance and music each evoke emotional and physical responses on the part of spectators in a different way. Synchronisation between dance movements and music creates certainty and predictability about how dance will develop itself in relation to music and vice versa. Opposition creates uncertainty and unpredictability in this respect, since spectators cannot rely on similarities between musical and choreographic characteristics. Assimilation combines predictable and unpredictable moments between dance and music. The exact amount of certainty and predictability of dance and music depends strongly on the predictability inherent to dance and music separately. When predictable music is synchronised to unpredictable and unconventional movements, spectators may still perceive the combination of music and dance as unpredictable.

6.4 Rhythm

Rhythm is the most important characteristic that relates dance to music, since both art forms organize and structure sounds and movements in time. Therefore, the connection between music and dance is highly dependent on this shared characteristic. This close connection relates primarily to pulse and is best noticed by looking at dancing bodies. Whenever human beings physically respond to music by moving their body, the content and quality of their movements may vary endlessly, but the rhythm of the movements always obeys the rhythmical pulse of the music. This means that accents in the flow of movement, such as poses or changes in direction (usually in the form of a bounce) coincide with the pulse of the music. It is extremely difficult to move in a different

rhythmical pulse, since one cannot do so without consciously ignoring the musical pulse and concentrating on counting differently. Moreover, any choreography that completely surpasses the rhythmical pulse of the music results in bodily rejection on the part of dancers, who may claim that it goes against the natural logic of the body. It also creates perceptual confusion on the part of spectators as they strongly expect dance movements to coincide with the pulse of the music. It is possible, however, for dance movements to go against downbeats in the music without creating too much confusion, provided this occurs only occasionally. Dance movements create surprise on the part of spectators by occasionally surpassing the rhythmical pulse of the music. The amount of attention and certainty with which spectators expect the music and dance to accentuate is highest during downbeats, which means the impact of unexpected events on these beats is also highest during those beats.

Musical meter determines the structure of movements to a lesser extent than rhythmical pulse. The upbeats and other beats in musical meter do not have to be strictly followed by dance movements as much as downbeats in order to be perceived as cohesive and in line with the music. In fact, dance movements that coincide exactly with all beats in the music may be perceived as static and unnatural, because it would require a dancer to move from pose to pose on each beat and move around in exactly the same speed the entire time. This does not mean that musical meter can be completely ignored by the dance movements. Triple rhythms such as 3/4 and 6/8 evoke distinctively different rhythmical quality and accentuation from double rhythms such as 2/4 and 4/4.

Choreographers can create surprise on the part of spectators by crossing the metrical division of the music according to two musical techniques. For example, two bars in triple division may be performed as if they are three bars in double division, creating syncopated accents. This technique is called *hemiola*. The second technique is an irregular grouping of notes into tuplets, triplets, quadruplets and quintuplets (groups of two, three, four or five equally long notes) or more notes. These musical techniques are often used in the relation between music and dance. In this case, the music keeps a regular rhythmic division while the dance movements perform the irregular rhythms. Since spectators often use the music as a projection on which dance movements are

perceived, their expectations are based on the regular rhythms of the music. Therefore, the irregular division of meter in dance movements comes as a surprise.

Apart from pulse and meter, dance relates to music through timing and phrasing. Phrasing is especially important in dance, since dance manifests itself through the development of a movement phrase involving fluctuations in movement quality. Provided the movements coincide with the rhythmical pulse and meter of the music to a great extent, choreography makes extensive use of expressive timing and phrasing. According to Elizabeth Sawyer: "Meter divides, phrasing connects; meter measures time, phrasing enriches it. In phrasing we release the confines of metrical counts." (Sawyer 1985, p.129) Dance pianist Harriet Cavalli speaks of ebb and flow and of peaks and valleys in music and dance (Cavalli 2001, p. 9) in explaining phrasing. However romantic their views on phrasing might be, both writers point out the importance of phrasing and expressive timing. In fact, dance and music each have their own timing of phrases, which means they coincide slightly, but never exactly. This results in a constant going back and forth between the spectators' expectations being met and being surpassed.

Although rhythm is the most important element that connects music and dance, the other elements discussed in the previous chapters also influence spectators' expectations about dance and music to large extent. In the following sections, musical elements are combined with choreographic elements.

6.5 Direction, tonality and natural laws of the body

In this section, tonality is discussed in relation to direction and natural laws of the body. Although direction and natural laws of the body are not entirely the same as tonality, they do structure choreography in more or less the same way as tonality does with music. In fact, descriptions of motion in music usually refer to tonality. For example, an ascending melody line including all scale degrees followed by a descending octave (i.e. the distance between eight scale degrees) may be visualised as an upwards movement of a body part – for instance an arm – followed by a drop to the floor. Moreover, the limitations of tonality in determining which notes are in and out of tune may be compared to the limitations of the natural laws of the body in dance movements, which is the case when an arm is stretched out as far as possible and cannot be stretch out any further.

As has been discussed in the previous chapter, spectators make extensive use of the information a flow of movement and dancer's point of focus convey in creating expectations about direction of movement. They may also use music, especially when the music and dance are in synchrony, to create expectations about how movement develops in terms of direction. For example, high notes in a melody may be combined with light movements high into the air whereas low notes may be synchronised to movements performed on the floor. In these cases, the spatial image of the movements is enriched by a visual image of the motion of music. Surprise can be created by ignoring or juxtaposing the melodic development of the music by the dance movements. Choreographers and composers may make use of counterpoint techniques as a way of interaction between dance and music. In music, counterpoint is the relationship between two melodic lines, which are independent in terms of contour and rhythm and dependent in terms of harmony. Creating counterpoint between music and dance, a flow movement may be dependent upon the musical melody in terms of pulse, but independent in terms of direction and rhythmical accentuation.

6.6 Exposure, genre and style

As has been made clear in previous chapters, expectations about unknown music and dance vary significantly from expectations about familiar music and dance. This also holds for the combination of familiar music and unfamiliar dance or vice versa. When choreography is performed to well-known music, spectators' expectations about the dance movements are usually largely based on the music. In the case of well-known choreographies performed to unknown music, spectators' expectations about the music usually become highly dependent on the dance movements. Moreover, expectations about the one become stronger as spectators have more certainty about what to expect with respect to the other. For example, when spectators know there is going to be a climax in the music, they might strongly expect the choreography to reach some sort of climax as well.

These expectations are veridical, as they depend upon the episodic memory (see chapter 3). The physical and emotional effect evoked by the surpassing of veridical expectations is usually stronger than the effect of semantic expectations being surpassed.

This is because the amount of certainty with which spectators create veridical expectations is usually slightly stronger than the amount of certainty about semantic expectations. Marco Goecke's version of *The Nutcracker* for Scapino Ballet Rotterdam is an example of a choreography that surpasses spectators' veridical expectations to a great extent. The Nutcracker is a famous and popular choreography and it is usually performed in synchronicity with the equally famous music by Pyotr Ilyich Tchaikovsky. In Goecke's version of The Nutcracker, excerpts of the music are played to excerpts of the choreography. While the music remains the same, the choreography changes drastically. Moreover, synchronicity between music and dance is transformed into opposition with occasional moments of assimilation. This creates extreme difficulties for spectators to make accurate predictions about the dance movements. Spectators can not rely on their episodic memory of previous performances of the Nutcracker. This is made even more difficult by the music, which remains exactly the same. For example, at several moments the music reaches a big climax while the choreography rejects any form of climax. Moreover, many parts of the music are performed by a big orchestra, while these parts are performed by one or two dancers only. This creates a huge discrepancy between music and dance and thereby surpasses spectators' expectations completely.

Not only previous exposure to dance and music, but also genre and style influences spectators' expectations. When, for example, hip hop music is played, spectators' may expect dancers to start performing hip hop movements and vice versa. Crossing genres and styles between music and dance creates effects that are similar to those evoked by crossing genres and styles in music and dance separately. Spectators might also be surprised by temporarily changing only one of the two art forms. For example, temporarily changing the performance of a classical music composition into a reggae style performance may surprise spectators and cause them to expect a similar change in the choreography. When this change indeed occurs, the overall change in style and genre is more significant. When this change does not occur, however, spectators might be even more surprised by the discrepancy between the music and dance in terms of style.

6.7 Dramatic structure

In her book *The art of making dances*, Doris Humphrey presents three areas in which music and dance relate to each other: melody, rhythm and drama (Humphrey 1959, p. 132). Melodic and rhythmic connections between music and dance have been discussed in earlier sections of this chapter. Humphrey argues that the formal structure of the music does not need to be closely followed by the dramatic structure of the music in order to fit the emotions presented in the music. Moreover, she holds it as highly important not to make choices regarding music and choreography based on a preconceived idea (Humphrey 1959). Music and choreography evoke dramatic ideas and emotions through their interaction with each other.

In this section, the dramatic structure of music and dance is explored in relation to expectation. Choreography usually involves some sort of dramatic structure and characters, which create expectations on their own. When these are combined with musical emotions, spectators may experience surprise. One example has been presented in section 6.2, in which the movement quality of two dancers portrays the emotion sadness. Spectators may strongly expect the music to evoke the emotion sadness in order to fit the visual image. Their expectations may be surpassed by joyful music, which usually results in confusion on the part of spectators. As Humphrey points out, the juxtaposition of musical and choreographic emotions stimulates different interpretations of the music and dance, which results in the intensification of the overall emotional experience.

6.8 Summary and conclusion of this chapter

In this chapter, music and dance are combined in relation to expectation. A short exploration of aural versus visual perception points out two different types of perception: one type is based on recognition of emotional gestures and occurs consciously, while the other is based on expectation and occurs pre-eminently unconsciously.

Following Elizabeth Sawyer's division, three ways through which music and dance relate to each other are presented in this chapter: synchronisation, opposition and assimilation. The latter is a combination of synchronisation and opposition. Synchronised music and dance usually creates better predictability than opposition between music and

dance, since spectators may make use of the music to create expectations about the dance and vice versa.

Furthermore, various aspects of movement and characteristics of music have been combined and compared to each other in relation to expectation. Firstly, rhythmic interactions between music and dance influence spectators' expectations to a great extent. Dancers may move in synchrony with the rhythmical pulse of the music and therefore meet spectators' expectations regarding rhythmic synchronisation. However, by producing a significantly different phrasing and timing of accents, dancers are able to surpass spectators' expectations without creating much chaos or confusion. In creating expectations about the direction of movement, spectators may not only rely on their knowledge of the natural laws of the body. They may also make use of the melodic development of the music, which usually correlates with the development of a flow of movement. However, choreographers may surpass spectators' expectations by contradicting these two types of development.

Crossing between different genres or styles of performance has been discussed in relation to music and dance separately. Exposure to different kinds of music and different kinds of dance enables listeners and spectators to combine expectation schemas for two or more genres. This also goes for the combination of different genres or styles between music and dance.

Finally, the dramatic structure of choreographies may be influenced by music. A dramatic emotion, conveyed through gestures and quality of movement, may be either intensified by a similar musical emotion or crossed by a different musical emotion. The juxtaposition between musically evoked emotions and choreographic emotions may create surprise on the part of spectators and stimulate different interpretations of the dramatic development.

One important conclusion from this chapter, as well as the previous chapter, is that the ITPRA theory is applicable to dance, although slightly differently than to music. The combination of the two creates even more complicated emotional and physical responses. Moreover, there is still a lack of experimental research to confirm and prove the numerous statements produced in these two chapters, especially about the influence of expectation in spectators' emotional and physical responses to dance. The kind of

expectations and amount of certainty with which these expectations are created may be measured through neuropsychological experiments. In order to do this, experimental research methods need to be developed and carried out. The next chapter focuses on the possibilities to provide statistical background to many of the claims that have been made in these two chapters. It presents a number of suggestions for experimental research regarding the relation between expectation, music and dance.

Chapter 7 Experimental research

7.1 Introduction

As has become clear in previous chapters, the amount of statistical evidence about physical and emotional responses to dance is significantly smaller than that of physical and emotional responses to music. Neuropsychological experiments have so far focused mainly on general movement instead of dance movement, as may be noticed in Ivar Hagendoorn's discussion of experiments (Hagendoorn 2004a and b). Although dance usually involves aimless movements, spectators are as capable of predicting those as they are of predicting general or everyday movements. Moreover, the interaction between music and dance in relation to expectation has rarely been a topic for experimental research.

However, the interest in this topic is growing quickly, as Liesbeth Wildschut points out (Wildschut 2003). Since the discovery of mirror neurons, for example, there is more awareness about the way dance and music evoke physical and emotional responses. Only recently, cognitive neuroscientist and dance scientists, such as Corinne Jola and Karen Wood, have conducted neuropsychological research on dance movements in combination with music and sound.[12] To my opinion, experimental research combining both art forms can provide both fields of theory with useful new insights into music and dance. This chapter therefore presents a number of methods to analyse and measure the correlation between expectation and dance as well as the interaction between dance and music in relation to expectation.

David Huron describes eight different methods for the detection and measurement of musical expectation. Most of these methods are useful for detecting and measuring choreographic expectation as well. This chapter describes these methods and explains how may prove to be relevant to dance. Each of the following sections focuses on one method. A short description of each method is provided, including its most important advantages and drawbacks, followed by a number of suggestions for experiments

[12] Both Corinne Jola and Karen Wood are part of an interdisciplinary research project called 'Watching Dance', in which they combine dance and neuropsychology. See: [http://www.watchingdance.org].

applying this method firstly to dance and secondly to the combination of dance and music.

7.2 Method of production

This method is developed by James Carlsen, Pierre Divenyi and Jack Taylor. It requires participants to listen to a sequence of tones and to continue the sequence by singing tones or otherwise playing them on a keyboard. When the experiment was originally carried out by Carlsen, Divenyi and Taylor, it included three different groups of participants: American, Hungarian and German participants. Significant differences were found between the sequence continuations of each group, which shows that exposure to different types of music produces different musical expectations. The method has a number of drawbacks. For example, participants need to have at least some musical talent in order to be able to produce exactly the tone that they planned to produce and they cannot be scared of improvising. Moreover, the production of musical tones requires some conscious attention, while in real life the perception of music occurs largely unconsciously. A huge advantage of this method, however, is that it does not reduce the amount of possibilities for participants by having them produce one tone only. Huron states: "[…] whereas many other experimental methods assume that the preeminent expectation will pertain to the immediately succeeding tone, the method of production readily allows a participant to suggest several continuation notes as a coherent group." (Huron 2005, p. 45)

The method of production is suitable in experimental research into the expectation of dance movements. The theory may provide statistical evidence for the claim that spectators create expectations regarding various choreographic characteristics. Moreover, this theory may provide answers as to what kind of expectations spectators create exactly. Instead of hearing and producing tone sequences, participants watch a movement sequence and continue this sequence by producing those movements they think are most appropriate to the sequence. In this respect, dance provides a slight advantage over music, because one does not need choreographic knowledge to be able to improvise movements. However, it does take courage to improvise a movement sequence in front of people or

cameras. Stage fear may cause participants to restrain their movements. Moreover, the possibility of producing any kind of movement creates difficulties on the part of researchers. Movements cannot be analysed the way music can be analysed by notating all notes exactly. Researchers, however, may be able to analyse certain choreographic elements, such as direction and rhythm. For example, they may investigate whether participants are likely to change direction or not and if they are likely to perform their movements in a similar rhythm.

The experiment may be carried out with or without music. In the case of silence, the participants' expectations are focused entirely on the choreographic material. The movements they perform are based exclusively on how they expect a movement sequence to proceed. However, when a movement sequence is performed to music, this may steer the participants into a particular direction. Their way of moving might depend strongly on how they expect the music to proceed, which means they try to adapt their movements to the music. The amount of influence of music on participants' choreographic expectations might be measured by dividing participants into one group that carries out the experiment without music, one group that carries out the experiment with music that does not involve major changes and one group that carries out the experiment with music that changes drastically. Participants might also be asked whether they were familiar with the music in order to find out if there are differences between expectations in the case of familiar music and unfamiliar music.

7.3 Probe-tone method

A well-known experimental research method is the probe-tone method, devised by Roger Shepard and Carol Krumhansl. This method requires participants to listen to a musical context (such as a short melody or succession of chords), after which a single note or chord is played. Participants then have to judge the goodness of fit of that particular note or chord in the musical context. This method is based on the claim that expected tones are perceived as better fitting the musical context than unexpected tones. The musical context can be repeated several times, each time presenting a different probe tone. Researchers usually limit the number of possible probe tones to a range of two or three scales. An advantage of this method in comparison to the method of production is that two different

possibilities may be judged as equally fitting a musical context. In the method of production participants may perform only one possibility each time, which means that they have to choose one possibility over the other. Another advantage is that the probe-tone method provides information about 'badly' fitting probe-tones. A disadvantage of this method, however, is that the music has to stop in order for the probe-tone to present itself. Therefore, participants might be inclined not to judge the goodness of fit of a probe-tone, but its goodness of fit as a termination of the musical sequence.

The probe-tone method is applicable to choreographic expectation to a certain extent. The method may provide answers as to how spectators expect movements to succeed previous movements, based on the hypothesis that participants judge expected movements as better fitting a movement sequence than unexpected stimuli. An obvious problem with this method is that it assumes that the relation between dance movements is similar to the relation between musical notes. However, dance does not involve any hierarchy or system, within which all movements stand in relation to one basic movement (such as the tonic in a musical scale). Therefore, dance movements can hardly be judged as in or out of tune with that basic movement. In order to use this method in dance research, one has to adjust a number of elements. For example, instead of asking participants about the goodness fit of a probe-movement in relation to an entire sequence, researchers may investigate whether participants judge probe-movements to fit to the last movement of that sequence. In this case, participants judge whether the probe-movement is a good successor of the last movement. For this, they must first show the movement sequence, which is followed by a separately performed probe-movement. The sequence may be repeated several times, each time changing one aspect of the probe-movement, such as direction, timing or rhythm.

Moreover, the probe-tone method may be used to focus especially on participants' expectation about possibility versus impossibility. This relates to an article by Ivar Hagendoorn (Hagendoorn 2004b, p. 87) in which he presents two photographs of the same woman holding her arm in the same position in each photo (see figure 7.1 on the next page). He suspects that human beings automatically imagine the woman moving her

head from the first position to the second position via the shortest route that is anatomically possible.

Fig. 7.1 Apparent motion of the human body. InHagendoorn 2004b, p.87.

This variant of the probe-tone method may be used to investigate whether this holds for images of moving bodies as well. In this case, two movement sequences may be performed separately and participants have to judge whether the start of the second movement sequence fits the last movement of the first movement sequence. By doing this, researchers may investigate whether participants are able to connect the two movement sequences to each other.

The experiment may be carried out with music in order to investigate how spectators judge how well movements fit the music. In this variant of the method, both the movement sequence and probe-movement are performed to music. One possibility is to stop the movement sequence while continuing the music shortly. This way, participants might judge whether a probe-movement fits the music. Another way to carry out the experiment is to use two or three groups of participants. While this time the music stops at the same time as the movement sequence, the probe-movement is performed to different music for each group. Participants might judge one kind of music as better fitting the movement than another type of music.

7.4 Betting paradigm

This method is developed to investigate the amount of certainty with which listeners create expectations about music. For the betting paradigm experiment, participants are

given poker chips. They then listen to the first pitch of a melody and bet on those pitches they expect to occur next. Correct bets are rewarded tenfold, while chips on incorrect bets are lost. Participants are free to distribute their chips across several pitches. This process repeats itself until the entire melody is revealed. As with all methods, the betting paradigm has a couple of advantages and disadvantages. The most important advantage is that it provides information about the amount of certainty with which expectations are made. Moreover, participants are free to bet on several continuations at the same time, which means they are not confined to expecting one pitch at a time. A problem with this method is that it takes an enormous amount of time to complete one melody. Another problem is that it requires participants to have a certain degree of musical skill. Moreover, since after each bet the correct pitch is revealed, participants receive constant feedback on their expectations and may therefore gradually learn how to create better expectations during the experiment.

The betting paradigm is a useful but tricky method when it is applied to dance movements. With this method, the amount of certainty with which spectators create expectations may be measured. The betting paradigm requires a confined number of possibilities, while dance does not have a fixed vocabulary of any kind. Moreover, it would not make sense to have participants first watch a movement from the movement sequence and then watch various possible continuation movements, because they may fail to remember the initial movement sequence. In the case of music, all possibilities in terms of notes may be presented graphically (for example, on a keyboard), which means they do not have to be played. In the case of dance, movements cannot be presented graphically on paper or on an instrument. Therefore, a number of adjustments would need to be made in order for the method to work. The most important adjustment is to replace movement possibilities on which participants bet with possibilities regarding direction or rhythmical cues. For example, a dancer produces the first movement, after which participants place their bets on the following options: left, right, stop, up, down. In case the movement is produced in a right direction, the possibilities can be translated as a change to the left, a continuation to the right, a stop at same position, a fall to the ground or a jump into the air. The same can be done with a number of other choreographic

elements such as rhythm (presenting options such as: quicker tempo or slower tempo, same rhythm or different rhythm) and style of performance (presenting options such as a continuation or an abrupt stop of the movement flow, a light movement or a heavy movement).

In fact, all these options may be grouped into oppositions. To my opinion, the betting paradigm works best when it is structured in accordance with these opposing characteristics. This means that participants place bets on one of each opposed characteristic. For example, they place bets on whether they expect a movement sequence to continue into the same (horizontal) direction or not, whether there will be a vertical change in position or not, whether the next movement will be quicker or slower et cetera. Since dance movements usually involve changes (or continuations) with regard to all these characteristics at the same time, participants are given a fair change to incorporate all these characteristics in their bets.

As with the method of production, this method may use music in order to steer participants' expectations. There are two possibilities for this variant of the method. The movement sequence and the music either stop at the same time for each bet or the movements sequence stops one second before the music. In the latter case, it is revealed to what musical event the next movement is performed, which means participants receive more information about the succeeding moment. For example, if a movement sequence has been performed into the same direction for some time and it is revealed that during the next movement an unexpected musical event occurs, participants may expect the movement sequence to include a sudden change of direction (or any other movement characteristic) as well.

7.5 Bradycardic response method

This method requires participants to listen to music or watch movements while their heart rate is monitored. Participants' perception of unexpected stimuli usually results in short changes in heart rate. According to Huron, two important disadvantages with this method are the cost of expensive instruments on the one hand and the fact that the results convey quite a small amount of information on the other hand. This means that the experiment must be carried out numerous times in order for it to show representative results, which

makes the experiment even more expensive. Unfortunately, Huron does not explain exactly why the bradycardic response method conveys so little information, but it might have to do with the fact that each heart is different. This means that changes in heart rate may be inherent to one's heart rather than aural or visual stimuli. It takes numerous experiments in order to arrive at average heart rate results. Apart from its disadvantages, the method is a valuable tool to analyse spectators' responses to dance movements. It requires spectators to watch sequences of dance movements involving abrupt changes in direction, intensity, style, rhythm et cetera. It conveys accurate information about what types of stimuli result in changes of heart rate and, accordingly, changes in attention or action readiness.

It is hard to carry out experiments using the bradycardic response method for dance that is performed to music, because it presents a mayor problem. Since music and dance occur at the same time, it would be impossible to determine what moments of increased or decreased heart rate are due to musical expectations and what kinds are due to choreographic expectations. The only way to carry out these experiments is to use at least two groups of participants, having one group watch dance performed without music and another group watch dance to music. The comparison between the results of both groups may convey some information on the differences in heart rate between one watching dance without music and one watching dance with music. However, this information is most likely problematic, since these differences do not automatically prove that particular moments of increase or decrease in heart rate relate exclusively to either musical or choreographic expectations.

7.6 Evoked response potential (ERP)

The evoked response potential is quite similar to the bradycardic response method in that it requires participants to listen to music or watch dance movements while they are being monitored. The essential difference, however, is that the participants' brain is monitored instead of their heart rate. This method shows the amount of activity in certain regions of the brain. Whenever unexpected stimuli occur, several parts of the brain engage in a high amount of activity in order to process the perception of the stimulus and its consequences for the body. Those parts of the brain in which changes in activity take place convey

information about what kinds of stimuli relate to what parts of the brain. This, in turn, conveys information as to what physical and mental processes in our body relate to what types of stimuli. Previous experiments using this method discovered that parts of the brain relating to perception and parts of the brain relating to action were simultaneously activated by the occurrence of visual stimuli (Hagendoorn 2004a). This discovery resulted in a better understanding of the close relation between perception and action.

The drawbacks of this method are similar to those of the bradycardic response method. The method is quite expensive and takes a large number of participants, since each participants' brain is different. Changes in brain activity may be inherent to one's brain rather than aural or visual stimuli. Apart from these drawbacks, it conveys useful information as to what parts of our brain are involved in watching dance or listening to music. It does not come as a surprise that this method has previously been used in experimental research focusing on movement. Hagendoorn mentions various experiments in which participants either performed or predicted movements or watched movement sequences and still imagines while being monitored. When participants visually perceived unexpected events, various parts of the brain showed significant changes in activity, such as the motor control system and mirror neurons (see Hagendoorn 2004a, 2004b, 2005).

As with the bradycardic response method, applying this method to the combination of music and dance is a difficult task. Again, the only way to carry out experiments using both music and dance would require two different groups of participants (one group watching dance without music and another group watching dance with music) and compare the results of each group.

7.7 Reaction time method

This method has been extensively used in research regarding visual perception and nowadays becomes more and more popular as a method for aural and musical perception. It draws on the correlation between expectation and quickness of response. For this method, participants are asked to listen to a melody and indicate whether they believe each pitch ascends, descends or remains the same. The reaction time of each response is measured. Important advantages of this method over other methods include the fact that

there is no interruption of the melody (apart from the fact that it is usually played in about 60 percent of the normal speed) and that the experiment takes place at high speed. This means that participants' reactions are unconscious. An important drawback of this method, however, is that it only measures participants' reaction speed. It does not explain exactly why a response to a particular pitch occurrs slower than responses to other pitches.

As has been said at the beginning of this section, the reaction time method has been used in research regarding visual perception. In the case of dance, experiments may be carried out to determine the reaction time of spectators watching several dance movements. The amount of time that spectators need to process their perception of movements shows the amount of certainty which with movements are expected. In the case of unexpected dance movements, the amount of time needed is usually high. Experiments using this method require participants to indicate whether the direction of movements remains the same, changes into the opposite direction or stops. Participants may also determine whether the speed of movements changes, by having them indicate whether the tempo of the movements increases, decreases or remaines the same. The amount of time it takes participants to react may convey useful information about their expectations regarding these two choreographic characteristics.

A significant amount of additional information may be gained by performing the movement sequence to music. Since spectators' expectations about movements are influenced by music, so is the reaction time of participants indicating what events occur in a movement sequence. If the music and movements are in line with each other, it is usually easier for participants to predict movements. Therefore, the reaction time of participants might be faster due to clues provided by the music. However, in case the music and movements contradict each other, it is more difficult for participants to predict movements. Therefore, participants may be misled by the music and take more time to realise a movement did not proceed the way they thought it would or simply produce a wrong answer. As with many of the other methods, it would be interesting to carry out this experiment using two groups of participants (again involving one group that watches dance without music and another group that watches dance to music) and compare the results of both groups.

7.8 Summary and conclusion of this chapter

Throughout this thesis, several claims and suggestions have been made regarding the combination between music and dance in relation to expectation, such as the claim that spectators expect a flow of movement to correlate with the rhythmic pulse of the music. However, such a claim still lacks a background of statistical evidence. Although numerous research experiments have been carried out in which participants' responses to visual stimuli were measured, there is a lack of research experiments measuring participants' responses to actual dance movements and to the combination of dance and music.

This chapter presents a number of suggestions for experimental research to fill in this gap of information, according to several methods discussed by David Huron. These methods are the method of production, probe-tone method, betting paradigm, bradycardic response method, evoked response potential and the reaction time method. The method of production requires participants to watch a movement phrase and perform a possible continuation of this phrase. The probe-tone method requires participants to watch a movement sequence and indicate whether the next movement (called the probe-movement) fits the end of the movement sequence. Both methods measure participants' expectations regarding choreographic elements such as direction or rhythm. In the case of the betting paradigm, participants have to watch a movement phrase and bet on what they expect to occur next in terms of direction and rhythm. This method conveys information about the amount of certainty with which expectations about dance are created. The bradycardic response method and evoked response potential require technological equipment to monitor either participants' heart rate or brain activity, while participants watch a movement sequence. The results of these experiments measure either which moments in a movement sequence cause surprise in the form of increased attention or which parts of the brain are involved in watching dance movements. Finally, the reaction time method measures the speed with which participants indicate whether the speed or direction of particular movements in a movement sequence changed. It is based on the claim that expected stimuli are processed faster than unexpected stimuli. This means it conveys information as to what movements or movement characteristics were expected by participants.

In conclusion, all these methods may convey statistical information about how participants' responses to dance movements are influenced by their choreographic expectations. Consequently, a better understanding is created of how and why spectators' respond to dance emotionally and physically. The experiments may be carried out with or without music. Whenever music is involved in the experiments, participants would have to be divided into two groups, one of which watches and/or performs movements without music and one of which watches and/or performs movements with music. The results between the two groups may convey useful information as to whether participants' responses are influenced by music.

Chapter 8 Conclusion

This conclusion presents the most important findings of this thesis and a reflection on the research process.

One very important conclusion that can be drawn from the research is that dance and music evoke emotional and physical responses through expectation in a similar way. Although there are a number of differences between the perception of music and dance, one's expectations of both art forms are rooted in convention, exposure and memory. Music does not create exactly the same types of conventions as dance, but there are some significant similarities between them. For example, conventions of both music and dance relate to genre and style and to time and phrasing in a similar way. Therefore, listeners' and spectators' responses to unexpected events relating to these conventions occur roughly the same way.

This means that the ITPRA theory by David Huron is applicable not only to music, but to dance as well. The theory has proven its usefulness in explaining how spectators of a dance performance react to their expectations of the dance performance. Consequently, it is possible to answer the first half of the twofold research question that is proposed in chapter 1: H*ow can the ITPRA theory be used to analyse the role of expectation in spectators' emotional and physical responses to dance?* Several conventions of dance regarding natural laws of the body, direction, timing, dramatic structure and music determine to a significant extent spectators' expectations about dance. Exposure to dance genres and styles of dance leads to conventions being preserved in the semantic and/or veridical memory about those dance genres and styles. Based on these memories, spectators create expectations about dance. These expectations are not so much focused on what movements are performed, but on how movements are performed. This is due to the facts that the vocabulary of dance movements is extremely big and that movements cannot be categorised in the same way as musical tones can.

A discussion about the combination of music and dance in relation to expectation confirmed the importance of music in the creation of choreographic expectations. The latter half of the research question is as follows: H*ow can the ITPRA theory be used to analyse the influence of music on this expectation?* This thesis confirms the idea that

musical and choreographic expectations are created simultaneously and influence each other as such. Musical and choreographic expectations interact in the same three ways as music and dance do: through synchronicity, opposition or assimilation. Choreographers may cross spectators' expectations by changing characteristics of music while keeping choreographic characteristics the same or vice versa. For example, the quality and direction of movements may oppose the dramatic and melodic structure of the music while its rhythm and style may remain in synchronicity with the musical rhythm and style.

The last conclusion that can be drawn is that this thesis provides a theoretical framework for experimental research focusing on the relation between dance and expectation as well as music, dance and expectation. Moreover, suggestions are presented for experimental research in these three combined areas. These suggestions, according to various experimental methods, are all able to provide the much-needed statistical information about the relation between music, dance and expectation. Experiments by neuropsychologist Alain Berthoz and numerous others detected relations between expectation and human beings' responses to visual phenomena, such as moving objects, and dance theorist Ivar Hagendoorn connected the results of these experiments to dance. Moreover, recently Corinne Jola conducts neurocognitive research on the perception of dance and music, together with dance companies such as EG|PC. Apart from these quite recent initiatives, there has not been much experimental research focusing exactly on the correlation between expectation and emotional and physical responses to dance movements. As a result, there is not yet much statistical evidence for the claims made in this thesis, as is the case with the relation between music and expectation. Chapter 5 showed that although it is impossible to measure what exact movements are predicted by spectators of a dance performance, it is very well possible to measure spectators' expectations of numerous aspects of movement, such as direction, quality and natural laws of the body.

In reflecting on the research process and thesis, I am very positive that the goals of this thesis have been met. Not only did the research topic convey a lot of new information that can be used in future research, it also proved to be extremely interesting to combine three fields of study: musicology, dance theory and neuropsychological

theory. It was not always easy to select the most relevant theoretical points of view in all fields of study and to combine these in one theoretical framework. For one instance, the various topics that touch upon the main subject of this thesis, expectation, cover a wide range of theory individually. The amount of theoretical literature focussing on emotion, kinaesthesia, music, dance and neuropsychology alone is enormous. This provides a challenge to anyone who wishes to combine those topics in one study.

It would be interesting to conduct further research in order to prepare and carry out neuropsychological experiments focusing on the combination of music and dance, based on the conclusions of this thesis. The experimental methods that are proposed in chapter 7 have to be further investigated and transformed into real experiments. It would be especially interesting to combine these methods with the research methods that are used by Corinne Jola. This may produce statistical information necessary to investigate spectators' expectations about dance and music. Consequently, it creates a better understanding of how and why spectators' respond emotionally and physically to dance and the combination of dance and music.

Finally, this thesis has focused mainly on how changing characteristics of music and dance cause surprise on the part of spectators and listeners, which results in increased attention together with certain emotional and physical responses. Not much attention has been paid to predictable music and dance. Certain types of music make extensive use of predictability. In fact, the thesis I wrote during my Bachelor's degree focused entirely on the way predictable characteristics of a particular musical composition[13] evoke a decrease in attention and corresponding emotional and physical responses on the part of listeners. It would be interesting to investigate spectators' responses to dance performances that make extensive use of predictability and repetition as well, such as those of Anne Teresa de Keersmaeker and Krisztina de Châtel.

[13] *Canto Ostinato* by Simeon ten Holt. Extracts of the composition can be found on: [http://www.simeontenholt.com/]

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Summary

The ITPRA theory by David Huron evolved out of century-long discussions about the way music evokes emotions. In dance theory, the same sort of discussion has been issued over the past centuries. There are numerous explanations as to how music and dance evoke emotions, including imitation, contagion and expectation. A problem with most of these theories is that they suggest that all listeners and spectators experience the same emotions. Leonard Meyer was the first musicologist to write extensively about the influence of expectation in emotional and physical responses to music. According to Meyer, certain musical events create expectations about succeeding musical events similarly to dark clouds, for instance, creating expectations about changes in the weather. The ITPRA theory of David Huron is rooted in the work of Leonard Meyer to a great extent.

In dance theory, numerous theories about the emotional and physical impact of dance on spectators have been proposed. More attention has been paid to physical responses of spectators to dance, since dance is ultimately a physical form of art. The term kinaesthesia has been put forward to explain these physical responses. Several interpretations of the term have been discussed, such as imitation, tendency to act or action preparedness and expectation. Ivar Hagendoorn explicitly relates kinaesthesia to expectation, following on several neuropsychological experiments by Alain Berthoz and others regarding the perception of motion. According to Hagendoorn a constant change of visual stimuli produced by dance movements results in heightened attention, which in turn causes the arousal of emotions.

Although there have been many different interpretations of the relation between music and emotion or dance and emotion, the influence of expectation is noticed in both art forms. In dance theory, Ivar Hagendoorn's articles recently provide useful information about the relation between expectation and dance, while in music theory, the ITPRA theory by David Huron is the most recent work on expectation in relation to music.

The ITPRA theory by David Huron provides useful information as to how and why exactly one experiences emotions by listening to music. The ITPRA theory is based on

evolutionary biological theories largely, claiming that emotions are rooted in our biological defence mechanism. The occurrence of a dangerous event causes sudden physical and mental changes in our body in order for us to be able to react to a dangerous event quickly and appropriately. Through expectation, one is able to control the amount of energy that is needed for these physical and mental changes on the one hand and to preparations for the advent of event on the other hand.

One's reaction towards events occurs through five different responses: the imagination, tension, prediction, reaction and appraisal response. During the imagination and tension response, expectations of an event are created and preparations are made accordingly. The prediction response is an evaluation of these expectations and preparations, while the reaction and appraisal response relate to the outcome of the event itself. Responses to the expectation of the event may contradict responses to the outcome of the event, for example in the case of a positive surprise. Although the positive outcome of the surprise may evoke positive emotions, the fact that the surprise was not expected and prepared for accurately causes a negative prediction response (in the form of initial shock).

Expectation is based on memory. Huron discerns two types of memory, which result in two types of expectation. The semantic memory collects general information, such as language, while the episodic memory collects personal experiences. The semantic memory causes schematic expectations and the episodic memory results in veridical expectations. Exposure to a type of music creates expectations about that particular music. This means that, for example, a Western listener is able to create accurate predictions about Western music, while not being able to predict Indian music. This results in different responses to both kinds of music. *When* and *why* types of expectations are created about several characteristics of music. These are: tonality and harmony, rhythm and timing, genre and style.

Research has found that particular successions of tones are expected more than others by listeners, according to certain relations between scale degrees. In the case of rhythm, certain beats are highly expected, such as downbeats. Composers may therefore evoke particular emotional responses by either meeting listeners' expectations or surpassing them. A good balance between expected and unexpected musical events is

required for listeners' not to grow bored or get irritated. Finally, musical genre determines several characteristics of the music as well as its style of performance to a great extent. Since listeners are able to form more than one schema of expectations and switch between those different schemas while listening to music, composers and musicians may cross between genres and styles without crossing listeners' expectations too much.

A short comparison between music and dance made it clear that choreographic expectations are roughly similar to musical expectations. However, the nature of choreographic expectations is somewhat different. Instead of predicting exactly what movement will succeed a current movement, predictions are made regarding several aspects of movement. These aspects are: natural laws of the body, genre and style, space and direction, dramatic structure and time. Natural laws of the body include gravity and balance. Spectators know the limitations of a human body and are able to use this information in creating expectations about movements. Moreover, different dance genres and styles produce different expectations in a similar way to musical genres.

Furthermore, the space in which dance is performed, but also the direction of other movements within a flow of movement and the dancers' point of focus, convey useful information to spectators, which they may use in order to create accurate choreographic expectations. Another characteristic that influences spectators' expectations, put forward by Doris Humphrey, is the dramatic structure of a choreography. Sudden changes in a narrative structure cause as much surprise on the part of spectators as sudden changes in direction to.

Finally, timing plays a highly important role in spectators' expectations about dance. Temporal aspects of dance relate to music to a great extent. Elizabeth Sawyer discerned three ways through which music and dance relate to each other: synchronisation, opposition and assimilation. The latter is a combination of synchronisation and opposition. Synchronisation between music and dance usually creates better predictability than opposition between music and dance, since spectators may use musical clues in creating expectations about the dance.

Various aspects of movement interact with characteristics of music in relation to expectation. Firstly, rhythmic interactions between music and dance influence spectators' expectations to a great extent. Dancers may move in synchronicity with the rhythmical pulse of the music and therefore meet spectators' expectations. However, by producing a significantly different phrasing and timing of accents, dancers may surpass spectators' expectations without creating much chaos or confusion. In creating expectations about the direction of movement, spectators may not only rely on their knowledge of the natural laws of the body. They may also make use of the melodic development of the music, which usually correlates with the development of a flow of movement. However, choreographers may surpass spectators' expectations by contradicting these two types of development.

The crossing between different genres or styles of performance has been discussed in relation to music and dance separately. Exposure to different kinds of music and different kinds of dance enables listeners and spectators to combine expectation schemas for two or more genres. This also goes for the combination of different genres or styles between music and dance.

Lastly, expectations regarding the dramatic structure of choreographies may be influenced by music. A dramatic emotion, conveyed through gestures and quality of movement, may be either intensified by a similar musical emotion or crossed by a different musical emotion. The juxtaposition between musically evoked emotions and choreographic emotions may create surprise on the part of spectators and stimulate different interpretations of the dramatic development.

Throughout this thesis, several claims and suggestions have been made regarding the combination between music and dance in relation to expectation, such as the claim that spectators expect a flow of movement to correlate with the rhythmic pulse of the music. However, such a claim still lacks a background of statistical evidence. Although numerous research experiments have been carried out in which participants' responses to visual stimuli were measured, there is a lack of research experiments measuring participants' responses to actual dance movements and dance movements in relation to

music. Only recently, neurocognitive scientist Corinne Jola has conducted research on the relation between cognition, dance and music.

Therefore, a number of suggestions for experimental research are presented to fill in this gap of information, according to several methods discussed by David Huron. These methods are the method of production, probe-tone method, betting paradigm, bradycardic response method, evoked response potential and the reaction time method. The method of production requires participants to watch a movement phrase and improvise a possible continuation of this phrase. The probe-tone method requires participants to watch a movement sequence and indicate whether the next movement (called the probe-movement) fits the end of the movement sequence. Both methods measure participants' expectations regarding choreographic elements such as direction or rhythm. In the case of the betting paradigm, participants would have to watch a movement phrase and bet on what they expect to occur next in terms of direction and rhythm. This method conveys information about the amount of certainty with which choreographic expectations are created.

The bradycardic response method and evoked response potential require technological equipment to monitor either participants' heart rate or brain activity, while participants watch a movement sequence. The results of these experiments convey information about what moments in a movement sequence cause surprise in the form of increased attention and what parts of the brain are involved in watching dance movements. Finally, the reaction time method measures the speed with which participants indicate whether the speed or direction of particular movements in a movement sequence changed. It is based on the claim that expected stimuli are processed faster than unexpected stimuli. This means it conveys information as to what movements or movement characteristics were expected by participants.

All these methods may convey useful information about how participants' responses to dance movements are influenced by their choreographic expectations. They may be used in addition or in combination to recent neurocognitive research by Ivar Hagendoorn and Corinne Jola. The experiments may be carried out with or without music. Whenever music is involved in the experiments, participants would have to be divided into two groups, one of which watches and/or performs movements without

music and one of which watches and/or performs movements with music. The results between the two groups may convey useful information as to whether participants' responses are influenced by music. This creates a better understanding of how music influenced spectators' expectations and their emotional and physical responses to dance.