DANCE, AESTHETICS AND THE BRAIN

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However, things are unlikely to be so simple.

CONTENTS

PART 5. UNDERSTANDING

PREFACE

This book marks the formal end of a project that I started, now, almost fifteen years ago. While at university I had become fascinated by contemporary dance. Like many people I had always associated dance with *Swan Lake* and *The Nutcracker*, which didn't really appeal to me. I had never made the connection between contemporary dance and the music videos that I enjoyed watching, such as *True Faith* by New Order, which I later learnt was choreographed by the French choreographer Philippe Découflé. All of this changed when one day, at the urging of a friend, I attended a performance by the Netherlands Dance Theatre. That evening I discovered that contemporary dance can be interesting, moving and exhilarating. After the show I instantly bought a ticket for another performance, which turned out to be equally mesmerizing. Yet a few weeks later I was so thoroughly bored during a performance by a different company that I found it hard to concentrate on what was happening on stage. If I hadn't already had a ticket for another performance my infatuation with contemporary dance might have been short-lived.

At university, while studying philosophy, I had read most of the major works in aesthetics, but none of what I had read provided a ready answer to the seemingly simple question of why watching some people move about on a stage can be fascinating and moving on one occasion and boring on another.

One day it occurred to me that everything we see, hear, feel and think, is mediated by the brain and that, to understand what moved, bored and fascinated me in watching dance, I should turn to psychology, cognitive science and the burgeoning field of cognitive neuroscience. Like most people, at first I bought some popular introductions to neuroscience, but before I knew it I found myself immersed in academic journals and trying to keep up with the latest research findings. On a visit to Paris, while browsing the new releases in science and philosophy at Gibert Joseph, a large bookstore on the Boulevard Saint-Michel, I happened upon a book by the French neuroscientist Alain Berthoz, *Le Sens du Mouvement* (1997). When I read the book's main thesis, that the brain is an organ not to take account of situations, but 'to predict the future [and] to anticipate the consequences of action' (Berthoz 2002: 1), I instantly made a connection with the aesthetic category of the sublime, or rather the French philosopher Jean-François Lyotard's account of the sublime. The discrepancy between the brain's internal prediction and the actual outcome could provide the same kind of shock as the feeling of the sublime. For a while I believed I had the beginning of an answer to the question of why watching dance can be thrilling and engrossing. By this time my mind was brimming with inspiration and so I decided to share my ideas and write a paper about dance and the brain.

As my pile of notes grew, I decided to split the paper in two, one dealing with perception and aesthetic experience and the other with motor control. Before long I realized that, to say what I wanted to say, I would have to write a book. As it turned out doing so took slightly longer than I had anticipated. In the meantime I had started to choreograph myself and since I pursued my intellectual and artistic endeavours in the little spare time that my job in finance left me and since I am also interested in a lot of other things besides dance, philosophy and cognitive neuroscience, for many years the book remained in a permanent state of incipient development. Every now and then I would go back to writing and doing research until something else demanded my attention again. In 2008, at long last, I decided to take some time off to revisit all my material and finally write what I had wanted to write some ten years earlier.

In the intervening decade a lot has happened in cognitive neuroscience. Nearly every department now has its own neuroimaging laboratory, which has led to a flood of research papers. As in all of science each field of inquiry has divided into numerous subfields. What was ambitious in the late 1990s, to present a survey of current research and apply the insights to dance, has become near impossible. And so, in writing this book, I again had to make choices.

Perhaps the most radical choice is to focus exclusively on dance as a performing art and on the perspective of the spectator and the choreographer. In passing I will say a few words about motor learning, but the question of how dancers maintain balance or remember a 28-minute choreography is beyond the scope of this book. So is the question of how dancers themselves experience dancing. I have also deliberately, though reluctantly, chosen not to do any experiments of my own. Setting up an experiment takes considerable time. Apart from that, lack of data is not the biggest problem in cognitive neuroscience and experimental psychology. The challenge is to make sense of the vast amount of data that has already been accumulated.

This book is intended as a map. It is my hope that it will serve as a guide for readers wishing to explore some of the questions that watching a dance performance can give rise to. Cognitive neuroscientists, philosophers and dance scholars may find in it directions for future research, while dancers and choreographers may find in it ideas for charting out new choreographic territories. Evidently a book of this nature can never be comprehensive or up-to-date. As the field changes, maps become obsolete, although some main roads and historical landmarks may continue to serve as guidelines.

The present text differs substantially from the book I had originally set out to write. For a while I contemplated adding the subtitle *A Critical Inquiry* to the current title. As I delved into the literature once more I became increasingly aware of some of the methodological issues that I had previously ignored. Philosophers and critical theorists may still find that I lean too far towards the ontologically questionable contentions of cognitive neuroscience, while cognitive neuroscientists may find that some of my philosophical meanderings are unsubstantiated and in need of empirical cross-validation.

This is an academic text and I'm afraid that, despite my attempts to make it accessible to all readers, some passages are pretty dry and hardgoing. Unfortunately I am no Saul Bellow or David Foster Wallace either. No matter how hard I try, I will never be as fluent in English as I am in Dutch (not that writing in Dutch would have made that much difference).

In writing this book I have sought to refer to dance performances that are still being performed and of which video recordings can be found online. I have also created a special section on my website, www.ivarhagendoorn.com, where you can find supplementary material in the form of links to photos and videos of the performances to which I refer throughout this text.

ACKNOWLEDGEMENTS

I vividly remember the first time I saw a performance by William Forsythe and the Ballett Frankfurt. It was early in the evening. I had just visited the Musée d'Orsay in Paris and was walking along the Seine, not quite knowing where to go or what to do, when I saw a billboard announcing a performance by the Ballett Frankfurt at the Théatre du Chatelet. I checked the date and time, searched for the theatre on my map of Paris, looked at my watch and realized that if I ran I could still make it in time. A week earlier, after learning of my newfound love for contemporary dance, someone I met at a gallery opening in Amsterdam, had insisted that, if I ever had a chance, I should definitely attend a performance by the Ballett Frankfurt. I didn't know at the time that the opportunity would present itself so soon.

When I arrived at the theatre, slightly out of breath, but glad I'd made it in time, a crowd was struggling to get hold of the last tickets. I waved two fifty francs bills in the air and managed to obtain a ticket for myself and for the Brazilian girl standing next to me. Being 6'6" tall sometimes has its advantages. When the performance was over I was totally blown away. What happened on stage seemed an embodiment of how I imagined my thoughts moved, connected, and organized themselves. I wanted to climb to the top of the Eiffel Tower and tell the entire world that they should go and see this.

The next week, by a lucky coincidence, I saw another piece by William Forsythe performed by the Netherlands Dance Theatre in The Hague and a few weeks later I got on a train to Frankfurt longing for more. In the next few years, as often as my student budget allowed me, I travelled to Frankfurt, Paris, Brussels, Antwerp and wherever in Europe the company performed. In January 1995, by another lucky coincidence, I had the good fortune of meeting William Forsythe. In the years since we have become friends and we have spent many hours talking about dance, art, mathematics, science, philosophy, beautiful women and the world at large. The present book would not have been without his ongoing support, encouragement and inspiration.

It was also William Forsythe who encouraged me to not just write about dance, but to work with dancers myself. Since my education is purely academic, at first I dismissed the idea, but in 1999 I decided to organize a workshop to put some of my ideas to practice. Soon afterwards I created my first choreography. In 2003, a dream that I had never actually dreamt, because it was beyond the horizon of my imagination, came true when William Forsythe invited me to create a piece for the Ballett Frankfurt.

I owe a lot to the dancers I have had the pleasure of working with. It is by actually working in the studio that I have learnt the most about dance. I would also like to express my gratitude to the dancers of the Ballett Frankfurt and the Forsythe Company, both past and present, for their friendship and hospitality throughout the years, especially Tony Rizzi, Dana Caspersen, David Kern, Esther Balfe, Francesca Caroti, Brock Labrenz, Tamasz Moritz, Noah Gelber, Crystal Pite, Nik Haffner, Laura Graham, Prue Lang, Thomas McManus and Christine Bürkle.

I am grateful to Beatrice de Gelder for arranging a temporary position as a researcher in the Department of Cognitive and Affective Neuroscience at Tilburg University, which allowed me to take a temporary break from the world of finance to finish this study. I would also like to thank Michael Arbib for offering me a position as a visiting scholar in the Department of Neuroscience at the University of Southern California and for opening doors that would otherwise have remained shut.

Many thanks also to João da Silva, coordinator of the post-graduate program in choreography at the ArtEZ Institute for the Arts and to all of my students for many discussions about dance, choreography and critical theory.

There are many people in the world of dance, music, film, theatre, architecture and the visual arts with whom I have had the pleasure of discussing my research and who have questioned and challenged me on various occasions. I would especially like to thank Elizabeth Corbett for her invaluable advice not to iron out each and every flaw: if you do the work as a whole will become flat. It is as true of choreography as it is of writing.

I should also thank my investment banking colleagues for their sceptical questions and comments. It is good to be constantly reminded that there are people out there who couldn't care less about what you are passionate about.

Over the years a number of psychologists, biokinesiologists and cognitive neuroscientists have given me feedback on my research. I would especially like to thank Michael Arbib, Marc Jeannerod and Ricarda Schubotz. I would also like to thank the participants in the workshops and the attendants at the lectures, symposia and conferences where I have presented my research. A word of acknowledgement is also due to the anonymous referees who reviewed the papers on which part of this book is based.

Finally, I would like to thank my parents for encouraging me, ever since I was a child, to never stop expanding my horizon and to always keep going, no matter what.

1

INTRODUCTION

In 2005, after years of playing in small clubs, the American rock band OK Go gained worldwide recognition when the music video for their song *A Million Ways* became a surprise hit on YouTube. In the video the four band members perform a simple dance in the lead singer's backyard. The video was filmed in one take on a borrowed camera, cost less than 10 dollar to make and was allegedly released without the band's record label's knowledge or consent. Summer 2006 the band followed up their success with another low-budget video for the song *Here It Goes Again*. It shows the band members performing an intricate dance routine on eight treadmills that had been lined up in a spare room of choreographer Trish Sie's apartment. The video proved to be even more popular than their previous release. Within one week of being posted on YouTube it had been watched more than one million times. With more than 50 million views for a while it was one of the most popular videos on YouTube.[1]

The fact that a video has been viewed 50 million times does not mean that 50 million people have seen it or that those who have seen it have watched it in its entirety. Even so, these numbers are significant, if only because there are countless clips on YouTube with far less views. *Here It Goes Again* reached number 38 in the Billboard Hot 100 and number 36 in the U.K. Singles Chart so the single didn't sell that many copies. This suggests that it is the video that people want to see and not the song they want to hear. The four band members look like ordinary 30-something guys. It therefore seems unlikely that there will be many viewers who watch the band's music videos just to see the guys. And so, in the absence of any other factors that might explain the popularity of the videos for *A Million Ways* and *Here It Goes Again*, we are left with the conclusion that people enjoy watching the dance.

The popularity of music videos featuring extensive dance routines dispels the myth that dance is a minor art. The opposite is true. Of all the arts music, film and dance are the most popular. I know that *The Lord of the Rings*, *The Da Vinci Code* and *The Little Prince* have sold more than 80 million copies around the world and I know that the Musée du Louvre, the Metropolitan Museum of Art, Tate Modern and London's National Gallery attract millions of visitors every year. But none of this comes close to the popularity of the

[1] February 2009 the record label pulled the original video from YouTube and re-uploaded it at a different YouTube channel, so the current number of views does not reflect the number of views since the video's first release.

music videos for Michael Jackson's *Thriller* or Beyoncé's *Single Ladies (Put A Ring On It)*, which, as of this writing, has been viewed more than 150 million times and that only includes the official views on YouTube. Why would people be watching these videos if they didn't enjoy watching the dance? And why would music videos, which, after all, are intended to promote the song and the artist, include a choreographed dance number if people didn't enjoy watching it?

If you're reading this book, chances are I don't need to convince you that dance is worthy of reflection, that it can be captivating, thrilling, moving and awe-inspiring and yes, I am the first to admit, boring, stupid and downright silly. It is worth remembering though that there is more to dance than *Swan Lake*, Cunningham technique, ballroom dancing and tribal rituals and that there are many people who don't like dance, or rather, *think* they don't like dance. Many of my friends and colleagues, who would never consider attending a dance performance, got a kick out of the video for *Here It Goes Again*. Millions of people around the world were enthralled by the martial arts scenes in *The Matrix* (1999) and *Crouching Tiger Hidden Dragon* (2000), which, of course, are perfectly choreographed dance sequences. I am pretty sure that the same people would be blown away by William Forsythe's *Enemy in the Figure* (1989), one of the most exhilarating contemporary dance performances.

But what is so fascinating about watching one or several people move about on a stage or a small window on your computer screen? Why are people thrilled after a performance of William Forsythe's *In the Middle Somewhat Elevated* (1987), Jiří Kylián's *Falling Angels* (1989) and Pina Bausch's *Sacre du Printemps* (1975)? Why do people laugh during a performance by Les Ballets Trockadero de Monte Carlo? Why are people moved, some of them to tears, by William Forsythe's *Quintett* (1993) or Pina Bausch's *Café Müller* (1978)? Why do some people leave after about twenty minutes during a performance of *The Show Must Go On* (2001) by Jérôme Bel and why do others consider it interesting? Why are the music videos for *Here It Goes Again*, *Thriller* and *Single Ladies* so popular?

I believe that we can address these and other questions by analysing the mental capacities that are exercised when people watch a dance performance and by investigating the neural conditions that facilitate and constrain those capacities. However, doing so requires that we suspend any preconceived notions of art and look beyond conventional aesthetic concepts such as beauty, taste and style and instead focus on the multiple effects watching a dance performance has on a viewer. It is a fact that people laugh when they are amused, that they cry when they are moved, that they lose their sense of time when they are captivated by a performance, a novel or a movie and that they are temporarily filled with glee when, at the end of a novel, they suddenly understand that there were two killers, not one. People may not be moved, thrilled and fascinated at all times and to the same degree, but these are additional facts that can be established. The study of attention, emotion and cognition and their neural underpinnings is the province of psychology and cognitive neuroscience. It follows that psychology and cognitive neuroscience can also illuminate empirical questions in relation to art and aesthetics.

The present inquiry rests on two central claims. First, art and aesthetic experience are governed by implicit and explicit rules, some of which have their roots in human psychology and brain function. Second, there is a duality between a work's aesthetic properties and an observer's aesthetic experience, provisionally understood as the totality of thoughts, feelings, memories and associations occasioned by the observation of an object's or event's formal, aesthetic, symbolic or expressive properties. It follows that we may learn more about the nature of aesthetic properties by studying the components of aesthetic experience and that, conversely, we may learn more about the nature of aesthetic experience by studying a work's aesthetic properties.

1.1 RULES AND PATTERNS

As Wittgenstein remarks in his *Lectures on Aesthetics*, art and aesthetic judgement are governed by implicit and explicit rules. Wittgenstein himself gives the example of a tailor, who 'learns how long a coat is to be, how wide the sleeves must be, etc. He learns rules – he is drilled – as in music you are drilled in harmony and counterpoint' (Wittgenstein 1966: 5).[2] As Wittgenstein adds, the customer who judges the end product is also guided by rules in his or her aesthetic judgement. When trying on a new coat he or she might comment that the sleeves are of unequal length or that the buttons are positioned unevenly.

If Wittgenstein's example does not convince you of the ubiquity of rules in art and aesthetics just open your photo album on your computer. If you were to browse through all your photos you might begin to notice various patterns. You might notice that you always keep the horizon straight or that, when taking a portrait, you always make sure never to cut off part of the person's head. And so, even though you may not be aware of it, your photos are guided by various *implicit* rules.

In the early days of mass photography consumer cameras used to come with a manual explaining how to make a good photo. For instance, when making a portrait you should check the surrounding area for trees and poles sprouting from the subject's head and you should move in close and fill the frame with the subject, thus eliminating any background distractions. The compositional guidelines that you learn about in a photography course and that your parents may have taught you when you got your first camera are all *explicit* rules that you may choose to apply when making a photo. Some of these *explicit* rules aim to override a natural tendency, that is, an *implicit* rule, which people adopt when taking a photo. For instance, many people tend to place the subject in the middle of the frame, which can make a picture static and less interesting. Photography manuals therefore recommend the rule of thirds, a centuries old rule of thumb, which states that one should

[2] It is should be pointed out that these lectures come to us in the form of notes taken by some of the students who attended the lectures at Cambridge University in the summer of 1938.

imagine breaking up the picture area into three parts, both horizontally and vertically, and position the main subject along the lines or at the intersections. Today, most digital cameras come with a tic-tac-toe grid in the viewfinder or on the LCD display, making it even easier to compose pictures using the rule of thirds, as long as you know what that grid is for, of course.

When I speak of rules I refer to the implicit and explicit rules that make that patterns emerge in the most general sense of the word. There are rules that define cubism, impressionism, modernist architecture, gothic novels, detective stories, classical ballet, kathak and serial music. There are implicit stylistic rules that distinguish the work of the early Jiří Kylián from that of the late Jiří Kylián and that distinguish the work of Jiří Kylián and choreographers who danced with Netherlands Dance Theatre (NDT), such as Nacho Duato and Paul Lightfoot, from that of choreographers who worked with Alain Platel and Les ballets C de la B, such as Sidi Larbi Cherkaoui and Koen Augustijnen, no matter how big the internal differences within their work may be. It may not be possible to actually formulate a set of rules that defines a style, a genre or a body of work, but one can tell that *Sinfonietta* (1978), *Symphony of Psalms* (1978) and *Forgotten Land* (1981) are early works of Jiří Kylián, whereas *Wings of Wax* (1997), *Click-Pause-Silence* (2000) and *27'52"* (2002) are representative of the 'later' Kylián. One can also tell that Nacho Duato has his roots in NDT and not in the Merce Cunningham Dance Company or Pina Bausch Tanztheater Wuppertal. One can tell that this is so because one recognizes certain patterns in the work of Nacho Duato, Jiří Kylián, Merce Cunningham, Pina Bausch, Willem de Kooning, Alberto Giacometti, Georges Bracque the artists associated with Cobra and so on. And wherever there is a pattern there is a set of rules from which the pattern emerges.

The implicit rules that define an individual work of art can spread if other artists copy some of its defining compositional elements. This is how serialism, cubism, fauvism, minimalism, abstract expressionism and other art movements emerged as a distinct style. Rules can also be carried over from one generation to the next through tuition or made explicit in the form of handbooks. The Vaganova method, the Bournonville method, Limon technique, Manipuri and other styles and genres in dance are taught from one dancer to another. If a whole generation dies, as nearly happened with the traditional Khmer dance of Cambodia, a dance style and the rules that govern it may vanish.

Contrary to Wittgenstein, who was adamant that 'aesthetic questions have nothing to do with psychological experiments' (Wittgenstein 1966: 17), I believe that some of the rules people use when exercising aesthetic judgement, whether consciously or unconsciously and whether in making or appreciating art, have their roots in human psychology. There is a reason that a cluttered background will be distracting while a plain background will emphasize the subject (☞ §9.1). There is a reason that balance and unity are pleasing to the eye and that natural lines can strengthen the composition (☞ §5). As a matter of fact, Wittgenstein admits so much when he remarks that, 'if you haven't learnt Harmony and haven't a good ear, you may nevertheless detect any disharmony in a sequence of chords' (idem: 5). In his lectures he did not, however, expand upon this observation nor did he explain what it means to have a good ear and how one acquires it.

Art is the product of social, cultural, economic, political *and* psychological forces. Psychological principles alone cannot explain the emergence of perspective during the Italian Renaissance and the emergence of Ausdruckstanz and Tanztheater in twentieth century Germany. What is more, under the influence of social and cultural forces aesthetic principles may diverge from their roots in psychology. People may work in a certain manner because that is how they are supposed to work or because previous generations have worked in this manner for as long as anyone can remember. Artists may also react against the implicit rules of a particular style, which is what the pioneers of modern dance did when they broke with the rules of ballet.

Across different cultures we may nonetheless find structural similarities in the cultural artefacts people produce. We may find patterns in the stories people tell and in people's natural inclinations when they snap a photo or make a drawing. When asked to draw a face on an empty sheet of paper most people will do so in the middle, not in one of the corners, and they will adjust the size of their drawing to the size of the sheet of paper. Few people would draw a big nose and then claim that the sheet is too small and few people would start with a cubist drawing or draw the face upside-down. These kinds of compositional rules are the product of general psychological principles.

The French anthropologist Claude Lévi-Strauss was one of the first to claim that social institutions and cultural artefacts are a concrete manifestation of the intrinsic capacities of the human mind and their substrate in the brain. They make that only some and not all possible structures emerge.[3] Accordingly, as Wiseman (2007: 46) puts it, in principle,

> 'the end point of any structural interpretation – although it is doubtful that any actual structural interpretation has ever reached it – is when the hidden structures that it uncovers are finally shown to reflect unconscious mental structures. Structuralism tries to close a vast loop that traces in reverse the genesis of social institutions to their source in the patterning operations of the brain. The structural analysis of culture aims to reveal that the macrocosm that is social reality is contained in the microcosm that is the human brain, where we will find the "modèle réduit" of all possible social systems.'

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[3] Throughout his work one can find assertions to this effect. 'Even if social phenomena must be provisionally isolated and treated as if they belonged to a specific level, we know very well that – de facto and even de jure – the emergence of culture remains a mystery to man. It will so remain as long as he does not succeed in determining, on the biological level, the modifications in the structure and functioning of the brain, of which culture was at once the natural result and the social mode of apprehension. At the same time, culture created the intersubjective milieu indispensable for the occurrence of transformations, both anatomical and physiological, but which can be neither defined nor studied with sole reference to the individual' (Lévi-Strauss 1983: 14).

For a long time the thesis put forth by Lévi-Strauss remained a theoretical possibility, but in recent years significant advances have been made in our understanding of human brain function and so we may ask whether we are any nearer to closing the loop envisioned by Lévi-Strauss.

In this study I seek to relate the patterns one can observe in dance and choreography to their roots in the mind and brain. For example, a typical pattern that one finds in many dance performances is that the dancers are arranged in symmetrical configurations. The emphasis is on dance as a performing art (more about which later) and choreographed dance performance. Indeed, much of what I have to say deals with choreography, that is dance composition, rather than dance per se. In dance, as in music, there is a difference between performing and composing. Playing a musical instrument and composing a musical score require different forms of mastery. It is the same in dance, theatre and cinema. A great dancer does not necessarily make a great choreographer and some choreographers don't even have dance training (e.g. Jan Fabre). As I will argue in more detail below, there is a relation between the structures one can find in choreographed dance performances, the choices choreographers make in choreographing a dance performance and the response of the audience watching a dance performance. The binding factor are the mental capacities that are engaged when one watches a dance performance. By investigating these mental capacities, their neural underpinnings, variability, dependence on environmental conditions and so on, we may learn more about the nature of dance and choreography.

Like Lévi-Strauss, who was mostly interested in the structures underlying collective behaviour, I am primarily interested in different manifestations of dance and choreography and less concerned with what any one individual spectator might think or feel when attending a dance performance. The structure of the mind and brain affects the *distribution* of cultural phenomena, it explains various regularities in people's behaviour, but it says little about any one person's memories, associations, emotions and aesthetic judgement. To explain why a particular person does what he or she does and feels what he or she feels one would need to know that person's private history and his or her personal convictions, beliefs, values and preferences. The most that psychology and cognitive neuroscience can illuminate in this regard are the factors that constrain a person's thoughts and feelings. The specific examples derived from my own experience that I refer to throughout this study therefore only serve to clarify a particular question or hypothesis or to illustrate the exercise of a particular mental capacity.

I am aware that, in emphasizing the rules that govern art and aesthetic experience, I put myself in a long tradition. The British empiricists Francis Hutcheson (1694-1746) and David Hume (1711-1776) held that judgements of taste operate according to general principles, which might be discovered through empirical investigation. The rationalist philosophers of the German enlightment, such as Christian Wolff (1679-1754), Alexander Baumgarten (1714-1762) and Gotthold Lessing (1729-1781), similarly held that 'aesthetic criticism and production is governed by rules, which it is the aim of the philosopher to discover, systematize, and reduce to first principles' (Beiser 2009: 2). Perhaps I should state in advance that I'm not going to 'derive' any rules, formulas or compositional principles. I will seek to discover a number of *invariant relationships* (☞ §1.3) that are associated with various *aesthetic properties* (☞§30).

Against the view that art and aesthetic criticism are governed by general principles it has been argued that there are no purely descriptive statements of which one might say: 'If it is true, I shall like that work so much the better' (Isenberg 1949: 338). However, to repeat, I am not so much interested in matters of taste, let alone in determining whether a particular work is 'good', as in the regularities in art and people's responses to art. Of course, the premise of art education and masterclasses is that one *can* improve one's skills and that a teacher *is* capable of pointing out how one might improve one's performance of, say, Bach's cello suites. This still leaves room for interpretation and one may still prefer one performance over another, one may not even like Bach's cello suites at all, but as I will argue, there are some general principles that, on average, predispose the audience in a certain way. Why else would movies be accompanied by a soundtrack?

I know that since the advent of romanticism in the late eighteenth century any mention of rules in connection with art is considered suspect. Art is freedom. But as the French author Raymond Queneau once wrote with reference to the automatic writing techniques practised by the surrealist poets, 'the sort of inspiration that consists in blindly obeying every impulse is in reality a kind of slavery. The classic writer who composes his tragedy by observing a certain number of rules that he knows is freer than the poet who writes whatever comes into his head, and who is a slave to other rules that he doesn't see' (Queneau 2007: 36).' If we can retrace some of the *implicit* patterns in dance and choreography to their psychological or neural concomitants we may be able to find a new kind of freedom. It may allow us to avoid the patterns that, unconsciously, creep into our normal ways of thinking and doing. The present analysis therefore also has a *critical* dimension.

1.2 DANCE AS A PERFORMING ART

This book is about dance as a performing art.[4] I have little to say about people who dance at a party and about religious practices during which people dance in order to get into a trance. I am aware that dance as a performing art is a highly problematic, theory laden and culturally specific term and that dance scholars will instantly sharpen their knives, load their guns and poison their arrows upon reading this term. So let me explain.

[4] Occasionally I will refer to cinema, theatre and the visual arts to illustrate a particular thesis or to show that the analysis has a wider application.

Defining art and derivative terms such as dance (as an art form) is notoriously difficult. Many authors have grappled with this issue and I do not pretend to settle it here.[5] Sparshott (2004: 278) writes that 'an art form is categorized as dance if its principal medium is the unspeaking human body in motion and at rest.' However, the actors in the productions of Romeo Castellucci and the Socìetas Raffaello Sanzio are mostly silent yet his work is considered theatre; the dancers in some productions of William Forsythe, Pina Bausch and Jérôme Bel speak throughout the show yet their work is considered dance and included in dance festivals. The absence or presence of speech is therefore not a defining factor. Sparshott claims that 'the key concept is that of the body' (idem: 278) and that 'the arts of dance are the arts of the human body visibly in motion' (idem: 279). There is, however, no need to invoke the *human* body. In the music video for *Hell Yes* (2005) by Beck four humanoid robots developed by Sony perform an intricate dance routine. It might be argued that these robots resemble a human body, but one could easily conceive of a dancing robot with different features. As Fabbri (2007: 64) argues, artistic practices are not defined by their medium, but by their capacity to construct an experience out of heterogeneous elements and by their capacity for transformation. Walking becomes dance when it is part of a choreography and singers become actors when they perform a role, as they do in an opera.

What distinguishes dance as a performing art from social dance and dance as a form of physical exercise is that it is performed *for* an audience. It is aimed at and directed towards another person or group of persons. It doesn't matter whether the audience is actually present or implied, as it is during a rehearsal, and whether the audience is real or virtual. To a naïve Western observer visiting an Asian country a dancer who dances alone inside a temple may appear to be dancing by herself, but her movements may be intended for the all-seeing eye of a deity. Similarly, a dancer rehearsing a solo inside a dance studio will take into account how she imagines her dancing will look from the audience's point of view. When she dances inside her kitchen she may just be fooling around without minding her movements. What matters when dance is performed for an audience is how it looks (from the outside) and how it affects an observer and not, or not just, how it feels (from the inside) or whether it enhances the dancer's physical strength, agility or concentration.

It might be objected that my account relies on an implicit notion of dance (and performance). A dance performance no longer needs to involve any movement and choreography no longer needs to involve dancers. In 1957 the American choreographer Paul Taylor performed a short choreography called *Duet* in which he and another dancer stood and sat still for four minutes. The dance critic Louis Horst responded with a review in the *Dance Observer*, which consisted of four square inches of blank space with the initials 'L.H.' at the bottom (Reynolds and McCormich 2003: 383). In 2005 visitors to the Dutch Springdance festival in Utrecht were invited to position themselves at a strategic place at the city's principal railway station, the busiest in The Netherlands, to watch the

[5] Carroll (2000) offers a good overview of recent theories and debates.

arrival and departure of the trains, which the programme described as exhibiting an intricate choreography. For another performance the audience was invited to call a telephone number to listen to a verbal account of the single spectator who had witnessed the sole performance of the piece.

Even though they defy standard notions of dance and choreography these performances fit perfectly within the present framework, since each of these performances is intended *for* an audience. The crucial difference between dance as an art form and other forms of dance is the rapport with the audience. I will have more to say about this when I discuss the relationship between dance and (animal) play and the evolution of dance (☞ §26.1).

Even though most of the examples to which I will refer throughout this text stem from the narrow confines of the tradition that emerged in sixteenth century Europe and evolved into what is now known as modern or contemporary dance, the analysis pursued in this book is not restricted to what is performed in theatres and at modern dance festivals, but applies to anything from acrobatics, rhythmic gymnastics and synchronized swimming, to striptease, figure skating, bharata natyam and capoeira in so far as the dance is intended for an audience. Ballroom dance, too, becomes a performing art when a couple enters a dance competition. From that moment on the dancers no longer dance because they take pleasure in each other's proximity and in synchronizing their movements, but in order to impress the jury. They will thus try to perfect their moves or include moves that they think will make an impression on the jury. The competition may even take away the pleasure from the dancing and it may drive the dancers apart as one of them becomes increasingly annoyed with the other's lack of talent or ambition. I grant that the current definition is not waterproof, since practitioners of contact improvisation may claim that it is not the audience, but the other dancer that matters when they perform, but it does highlight a defining aspect of dance as a performing art and as a working definition it serves to delineate, albeit in broad terms, the object of this study.[6]

1.3 EXPLANATION AND CAUSATION

People may have all kinds of reasons for attending a dance performance. The parents of a dancer who just joined the company may attend the show because they are proud of their eldest daughter and because this is their first chance to see her in her new job. Her newfound boyfriend, a quantitative analyst in the equity derivatives department of a prestigious American investment bank, may have no eyes for the choreography, but only for her. The stage, sound and lighting technicians are present because, well, it is their job. However, there may be some people in the audience who attend the performance because

[6] If the dance is performed inside a theatre or another performance space the institutional framework is that of a dance performance (☞ §1.5).

they either hope or expect to enjoy it in some form or another. The reason they attend the performance is therefore that it affects them in a certain way.

I don't think there is anything controversial about the claim that a dance performance, or indeed any object or event, can produce a variety of effects. Music, when played too loud, can cause hearing damage, blasphemous cartoons can get some people upset and dance can damage the studio floor. The effects that I am interested in here are related to the object's aesthetic properties (☞ §30) and to the aesthetic experience (☞ §29) that results from observing the object. I am aware that both of these terms cry out for clarification and if you can't wait, feel free to jump to the relevant chapter. For the moment I will take aesthetic experience to refer to the totality of the thoughts, feelings, associations and memories that occur when one observes a work of art or the formal, symbolic, expressive or aesthetic properties of an object or event. I am aware that this makes aesthetic experience contingent on a notion of art and/or aesthetic, formal, symbolic or expressive properties, but as a working definition it will do.

We can represent the relationship between an object and the effects it produces in the form of a simple equation or diagram:

(1.1) $$X \rightarrow Y$$

in which X represents the object or event, in our case a dance performance, and Y stands for the effects it produces. Like all models the present equation is an abstraction. Usually the input variable X is not a single variable but a combination of multiple factors. For instance, music is an integral part of most dance performances and so, ideally, we would have to distinguish between the effects produced by a dance performance and by the choreography.

Since we are interested in the effects that occur when X is *observed* by a spectator we need to add an intermediate stage between X and Y to represent the fact that the transformation from cause to effect is mediated. If we were to put this into a diagram it would look something like this:

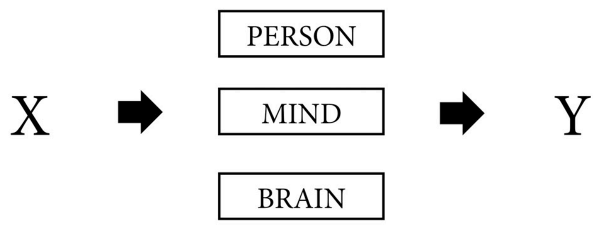
(1.2) $$X \rightarrow \boxed{?} \rightarrow Y$$

As before the X in this diagram stands for a dance performance, but it may also stand for a work of art in general or the view from the top of the Empire State Building. Y stands for the effects that occur when X is observed. The black box stands for the observer. The arrow that connects the X and the black box indicates that the X is observed or perceived. The arrow that connects the black box and the Y indicates that it is the observation of X that produces the effect Y. If we take X to be a work of art we would have to include another arrow for context, or perhaps we can consider the white space around the schema as a whole as context. The present diagram is an abstraction. The actual process is iterative and dynamic and involves feedback loops at various time scales.

The question that we now need to address is what the black box stands for. But this is not the only question. As you can see there are now two arrows in our schema, two arrows that connect the X and the Y, which raises an important question. If we take Y as the effect, within the language of cause and effect, are we to take X as the cause and the processes in the black box as the function that transforms the causes into an effect or are these processes the cause that the X produces the effect it does?

There are basically three levels at which we can analyse the intermediate stage between X and Y: the person, the mind and the brain (Figure 1.3). As I will argue in more detail below (☞ §1.6) it is the person who interprets, understands and judges a novel, a movie or a dance performance, not the body, the brain or some part of the brain. Interpreting, understanding, feeling and remembering are all mental capacities. It follows that we may learn more about the effects produced by the encounter with an object or event by investigating the mental capacities that are engaged during such an encounter. Like all human powers, the capacity to perceive, feel, understand, anticipate and pay attention is made possible by numerous brain mechanisms. It follows that an investigation into the neural conditions that endow humans with their perceptual, cognitive, cogitative and affective powers may also tell us more about the effects produced by the encounter with an object or event. Of course, the question is whether it is really necessary to go all the way down to the level of brain function to gain a better understanding of matters relevant to aesthetics.

(1.3)



We commonly attribute the reason why we like or dislike something to the object and not to a brain process. We enjoy a piece of chocolate because of its flavour, not because of something happening in our brain. However, occasionally you may not be in the mood for avant-garde music and instead prefer something undemanding and soothing. In fact, you may not be in the mood for any music or indeed anything at all and just wish to go to bed early, which may not be such a bad idea. You may have a headache; you may be slightly irritable because of a cold or because a project did not go as planned. You may also be tired after a long day at the office and fail to understand the complex visual metaphors in the theatre performance you attend at night. All of this can be traced back to the workings of the brain. So in this sense the brain processes that mediate X and Y do bias the outcome regardless of the input.

As the above examples illustrate we may learn more about the effects produced by the encounter with a work of art by analysing the neural underpinnings of human cognitive and affective capacities. Perhaps I should emphasize that I am *not* saying that we *should* analyse aesthetics at the level of brain function let alone that we should *not* analyse art and aesthetic experience at the level of persons and institutions. All I am saying is that recent advances in cognitive neuroscience have made it possible to address questions related to aesthetic experience at the level of cognitive, affective and neural processes. At the end of our inquiry we will need to assess whether this level of analysis actually produces any useful insights.

Until now I have taken the X in our model, the object, the work of art, the dance performance, as given. But cultural artefacts, of which works of art are a special case, are themselves a product of the raw material that serves as input. In dance the dancers, the movements, the music, the lighting, the costumes and so on, can all be considered input to the final composition. The transformation from raw material into cultural artefact does not happen out of the blue or as a result of some chemical process. It is the result of an active process of selection, fabrication, planning and composition by an artist or artisan.

If we let Z be the raw material and X the work of art we can again represent this relationship in the form of a diagram:

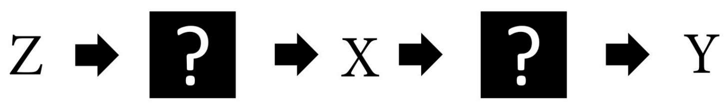
(1.4)

I should add once more that the actual creative process is iterative and dynamic. It rarely happens that an artist goes straight from raw material to finished artwork. Usually this involves many intermediate steps and so at each stage the X in our model becomes input for the next stage in the same way that one might add some salt and spices to the soup whilst cooking.

As before we can analyse the creation of a work of art at the level of the person, the mind and the brain. That is, we can analyse the mental capacities that are engaged when an artist creates a work of art and we can investigate the neural conditions that make these capacities possible and that guide and constrain the creative process.

If we combine the two diagrams in (1.2) and (1.4) then the full chain from raw material to the effects a cultural artefact produces on the observer looks like this:

(1.5)



What this means is that y is a function of x, or to put it in mathematical terms $y = f(x)$ and that x is a function of z, that is $x = g(z)$. We could thus write y as a composite function of z by inserting $g(z)$ into $f(x)$ like so $y = f(g(z))$. Assuming that we can take the inverse of f we can now write $g(z) = f^{-1}(y)$. [7] What this formula says is that there is an inverse relationship between the composition g, the process that maps the raw material into a work of art, and the process f that maps the work of art into the effects it produces.

Is there anything more to this than manipulating a couple of symbols according to some fancy mathematical rules? I believe there is. To write, paint or choreograph is a dynamic, iterative process whereby words, sentences, colours, lines, sounds or movements are composed, evaluated, changed, re-evaluated, deleted and inserted. Through this iterative process the artist arrives at the aesthetic properties (☞ §30) he or she wanted to achieve or that, once achieved, he or she considers accomplished. At times he or she might wonder how to bring about a certain effect. That is, he or she might wonder how to manipulate the material Z, to create a work X that will produce an effect Y. In the somewhat caricatural case of a horizontal line on a canvas one might imagine a painter stepping back to judge whether the line is perfectly straight. Indeed, Piet Mondriaan reportedly could spend weeks contemplating the precise positioning of lines and blocks of colour. This whole process of deliberation is set against the backdrop of the brain mechanisms involved in perception, attention, emotion and cognition.

Somniloquy (1967), a work by the American choreographer Alwin Nikolais (1910-1993), used slide projections, conventional spotlights and flashlights held by the dancers. The lighting design and the dancers' movements were interdependent and so both were choreographed simultaneously. As Nikolais explained in an interview:

> 'The dancers don't work to counts. The illusions worked best at a particular space speed, and the dancers had to learn what that was. In the final scene, where white dots were projected onto the entire stage, and the dancers moved through the dots, *I had them come out in the audience one at a time to see the effect that was being created. Once they knew the illusions they were creating, they could perform it better*. They had to develop a kind of tactile sense of the design on them' (Alwin Nikolais as quoted in Siegel 2007: 49; emphasis mine).

In a way the dancers inverted the effect so as to understand what they had to do. These days many choreographers record the rehearsals and performances on video so that the dancer(s) can see how their movements look from the audience's point of view.

With this model in the back of our minds the goal of the present study can now be described as an attempt to *explain* the relationship between X and Y, that is, a dance performance and the effects it produces on a spectator and the relationship between Z and

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[7] As you may remember from high school, if f is a function whose domain is the set X, and whose codomain is the set Y, then, if it exists, the inverse of f is the function f^{-1} with domain Y and codomain X, with the property: $f(x) = y$ if and only if $f^{-1}(y) = x$. For this rule to apply each element $y \in Y$ must correspond to exactly one element $x \in X$. This is not the case in our example.

X, that is, the choreographic process. The goal is therefore different from studies which seek to *describe* the dance of a particular geographic region or historical period and studies which seek to *interpret* individual dance performances or the work of a particular choreographer in the light of the work of Walter Benjamin, Gilles Deleuze, Slavoj Žižek or whoever happens to be the latest fashionable philosopher or critical theorist. I am aware that to speak of explanations in the realm of art and aesthetics calls for some clarification and justification.

People seek for an explanation whenever they are faced with something they don't understand: a failed harvest, the death of a child, the motion of the planets, a seemingly endless array of bad luck, the meaning of life or the remarkable fact that watching some people moving about on a stage can be fascinating and touching on one occasion and a complete and utter bore on another. Rather than adding to our knowledge (one's date of birth, the average distance from the earth to the sun[8]), explanations typically aim to contribute to our *understanding*. Once you understand how to add fractions containing unlike quantities you can add all fractions. Of course, this ability is then part of one's knowledge. However, one may know that $\pi = 3.1415926$ without understanding a thing about trigonometry. Accordingly, the goal of the present inquiry is not to accumulate knowledge about the mind and brain, but to gain a better understanding of dance and choreography. At its core this entire project is pragmatic. It is my hope that, if you are a dancer or a choreographer like myself, you will find some inspiration in my inquiry into dance, aesthetics and the brain.

Explanations come in various flavours. One can explain the meaning of a word and one can explain how to make an omelette. One can explain why one bought a ticket to see a particular dance performance (it received good reviews) and why one left after half an hour (it turned out to be extremely boring and it would have been a waste of time to stay any longer). Explanations can take the form of an exposition, such as when one explains one's plans, and they can offer a justification, such as when one provides a reason for one's actions, beliefs or opinions. In this book I will focus on a specific type of explanation: *causal* explanations.

Like some of the other key concepts referred to in this book the mere mention of the term causality or causation risks opening a Pandora's box of complications. For what is a causal explanation? If a person hits a piano key one usually hears a sound.[9] One might thus say that hitting the piano key causes a sound. However, philosophers disagree about the meaning of this statement. It might be argued that all we know is that every time someone hits a key one hears a sound. It might also be argued that what the statement means is that, if the key had not been hit and if the hammer had not been set into motion, one would not have heard a sound. It might be argued that the statement conceals a number of causal processes involving the transfer of energy from the finger to the key and from the hammer

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[8] 149,597,870.7 or about 150 million kilometres.
[9] Piano key example adapted from de Regt (2004).

to the string and so on. Each of these interpretations is associated with a particular *theory* of causality. So if you ever hear someone declare that correlation does not imply causation, ask him or her what he or she means by causation.[10]

As the philosopher of science James Woodward observes in his book *Making Things Happen. A Theory of Causal Explanation* (2003), a distinguishing feature of causal explanations 'is that they show how what is explained depends on other, distinct factors, where the dependence in question has to do with some relationship that holds as a matter of empirical fact, rather than for logical or conceptual reasons' (Woodward 2003: 4-5). According to Woodward a causal relationship between X and Y can be formally characterized as follows: 'X causes Y if and only if there are background circumstances B such that if some (single) intervention that changes the value of X (and no other variable) were to occur in B, then Y or the probability distribution of Y would change' (Woodward 2010).[11] A variable in this context refers to a quantity, a property or a state that can take on at least two different values. An intervention is an idealized experimental manipulation of X, which causes a change in Y, such that any change in Y occurs only through a change in X and not in any other way. Manipulating the value of X is therefore a means of bringing about a change in the value of Y. Background circumstances in this context are circumstances that are not explicitly represented in the relationship between X and Y. For example, when investigating the brain it is implicitly assumed that the rest of the body functions normally, that the flow of blood to the brain is not interrupted, that the person continues breathing and that the level of oxygen, the room temperature and the air pressure in the room remain constant.[12] In the performing arts one usually controls for background circumstances in that it shouldn't matter in which theatre a production is performed.

As Woodward points out, the bare claim that X causes Y is not very informative. One would like to know which interventions on X bring about a change in Y and how and under what circumstances and to what extent and what kind and so on. If a causal relationship exists between X and Y then there are some background circumstances and some interventions on X that will change Y. From this it follows that there are also some interventions that leave the relationship between X and Y unchanged. If a certain causal relationship continues to hold under a range of interventions one might call it *invariant* or

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[10] A great deal has been written on the subject of explanation and causation. The interested reader is referred to Salmon (1989).

[11] Woodward (2003) provides more precise definitions and distinguishes between total, direct and contributing causes.

[12] The interventionist account of causation developed by Woodward (2003) provides a methodological framework tailored to common research practice in cognitive neuroscience. Brain injuries represent an intervention by nature in the normal functioning of the brain. They allow researchers to investigate the behavioural impairments that result from damage to different parts of the brain (☞ §B.2). Transcranial magnetic stimulation (TMS) temporarily disrupts processing in relatively restricted areas on the surface of the cortex. It is a direct intervention, which makes it possible to study the involvement of a brain region in a particular task (☞ §B.4).

stable (Woodward 2003: 69; 239-314). Newton's laws of motion and Maxwell's equations are invariant under a wide range of interventions, which is why they are referred to as laws (Woodward 2003: 266). Additionally, an explanation should be neither too general nor too narrow. The question that we need to keep in the back of our minds at every step of our inquiry is whether it is really necessary to invoke the properties of neurons to explain aesthetic phenomena. Finally, a causal explanation should offer a specific and not a generic explanation. Disrupting oxygen intake and general heart failure will cause behavioural impairments, but these impairments are undiscriminating: they cause the entire body to malfunction or to stop functioning altogether. A disruption of *specific* brain regions causes *specific* behavioural impairments.

It is because there are certain invariant relationships in the artistic process through which raw material is transformed into a work of art (Z → X) that there are patterns in art. It is because there are certain invariant relationships in the relationship between a work of art and the effects it produces (X → Y) that there are patterns in people's responses to art. Because of the duality between aesthetic properties and aesthetic experience any invariant relationship in the mapping between X and Y translates into an invariant relationship in the mapping between Z and X and vice versa. The goal of the present study can thus be reformulated as an attempt to establish various invariant relationships in the realm of dance and choreography. Much of the work will consist in explicating the processes that underlie the mental capacities that are engaged when one watches a dance performance and in explaining how these processes feed back into the structure of a dance performance.

1.4 AESTHETICS, NEUROAESTHETICS AND THE PSYCHOLOGY OF ART

One of the central premises of the present inquiry is that aesthetic theory should be consistent with current empirical research in psychology and neuroscience. Aesthetics analyses the concepts people use to think about art. It asks what is meant by the word art, whether photography is an art, what the ontological status of a choreography is and whether it has any existence independent of a performance. It seeks to define the nature of aesthetic experience and the concept of the aesthetic. It analyses the notions of representation, expression, authenticity and style in art and it debates the nature and importance of beauty and the relationship between the artist's intention and a viewer's interpretation. In discussing these matters the discourse on art relies on psychological concepts of emotion, attention, interest, the unconscious and so on, which are often left unanalysed.[13] Of course, a philosopher might argue that an analysis of these concepts is the province of psychology and cognitive neuroscience. But if we are to gain a better

[13] For instance, Fabbri (2007: 151) writes that there is a mimetic movement in the relation between a spectator and the movement of a dancer and that the pleasure in watching dance relies on a form of empathy. However, this empirical assertion would need to be investigated (☞ §4).

understanding of art and aesthetics at some point both realms should be integrated and synthesized. That is the task I have set myself in this book.

The present book is part of a growing field. For many years Rudolf Arnheim's *Art and Visual Perception*, originally published in 1954, was one of the few texts that sought to explain regularities in art with the tools of experimental psychology. As he writes in the introduction:

> 'The relevance of these views to the theory and practice of the arts is evident. No longer can we consider what the artist does to be a self-contained activity, mysteriously inspired from above, unrelated and unrelatable to other human activities. Instead, we recognize the exalted kind of seeing that leads to the creation of great art as an outgrowth of the humbler and more common activity of the eyes in everyday life' (Arnheim 1974: 5).

I would go even further and claim that there is nothing humble about ordinary perception, nor is there anything exalted about creating art. Seeing a pattern and understanding a metaphor is as much a creative act as composing a pattern or inventing a metaphor. Joseph Beuys was right: everyone is an artist. Taking a photo, buying a postcard, selecting a wallpaper for your desktop, arranging your furniture, hanging a poster on your wall, recording and editing a video of yourself dancing to the latest song by Shakira and choosing a ringtone for your mobile phone, all involve aesthetic judgement. Why, after all, don't you just hang that poster on an empty spot on your wall? Why do you care whether it is straight and why did you buy it in the first place?

The 1980s saw a resurgence of interest in the cognitive and neural foundations of art and creativity. Musicologists were among the first to recognize the possible relevance of experimental psychology and cognitive science for the analysis of music and today there is a large and active international research community spread across different countries and institutions (Juslin and Sloboda 2009; Zatorre and Peretz 2001; Jackendoff and Lerdahl 2006). The 1980s also saw the emergence of cognitive film theory as a new paradigm in film studies (e.g. Carroll 1996; Currie 1995; Grodal 1999; Smith 2003). More recently, various cognitive neuroscientists and experimental psychologists have turned their attention to the arts by offering a tentative account of the mental processes and neural mechanisms associated with the perception of visual art (e.g. Ramachandran and Hirstein 1999; Zeki 1999; Livingstone 2002; Chatterjee 2010), watching dance (e.g. Hagendoorn 2002; 2004b; 2011; Calvo-Merino et al. 2008) and reading literature (e.g. Yarkoni et al. 2008). The present study differs from existing approaches in neuroaesthetics in several important ways.

First, most books and papers that aim to relate art to the functioning of the brain only deal with perception. Indeed, some books are little more than an introduction to the visual system with some paintings as examples (e.g. Zeki 1999; Livingstone 2002). Unfortunately, various authors also spend considerable time discussing visual illusions (e.g. Solso 1996), which only play a minor role in the visual arts. Many authors also appear to believe that aesthetics is only concerned with beauty and that accordingly 'neuroaesthetics is concerned with the neural underpinnings of aesthetic experience of beauty' (Cinzia and Vittorio 2009). There is, however, more to art and aesthetics than perception and aesthetic judgement and beauty has long ceased to be the sole objective in art. Art produces numerous effects such as pleasure, insight, excitement, laughter and crying, which involve the exercise of mental capacities other than perception and it can be annoying, boring and vacuous. I believe that, to gain a better understanding of art in general and dance in particular, all mental capacities should be taken into account. This is why in the present study in addition to perception I also devote a considerable amount of space to a discussion of attention, prediction, emotion and understanding.

Second, just as aesthetics should be consistent with current empirical research in psychology and neuroscience, neuroaesthetics should be consistent with the current state of the art in aesthetics. I believe that it is only natural that if one ventures out into an adjacent field of inquiry one takes note of the existing literature. Unfortunately, for many cognitive neuroscientists this appears too much to ask. Some authors even assert that neuroscience will put an end to centuries of fruitless speculation in aesthetics (e.g. Ramachandran and Hirstein 1999; Zeki 1999), but they appear little aware that much of what they claim has already been proposed and criticized by others before them. In the present inquiry I have therefore confronted the insights gleaned from cognitive neuroscience with classical and contemporary aesthetics.

Third, in recent years a number of philosophers and art scholars have taken an interest in cognitive neuroscience (e.g. Robinson 2005; Malabou 2004). Unfortunately, many take their ideas from a few popular science books. However, these books often paint a rosy picture of the underlying science and only touch on the surface. I believe that a serious inquiry into the neuroaesthetics of dance and choreography should take into account the latest findings. We should also be aware of the limits of cognitive neuroscience and current experimental paradigms and not take everything scientists 'suggest' in the discussion section of a paper for granted.

Finally, many existing books and scholarly papers in (neuro) aesthetics only deal with mainstream art. One cannot blame cognitive neuroscientists, philosophers and art scholars for not being up with everything that is happening at the forefront of visual art, dance, cinema, music and architecture. The framework developed in this book applies to all forms of dance as a performing art, from ballet to bharata natyam and from breakdance to neo-conceptual dance. For many years I have been in the privileged position of being able to travel across Europe and parts of North America to attend dance and theatre performances and visit museums, exhibitions, film festivals and contemporary art fairs, so I am fairly well acquainted with what's happening in the arts.

I am aware that a number of objections can be and have been raised against this whole enterprise of seeking to relate art and aesthetics to mental capacities and their neural concomitants. Does it matter in any way what happens where in the brain when one listens to music or watches dance? How does this knowledge enhance our understanding of art? Who cares whether it is the insula rather than the amygdala that is activated in a particular task? It might be of interest to neuroscientists, neurologists and neurosurgeons, but why should artists and audiences care about these findings? And doesn't art by its very nature lie beyond the realm of what can be studied with the methods of cognitive neuroscience? And, as Currie (2003: 718) asks, what is the aim of this research? 'Is it intended merely to discover the underpinnings of responses we can describe and evaluate in the familiar language of criticism and connoisseurship? Or is the aim to interpolate unfamiliar concepts into the domain of aesthetics itself, leading perhaps to a revised understanding of aesthetic values?' Of course, the proof of the pudding is in the eating, but I'll try and answer some of these criticisms in advance.

I once coined the term 'neurocritique' (Hagendoorn 2004a) to convey that cognitive neuroscience has a *critical* dimension in that it reveals the properties of the neural mechanisms, which make our perceptual, cognitive and affective capacities possible. Cognitive neuroscience can therefore be said to extend the critical program of structuralism and post-structuralism, which showed how language, as well as historical and social structures, shape the way we think. I also believe, naively perhaps, that greater self-knowledge can lead to more informed judgement. Reading about psychology and the workings of the brain can help us understand the fabric of our selves. As I once wrote, a better understanding of how perception, attention and emotion work may allow us to replace heedless criticism and blind admiration with informed judgement (Hagendoorn 2005).

I am the first to admit that there is little to be learnt from neuroimaging studies which proclaim to study the neural basis of judging beauty by having people watch reproductions of some paintings from the canon of Western art as they lie inside a brain scanner other than that something happens inside the brain (e.g. Vartanian and Goel 2004; Kawabata and Zeki 2004). There is nothing new or exciting about the observation that the brain is active when one engages in a mental task. It would be truly revolutionary if it would turn out that nothing happens! Looking at a painting and watching a movie engages multiple mental capacities and if the threshold is set low enough the entire brain will show increased activity. Recording the brain activity of someone watching a video recording of a dance performance or a short dance phrase inside a brain scanner will therefore tell us little, if anything at all. It might tell us something about the brain, but it won't offer any insight into dance and choreography. Sure enough the cerebral blood flow in different parts of the brain will change, there may even be patterns across different individuals, but then, so what? We might also observe that people's heart rate goes up when they are excited, but what does that tell us about the structure of the objects and events that are a cause for excitement?

I agree that humans cannot be ontologically reduced to their nervous system. It is the *person* who interprets, understands, judges and gets excited, not the body, the brain or some part of the brain (Bennett and Hacker 2003). One does not like chocolate because of some neurons firing in the posterior ventral pallidum. One likes it because it has a particular balance of sweetness and bitterness. One does not enjoy a comedy because of increased activity in some part of the brain, but because it is funny. Invoking one's brain does not add any relevant information. The firing of neurons does not allow us to discriminate between different stimuli either, since the same neurons may fire for different brands of chocolate as well as for blueberries and, who knows, fauvist paintings and your favourite music. I'll have more to say about this below (☞ §1.6), but why do people enjoy watching comedies and why do they all laugh at the same time? And what makes comedies funny anyway? To say that people enjoy comedies, because they make them laugh and that they make them laugh, because they are funny, doesn't explain much. Empirical questions such as these can only be answered through empirical research.

When you listen to music you don't just hear a stream of sound, you hear musical structures: you hear rhythm, themes, motives, phrases and refrains. Of course, the reason that you hear structures and patterns when you listen to music is that the sounds have been composed by a musician or composer. But a composer can only compose music because he or she is capable of hearing and imagining musical structures. We may thus ask which mental capacities are engaged when people listen to music that make it possible to hear musical structures (Jackendoff and Lerdahl 2006). We may ask how these capacities are acquired and whether they rely on a more general capacity, for instance the capacity for language. The same questions can be asked of dance and choreographic structures. A neuroimaging study is unlikely to reveal the structure of a fugue or the difference between a Beethoven string quartet and a symphony by Mahler or a Bach fugue and a Shostakovich fugue for that matter. The most that it will bring to light are the neural correlates of music perception. But using the tools of cognitive science we may learn more about the capacity for music and the metrical structure, the pitch structure and the grouping organization of music. The same tools may also tell us more about the nature and perception of dance and choreography. However, merely sliding someone into a brain scanner and recording what happens when someone watches a video recording of a dance performance won't offer much insight into the relevant mental capacities.

In his *Lectures on Aesthetics* Wittgenstein remarked that, 'people still have the idea that psychology is one day going to explain all our aesthetic judgements, and they mean experimental psychology. This is very funny – very funny indeed. There doesn't seem any connection between what psychologists do and any judgement about a work of art' (Wittgenstein 1966: 19). In fact, Wittgenstein anticipated the kind of experiments currently *en vogue* in cognitive neuroscience, whereby the neural activity is recorded as people listen to music, watch an excerpt from a movie or read a literary text. As he writes:

> 'Supposing it was found that all our judgements proceeded from our brain. We discovered particular kinds of mechanism in the brain, formulated general laws, etc. One could show that this sequence of notes produces this particular kind of reaction; makes a man smile and say: "Oh, how wonderful." (..) Suppose this were done, it might enable us to predict what a person would like and dislike. We could calculate these things. The question is whether this is the sort of explanation we should like to have when we are puzzled about aesthetic impressions, e.g. there is a puzzle – "Why do these bars give me such a peculiar impression?" Obviously it isn't this, i.e. a calculation, an account of reactions, etc., we want – apart from the obvious impossibility of the thing' (idem: 20).

Wittgenstein's comments only apply to individual aesthetic judgements. As I said above, I am not interested in what one person thinks or feels, but in the patterns that emerge when we consider the actions of multiple persons. Even though I will frequently refer to the kinds of studies, which seek to establish the mechanisms that enter into aesthetic judgement and that are the subject of Wittgenstein's scorn, in the end I do so in order to examine how these mechanisms translate into the kinds of implicit rules or regularities that govern both the creation and appreciation of art; the same rules that Wittgenstein himself was also interested in. In my view Wittgenstein did not thoroughly think through his own position and stopped short where the analysis becomes interesting.

Human behaviour exhibits numerous patterns and regularities, which are reflected in cultural practices, such as dance, and cultural artefacts, such as artworks. I don't think there is anything controversial about the claim that some of those patterns and regularities can be traced back to the properties of the neural processes that occur when the capacities to bring forth those products or to engage in those practices are exercised. The opposite claim would be that the structure of the brain plays *no* role in bringing about art and the world around us. If you believe, as I do, that this claim is false, the next question is which parts of the brain *do* play a role in the creation and appreciation of art.

1.5 THERE IS MORE TO ART THAN MEETS THE BRAIN

On a Friday morning in January, in the middle of the morning rush hour, a young man wearing jeans, a t-shirt and a baseball cap emerged from the underground at Washington D.C.'s L'Enfant Plaza station. He positioned himself against one of the walls inside the station's entrance, took out a violin from his case, placed the case in front of his feet, threw in some change and began to play. The young man was not an average street musician, but Joshua Bell, one of today's most celebrated violin players. Three days earlier Bell had given a recital at Boston's Symphony Hall for a sold out audience. Tickets for the event cost USD 100 or more.

Joshua Bell played for about 45 minutes on the same violin as he always does: a Stradivarius built in 1713 worth several million dollars. He began with the Chaconne from Johann Sebastian Bach's *Partita No. 2 in D minor*, generally considered one of the greatest pieces of music for solo violin ever written, followed by *Ave Maria* by Franz Schubert, two pieces by Manuel Ponce and Jules Massenet and another joyful, lyrical piece by Bach. He ended his impromptu recital with a reprise of the Chaconne.

Some three and a half minutes after he had started playing a woman tossed a coin into his case. Three minutes later someone stopped and stood against a wall to listen, one of seven people who would do so in the 45 minutes that Bell played. In all twenty-seven people gave money. Bell collected a total of USD 52.17, but that included a twenty dollar bill by a woman who had recognized him, having attended a concert at the Library of Congress three weeks earlier. More than 1,000 people just walked by without bothering to look.

The performance had been arranged by the *Washington Post* as a kind of urban behavioural experiment. The article that accompanied the experiment generated thousands of comments from around the world and won its author, Gene Weingarten, the 2008 Pulitzer Prize for Feature Writing (Weingarten 2007).

This one-off experiment seriously challenges any claims that aesthetic experience can be explained with recourse to perceptual processes alone. It might be objected that all commuters were in a hurry to get to work, they might have been reprimanded had they shown up a few minutes late. Since it was still early in the morning people may not have been in the mood for music. Some people may have been listening to their own music on their iPod while others may have been engaged in a conversation on their cell phone. It might also be objected that classical music only appeals to a small portion of the audience. But would the result have been any different if Bruce Springsteen had put on a disguise and played some of his best-known songs?

It could also be that, after years of being exposed to elevator music in shopping malls and restaurants, people no longer notice music played in an underground station. It simply melts into the background. And knowing that most street musicians are no good or that stopping to listen entails a moral obligation to give money, people may have acquired the habit to ignore them and to move on as quickly as possible. Even so, one would expect more than just a handful of people to notice that this particular player was out of the ordinary.

Asked about the performance afterwards Joshua Bell admitted that it felt strange to be ignored, and that, during the performance, he became grateful for every glance and every coin thrown into his case. The intervals between the pieces were particularly awkward, because people not only ignored his playing, they didn't seem to notice when he stopped either. One man did stop to listen for a full nine minutes. As he later explained, when he was approached by the *Washington Post*, he instantly recognized that this guy wasn't just a dime a dozen street musician and was baffled that other passers-by didn't seem to notice.

The *Washington Post* experiment lends support to institutional approaches to art. In this view art is not defined by any intrinsic qualities or exhibited features, but by its place in the Artworld: the system of relations that exist between the agents and institutions that participate in creating, presenting, funding, criticizing and theorizing about art (e.g. Dickie 1984; Danto 1981). An object or event derives its status as a work of art from the institutional setting in which it is situated, a museum, gallery, festival, catalogue, biennale and so on. People did not expect a player of Joshua Bell's stature to be playing inside an underground station during the morning rush hour, it was not framed as a high-calibre artistic performance, and so they walked by.

The institutional definition of art is not unproblematic though. If the status of being art is conferred by the artworld and if the artworld is defined by its object, just as the world of finance and the world of fashion, we are running in circles. A somewhat related view holds that something is a work of art because of its relation to other, pre-existing works of art (Levinson 1989; 1993). It is not so much the social, but the art historical context, which confers upon an object or event its status as art. The pieces played by Joshua Bell belong to the canon of classical music, so there is no doubt about their status as art. If his performance had been part of the third edition of the annual Washington D.C. street music festival, which stands in relation to previous performing arts festivals, it too would have been sanctified as art.

The institutional approach to art explains how an object can acquire the status of art when it is placed in the appropriate context. A fire extinguisher that hangs on a wall next to a fire alarm inside a museum is just that. But if it is placed in the middle of a room or if it is labelled 'Ivar Hagendoorn. *Fire Extinguisher* (2006). Collection François Pinault' and if Ivar Hagendoorn is acknowledged as an artist, for instance, because François Pinault is a well-known art collector, it acquires the status of a work of art. Similarly, when a dancer walks to the theatre she is going to work, but when she walks on stage during a performance she is working. In *Live* (1979), a ballet by Dutch choreographer Hans van Manen, a couple performs a duet while being filmed by a cameraman. The images are projected onto a big screen so the audience can see both the dancers and the dancers as seen by the cameraman. At some point during the performance, both dancers leave the stage and walk towards the foyer, where they continue dancing for another five or so minutes. Then the woman puts on her coat and exits the theatre, followed by the cameraman who continues filming her. The images are transmitted live to the theatre, where the audience can watch her, as she walks away into the night. A passer-by might just see a woman walking on the street, but within the framework of the theatre the performance continues until the film stops and the dancers return to take a bow (this sort of ruined it for me, I would have found it a lot more consistent and romantic if she had just vanished into the night).

In the case of Joshua Bell's performance inside the Washington D.C. underground station the question is not why the passers-by failed to recognize the music as art or as a musical performance, but why they failed to notice the music at all. This too may be attributed to context. To aesthetically appreciate something one has to be in the right frame of mind. But why is this so? And what is this frame of mind? How do people lock themselves off from intruding sounds, no matter how beautiful, on one occasion and open themselves up on another? To relegate the result of the *Washington Post* experiment to context is only half the answer. The other half depends on the allocation of attention. And to gain a better understanding of attention we need to turn to psychology and cognitive neuroscience (☞ §9).

Dance does not exist in isolation, but is always performed in a setting, whether a studio, stage, temple or street. This setting is both spatial and temporal as well as social, political and, on occasion, religious. The context in which a dance is performed determines in part how the performance is experienced and interpreted. But the knife cuts both ways. A simple action such as walking can acquire the status of art, but a demonstration of a *cabriole*, a *grand fouetté en tournant* or a *pas de bourrée* is just that: a demonstration. Consequently, a neuroimaging study in which the participants watch a demonstration of a number of isolated ballet moves (Calvo-Merino et al. 2005; 2006) may tell us something about the neural concomitants of the perception of human bodies in motion, but little about dance as a performing art. Similarly, watching a video of a person pacing around in an empty room may only evoke a range of associations, interpretations and emotions if the person watching the video *knows* that it is a work of art (by Bruce Nauman) and perhaps only within the context of a museum or art festival, not in a psychological experiment or when the person is lying inside a brain scanner.

It follows that, at some point, we will need to unfold or endorse a theory of art and aesthetic experience (☞ §29). We will also need to be careful not to fall for the wrong kind of reductionism. We need to account for the fact that people don't enjoy music, film, dance, literature or art in general. People are fond of *specific* films, books and music, for *specific* reasons and on *specific* moments. We need to account for the fact that, when you are not in the right mood, even your favourite music may get on your nerves. Our analysis should provide *specific* explanations and not generalizations for how a dance performance gives rise to an aesthetic experience. It should provide a different explanation for how different works produce a different emotional response. It should not only explain why some people enjoy watching some dance performances sometimes, but also why the same performances leave other people in the audience indifferent.

1.6 THE BRAIN, THE MIND AND THE PERSON

In his book *Inner Vision. An Exploration of Art and the Brain*, in a chapter titled 'The myth of the "seeing eye"', the neuroscientist Semir Zeki writes that Monet's contemporaries used to say of him that he 'painted with his eye but, Great God, what an eye' (Zeki 1999: 13). Zeki comments that 'this is of course nonsense: Monet, like all other artists, painted with his brain, the eye acting as a conduit for transmitting visual signals to the brain' (idem). But of course this is just as much nonsense. Monet painted with a brush. As Zeki writes, 'if it were nothing more than a figure of speech, one could easily forget it. In fact figures of speech often betray deeply ingrained modes of thinking in our culture and this one is no exception (Zeki 1999: 14). What Zeki doesn't seem to realize is that his own phrasing is a continuation of the mode of thinking he criticizes.

The notion that one paints with one's eye or one's brain is an example of what the philosopher Peter Hacker and the neuroscientist Max Bennett, in their book *Philosophical Foundations of Neuroscience* (2003), refer to as a mereological fallacy. Mereology is the logic of the relations between parts and wholes (surprise your friends next time you play Scrabble™ by adding 'ology' to 'mere'). A mereological fallacy is the logical error of attributing to parts of an animal attributes that are properties of the whole being and of ascribing mental capacities to brains or their parts, which can only be meaningfully attributed to human beings. The argument builds on a remark by Wittgenstein in his *Philosophical Investigations* (281): 'Only of a living human being and what resembles (behaves like) a living human being can one say: it has sensations; it sees; is blind; hears; is deaf; is conscious or unconscious.'

Cognitive neuroscience is rife with phrasings of the kind employed by Zeki. The brain is said to believe, decide, guess, interpret, categorize, combine, estimate, search, know, form hypotheses and so on. But as Bennett and Hacker don't tire to reiterate, it is the person and not the brain who thinks, feels, judges, interprets, analyses, decides and so on. To claim otherwise is not just wrong, it is meaningless. You don't use your brain like you use a pencil or a knife. You don't use the prefrontal cortex to make a decision and you don't use the premotor cortex to initiate a movement.

It might be objected that to speak of the brain as combining this and computing that is just metaphor. We lack the language to accurately describe what is really going on at the level of neural processing and so we revert to metaphor. It is all pretty harmless. To this Bennett and Hacker respond that it is so only as long as one remembers that it is a metaphor. One might say that people pay attention and that doing so involves the allocation of scarce resources, but it would be foolish to inquire about the rate of inflation. One might speak of the interaction between neurons in terms of competition, but that doesn't mean there is a referee. One might have a brainstorm session and during that session one might have a brainwave, but that doesn't mean that the brain is an ocean. And yet, according to Bennett and Hacker, cognitive neuroscientists often get carried away by their own metaphors. Having asserted that the brain 'interprets' they go looking for the 'interpreter', 'a device that allows us to construct theories about the relationship between perceived events, actions and feelings' (Gazzaniga 2000). If part of the brain is more active in a task requiring 'interpretation' or if patients with damage to part of the brain are impaired when asked to complete the task, the researchers cry victory and claim to have located the 'interpreter'.

As Bennett and Hacker write, it is the task of neuroscience to establish matters of fact concerning the structure and operation of the nervous system. *Cognitive* neuroscience seeks to explain 'the neural conditions that make perceptual, cognitive, cogitative, affective and volitional functions possible' (Bennett and Hacker 2003: 1 and 114). As you will have noticed this is also the definition to which I allude at various points throughout this book. Experimental psychology studies the forms and limits of these capacities, their individual differences, circumstance dependence and cultural variability. As Bennett and Hacker (2003: 114) point out, 'one studies powers and abilities by studying their *exercise*; and the study of the exercise and exemplification of human powers and abilities is an investigation into human behaviour and behavioural dispositions in the varying circumstances of life.'

The kind of philosophical analysis Bennett and Hacker (2003) engage in is of direct relevance to cognitive neuroscience and related fields, including the present endeavour. In order to formulate a hypothesis and interpret one's empirical findings one needs a conceptual framework. Wrong assumptions may lead one to ask the wrong questions and through a wrong interpretation of one's experimental findings one may arrive at the wrong conclusions. There is indeed a lot that can go wrong.

According to Bennett and Hacker contemporary cognitive neuroscience has retained the basic Cartesian framework of the relation of the mind to the body, replacing the mind with the brain. This is not the place for an extensive deconstruction of Descartes, which might show that he was less of a Cartesian than he is made out to be, and so I will reluctantly stick to the popular caricature, which conceives of Descartes as the man responsible for a turning point in the history of thought from whereon it all went horribly wrong. And so to oversimplify, Descartes conceived of the mind as an independent substance, he identified the person with the mind, he thought of the mind as a bearer of psychological attributes and took it to be capable of bringing about changes in the body. But, as Bennett and Hacker, along with countless contemporary philosophers, argue: the mind is not a thing, it is not a substance. To have a mind is to have a distinctive range of capacities (Bennett and Hacker 2003: 63). It is not something one might sell to the highest bidder or divide into two halves.

Cognitive neuroscience, to repeat once more, can only tell us so much. It can discover the workings of neural signalling and it can discover the causes of neurological disorders such as Huntington's disease and Parkinson's disease. What it *cannot* do, according to Bennett and Hacker, 'is replace the wide range of ordinary psychological explanations of human activities in terms of reasons, intentions, purposes, goals, values, rules and conventions by neurological explanations' (Bennett and Hacker 2003: 3). For instance, the neural concomitants of writing one's signature may well be the same regardless of the document being signed. However, it makes a difference if you put your signature on a blank sheet of paper, a cheque, a contract and so on. The meaning of each signature and the act of signing depends on the context, not on the neural firing pattern. To explain what one has done in signing the document one does not need to know what went on in the brain.

Bennett and Hacker have a point, but what cognitive neuroscience *can* do is explain the patterns in human behaviour and cultural artefacts. It cannot explain why a woman chooses to put on make-up on a particular occasion, but it can explain why people apply make-up on certain parts of the body, even though not everybody does so or does so on all occasions. This is the difference between cognitive psychology and cognitivist strands in philosophy on the one hand and structuralism on the other. Lévi-Strauss was not concerned with explaining the behaviour of an individual, who, as I said before, might have all kinds of reasons for doing what he or she does, but with collective behaviour. Empirical phenomena are concrete manifestations of what is possible. In the realm of human behaviour these possibilities are given by and constrained by the properties of the brain.

In *Philosophical Foundations of Neuroscience* Bennett and Hacker spend much time and effort analysing how a particular concept is used. However, their conceptual analysis ignores the fact that the language one speaks and the words and concepts one uses are historical. Concepts become obsolete because of new empirical findings, which occasion new theories and conceptual frameworks. The history of science is replete with concepts that for a long time guided research, but were later discredited (phlogiston, ether, the humour theory of temperaments to name but a few). It is unclear how a conceptual analysis might have shown the way to 'the high road of sense' to which Bennett and Hacker frequently refer.

Because of the now defunct theory of the temperaments English speakers still say of a person that he or she has a (bad) temper. But is there really such a thing as a temper? We say of a person that he has an adventurous nature or a gentle nature. But what does this 'nature' refer to? And do people have a personality? Does the unconscious exist? I'm not sure whether these questions can be decided empirically, but I'm not sure either whether a conceptual analysis will do much to illuminate these questions.

It is the person, who decides to go and see a dance performance, buys a ticket and attends the performance, not the brain or the prefrontal cortex. Asked what one thought of the show one might answer that it was moving. One might then go on to explain why it was moving. In doing so one typically refers to the events on stage, not to the events going on in one's brain. But the events on stage did not happen out of the blue: they were fine-tuned to achieve the looked-for effect; they were tweaked until they had the desired aesthetic properties. Through this process of tuning and tweaking a dual or negative image of the neural mechanisms that mediate perception, attention, emotion and cognition becomes invested in the performance. To explain why works of art appear the way they do we will therefore need to analyse the mental capacities that are exercised when people engage with a work of art as well as the neural conditions that facilitate and constrain those capacities.

1.7 THE LIMITS OF COGNITIVE NEUROSCIENCE

To appreciate the findings to which I will refer in this book it is important to know how all those results are obtained. If you are unfamiliar with the methods of cognitive neuroscience I have included a brief overview of the most important methods in Appendix B. Each of the methods used by neuroscientists to study the brain has its limitations. We need to be aware of these limitations so as not to jump to premature conclusions. There is a risk in embracing scientific results and we should take care not to build a theory or base our interpretation on a single, possibly spurious empirical finding or conceptually unsound experiment, otherwise new findings might render our account useless.

Many brain structures, such as the hippocampus, the amygdala and the thalamus, were originally identified based on anatomical characteristics (☞ §B.1). The insula was first described in 1796, the hippocampus in 1564, the pons in 1573, the corpus striatum in 1664 and the substantia nigra in 1786. However, it wasn't until the mid-twentieth century that the basal ganglia, as the group of nuclei comprising the striatum and the substantia nigra are now known, were recognized as an integrated system. While there may well be a good reason why the hippocampus and the amygdala have the shape they have, we now know that the amygdala is a collection of sub-nodes, each with a complex and differentiated cell structure. Does it still make sense to continue speaking of 'the' amygdala? An even bigger problem is the location of functionally defined areas such as Broca's area, Wernicke's area and the limbic system (☞ §19.3). Broca's area was originally located in the posterior portion of the left inferior frontal gyrus, but in recent years a battle has ensued over its location and characterization (Grodzinsky and Santi 2008). Indeed, there may not actually be such a thing as 'Broca's area'. We should therefore be aware that all anatomical descriptions are only approximate and open to further refinement.

Much of what we know about the brain derives from animal studies. There are, however, many anatomical differences between the human brain and the brains of monkeys and rats, the most commonly used laboratory animals. The human brain differs from that of other animals not only in size but also in microstructure and in the relative proportions of different regions. As Passingham (2009) observes, the human brain is not just a scaled up version of the monkey brain. Some parts of the human brain, such as the prefrontal cortex, are relatively larger than in monkeys. Furthermore, not all human brain regions map onto a counterpart in the monkey brain and there are neurons in the human brain, which are not found in the brains of monkeys. Such anatomical differences are not surprising. We would have to go back 25 million years in time to find the point where humans separated from old world monkeys, the family of the macaque commonly used in animal studies.

There are, of course, also many behavioural differences between humans and other animals, which depend, in part, on differences in the brain. Humans have language, they can reflect on their own mental states and those of others, they are aware of their own death, they have knowledge of cause and effect, they use tools to make tools, they dress themselves in clothes, they have the capacity for joint attention and they make art. So why use animals at all? Surely it is the human brain one wants to understand and not the rat or monkey brain? I must say that I am highly sceptical of animal experiments, especially when higher cognitive functions are involved for which the animal brain is a poor model and when the sole objective of the experiment is the acquisition of knowledge. However, it would make no sense to ignore the knowledge that has been acquired through animal experiments and so I will refer to animal studies, but with the caveat that the findings would need to be corroborated in studies with human subjects.

Studies of patients who have suffered brain trauma have provided many important insights into the relationship between the brain and behaviour (☞ §B.2). Neuropsychological case studies rest on the assumption that damage to a particular brain region leads to specific behavioural impairments. However, the brain may have reorganized in the time between the lesion and the experimental study. Effectively, one examines what the rest of the brain is capable of in the absence of the damaged region. Furthermore, advances in neuroimaging technology notwithstanding, it may be difficult to determine the exact location of a brain lesion. And while today's technology is more accurate than yesterday's, papers that were published 20 or 30 years ago may be based on an inexact or even incorrect localization. It follows that some caution is warranted when interpreting neuropsychological case studies.

It is fair to say that the development of neuroimaging technologies in the 1980s has revolutionized cognitive neuroscience (☞ §B.3). Indeed, most people now associate cognitive neuroscience with neuroimaging studies. One study reported that research papers accompanied by fancy colourful brain images are rated as more scientific than studies that don't (McCabe and Castel 2008). Cognitive neuroscientists themselves are proud of their big machines. As Christopher Frith, emeritus professor at the Wellcome Trust Centre for Neuroimaging at University College London writes in a popular introduction to cognitive neuroscience, 'hard science becomes big science when the measuring instruments used are very expensive. Brain sciences became big when brain scanners were developed in the last quarter of the 20th century' (Frith 2007: 7). Now that they could play around with big and expensive toys cognitive neuroscientists no longer had to look up to their colleagues in particle physics and astronomy. What is more, the machines produce such vast quantities of data that nobody really knows how to analyse them, but of course that's something you are unlikely to hear from a cognitive neuroscientist.

Despite the thousands of articles that have been published over the past 20 years, it is surprisingly difficult to name a single uncontested, revolutionary insight that can be attributed to the use of functional magnetic resonance imaging. In a recent essay celebrating 21 years of functional neuroimaging studies even Karl Friston, scientific director of the Wellcome Trust Centre for Neuroimaging at University College London and one of the most eminent researchers in the field, concedes that 'it is curiously difficult to summarize its achievements' (Friston 2009a). I don't doubt that, if you were to ask an astronomer about the scientific breakthroughs made possible by the Hubble telescope, which was carried into orbit by a space shuttle in April 1990, he or she would be able to name a whole list of important discoveries. If I myself would have to name a single advance that can be attributed to fMRI I would probably choose the discovery of the default network (☞ §11.1), even though ironically, this is a case of serendipity, because it first emerged as a problem in neuroimaging studies and was only later recognized as a phenomenon of interest in itself. But why is it so difficult to name an important discovery made possible by a technology that is now used by every cognitive neuroscience department? Perhaps it has something to do with the technology itself and the way it is currently employed.

In recent years much has been discovered about the relationship between neural activity and haemodynamics (Heeger and Ress 2002; Raichle and Mintun 2006; Logothetis 2008). While illuminating, these findings also point at some limitations of fMRI. It is often implicitly assumed that if one were to insert an electrode into the brain at a site with a greater BOLD signal one would observe an increase in the spiking rate, as one would observe in a neurophysiological experiment (☞ §B.5). However, an increase in the BOLD signal need not reflect an increase in the spiking rate of a set of task (or stimulus) specific neurons. It can also occur as a result of a change in the balance between excitation and inhibition within a particular region, since metabolism also increases with increased inhibition. And as Logothethis (2008: 876) notes 'this balance may be controlled by neuromodulation more than by the changes in spiking rate of a small set of neurons.' While the BOLD signal may thus measure neural *activity*, it need not measure neural *signalling*.

MRI scanners measure neural activity in voxels, the 3D equivalent of pixels. A typical voxel is about 55 mm^3 and can contain millions of neurons, tens of millions of synapses and several kilometres of dendrites and axons. More powerful fMRI machines and more sophisticated measurements may bring down this number by a factor ten and perhaps even hundred, but this won't alter the fact that a single voxel represents the activity of a large population of neurons. What is more, neurons signal at a speed of milliseconds, whereas the acquisition of an fMRI scan is measured in seconds. The BOLD-signal therefore reflects the aggregate activity of multiple processes.

If the same voxel would always be activated when the same person performs the same task or responds to the same stimulus, then at least we would know that this part of the brain is associated with this particular task. However, as various studies have demonstrated, the so-called test-retest reliability of fMRI studies, which measures the variation as the same person performs the same experiment two or more times in a row, is relatively poor, although the reliability varies by the interval in-between experiments and by cognitive task and experimental design (Bennett and Miller 2010). I should add that the whole concept of test-retest reliability in the case of fMRI studies is itself controversial. With repetition the person may learn the task, get used to the experimental conditions and thus be less nervous, pay less attention and so on. If the BOLD signal does not so much reflect the spiking rate of the underlying neurons as neuromodulation, then anything that alters the amount of attention needed to perform a task may affect the strength of the BOLD response.

Of equal concern is the fact that the *inter*-individual variability can be even greater than the *intra*-individual variability. In one study 81 subjects were tested on a number of simple tasks (Thirion et al. 2007). Next the population of subjects was split into 5 groups of 16 subjects. In all a total of 100 such splits were made. The groups were then analysed according to a standard procedure for fMRI group analysis. The variability between groups was such that entirely different conclusions would have been reached depending on the group of subjects. The authors concluded that a group would need to consist of at least 20 subjects to achieve an acceptable level of statistical reliability, while 27 (or more) would be preferable. At present most fMRI studies include 12-16 subjects, and sometimes even less, which might explain the great variability in findings.

As Poldrack (2006) has argued the interpretation of fMRI data often takes the form of a reverse inference: 'it reasons backwards from the presence of brain activation to the engagement of a particular cognitive function.' Let's say that a number of studies have demonstrated that the amygdala is associated with fear. If, in another experiment, the amygdala is activated in a particular task, it is then concluded that the *task* involves an element of fear and that, unconsciously, the subject is afraid. However, this type of reasoning is logically invalid, or rather, it is valid only if a particular brain area, in our example the amygdala, were active *if and only if* a particular cognitive process is engaged, in our case fear. The same study could also be a reason to conclude that the amygdala is associated with a much wider, as yet unspecified, range of functions.

As the above discussion shows, the acquisition, the analysis and the interpretation of functional neuroimaging data are all problematic. To quote Logothetis (2008: 876-77) once more, 'the limitations of fMRI are not related to physics or poor engineering, and are unlikely to be resolved by increasing the sophistication and power of the scanners; they are instead due to the circuitry and functional organization of the brain, as well as to inappropriate experimental protocols that ignore this organisation.' But, as Logothetis adds, nevertheless and despite its shortcomings, 'fMRI is currently the best tool we have for gaining insights into brain function and formulating interesting and eventually testable hypotheses, even though the plausibility of these hypotheses critically depends on used magnetic resonance technology, experimental protocol, statistical analysis and insightful modelling.'

Many of the empirical findings to which I refer in this inquiry are based on experiments in which a small number of subjects perform some simple or not so simple task. To determine whether the results are statistically significant scientists use a magical number known as the *p*-value: the likelihood of observing the data given that the null hypothesis is true. If the results are statistically significant, meaning that it is unlikely that they would have arisen by chance, the findings are submitted to a scientific journal. Of course, the observed effect may still be a matter of chance, it just happened with a very small likelihood. Conversely, if a study does not find a statistically significant effect, the effect may nonetheless be real. There's no way of deciding based on the *p*-value alone.[14] What is more, as various authors have pointed out (e.g. McCloskey and Ziliak 2009), a statistically significant result does not mean that the result itself is significant. And so, whenever it is claimed that 'significant activation' or 'significantly' higher, lower, or increased activity was found in this or that brain region, one should keep in mind that what was found is that the observed effect was *statistically* significant. We should also keep in mind that this itself need not mean much.

When testing a hypothesis one can reject the hypothesis when it is in fact true, which is commonly referred to as a Type I error, and one can *fail* to reject the hypothesis when it is in fact true, which is known as a Type II error. Researchers typically want to reduce the risk of a Type I error. There is, however, an inverse relationship between Type I and Type II errors. For any given sample size decreasing the Type I error generally results in increasing the Type II error (and vice versa). In trying to avoid Type I errors many cognitive neuroscientists choose a stringent threshold (a low *p*-value), thus creating a potentially large Type II error, meaning that activation that is real may be ignored. But what if that region is critical for the task? In a recent paper Lieberman and Cunningham (2009) note that over the past decade statistical thresholds (i.e. *p*-values) in fMRI research have become increasingly conservative. They argue that, apart from larger Type II errors, this may lead to 'a bias toward studying large rather than small effects, a bias toward observing sensory and motor processes rather than complex cognitive and affective processes and deficient meta-analyses.'

Another major problem, from a statistical point of view, is that most studies in experimental psychology and cognitive neuroscience have a small sample size of less than 20 subjects. Neuroimaging is costly and analysing the data time consuming, so most researchers would rather do four studies with 12 or 16 subjects than one with 50 or 100. Understandably, most researchers also prefer to pursue their own pet theories rather than to replicate a published report by another research group. If an experiment does not reject earlier findings, chances are slim that the report will be published and precious time and resources have been lost. It is only when results are rejected that one has a chance of getting one's replication results published.

In a much-debated paper Ioannidis (2005) argued that most research findings are, in fact, false. The argument is rather technical, but basically the idea is that, as the number of published research reports increases, so does the number of published false positives, that

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[14] For more on the use and abuse of null hypothesis testing in psychology I refer to Cohen (1994) and Krantz (1999).

is, papers that reject the null-hypothesis (of no effect) even though there is no effect.[15] Since there is a positive correlation between the number of published papers and the number of researchers, it follows that, as the number of researchers in a particular field increases, so does the likelihood that someone will find evidence for each and every false hypothesis.

What is more, as Simmons et al. (2011) show, it is relatively easy to find statistically significant evidence for almost *any* hypothesis. The culprit is what they refer to as 'researcher degrees of freedom'. When conducting an experiment, researchers may continue collecting data until they have found support for their hypothesis; they may continue mining the data until they have found something of statistical significance and they may leave out some observations that they consider outliers. So, if you thought that findings published in a scientific journal are true, think again.

In addition to these general problems of statistical inference neuroimaging studies pose several problems of their own. In another much debated article Vul et al. (2009) observed that many neuroimaging studies of emotion, personality, and social cognition report unusually high correlations between brain activation and personality measures. As they point out, the reason that the correlations are most likely overstated, is that only those correlations that exceed a certain threshold were included in the analysis.

Suppose that you are interested in the brain regions associated with disgust. You decide to present 12 participants with some neutral, mildly disgusting and truly disgusting fragrances while their brains are being scanned. Let's say that a particular part of the brain, the insula, can be divided into 100 sections (voxels). For each voxel you can now calculate the correlation across all 12 subjects between the neural activity in that voxel and your measure of disgust (not, mildly, very). Suppose that you then select the voxels, which you consider 'statistically significant', say those for which the correlation is higher than 0.75.[16] Let's say that there are 10 for which this is so and that the average of those 10 voxels comes down to 0.82. Obviously, this average does not represent the average activity of the insula, yet this is the number that the studies analysed by Vul et al. (2009) reported. If you take the BOLD signals for these 10 voxels and plot them against your measure of disgust it will seem as if there is a strong correlation between the activity in the insula and disgust. There may be a correlation, but by selecting only those voxels that exceed a certain threshold, it is overstated.

As various commentators pointed out (e.g. Lazar 2009; Linquist and Gelman 2009) there is nothing new about the non-independence problem identified by Vul et al. (2009): it occurs in various guises and under various names in all of science. While this particular

[15] A false positive occurs when your spam filter incorrectly flags an email as spam.

[16] This is one way of sorting through the vast amount of data generated by a single neuroimaging session (Lazar 2008). Effectively, many neuroimaging studies rely on a huge number of univariate hypothesis tests for each voxel whereby a voxel is selected if it is statistically significant relative to a null hypothesis of zero effect. Apart from the general issues with hypothesis testing, such an analysis assumes that all voxels are independent, which they are not. A solution to this problem is the use of multivariate methods (e.g. Norman et al. 2006; Lazar 2008).

problem is easily avoided, a more serious issue is that all fMRI studies are dependent on statistical methods. The beautiful brain scans that you can find in academic journals, popular science magazines and the science section of newspapers are usually rendered at a statistical threshold of $p<0.01$ or $p<0.005$. Analysing the same data set with different methods (parametric vs. non-parametric, univariate vs. multivariate etc.) may produce different results. Consequently, in the future, when more sophisticated statistical methods become available, perhaps some cherished findings may prove spurious and some functional brain regions may even vanish of the (brain) map.

Finally, one of the central assumptions in cognitive neuroscience and psychology is that all healthy normal humans have the same brain and share the same mental capacities. However, recent cross-cultural experiments have revealed considerable and systematic variation in people's systems of thought (Nisbett 2003). It is not just that people in different cultures analyse problems and situations differently, some studies suggest that they perceive the world differently. People may differ in what they pay attention to and in how they parse a scene into objects and events. There is accumulating evidence that differences in both high-level social cognition, as well as perceptual, attentional and emotional processes are reflected in underlying neural mechanisms (Han and Northoff 2008; Ketay et al. 2009). Since most psychology and cognitive neuroscience departments and laboratories are located at universities in North America and Western Europe, much of the world population, that is, people from Asia, Africa and Latin America, are under-represented in behavioural research. Since the subjects in experimental studies in behavioural science are typically undergraduate students who get credit for their participation, the sample is even less representative (Henrich et al. 2010). And yet, most authors assume that their findings can be generalized to the whole of mankind. But if people vary in their cognitive processes and if this variation can be traced down to differences in the neural correlates of these processes, then conclusions about the involvement of certain brain regions in a behavioural task based on a sample of Western university educated participants may be premature. If these findings are borne out then audiences in Asia may well perceive a performance differently then audiences in Europe and North America and (vice versa).

1.8 BEYOND THE LIMITS

If I have dwelled on the limits of cognitive neuroscience it is because in recent years the brain has replaced the gene as the ultimate answer to all of life's mysteries. Adding a neuroscientific gloss to an explanation of a psychological phenomenon generates more public interest and creates the illusion that the findings are scientifically sound, even when the neuroscience is irrelevant to the explanation (McCabe and Castel 2007; Weisberg et al. 2008). Books about the brain top the non-fiction bestseller lists and newspapers regularly report on the latest groundbreaking neuroimaging studies. As a consequence dopamine, mirror neurons and the prefrontal cortex have become household names and people now explain their emotions with reference to the amygdala. Amidst all this hype it is worth keeping in mind that the conceptual, methodological and statistical foundations on which all those findings rest are not as sound as they seem.

However, while each of the methods used in cognitive neuroscience has its limits, they only partially overlap. It is also worth emphasizing that cognitive neuroscience should not be equated with neuroimaging studies, even if it is the currently dominant tool. A solution to the above concerns is to consider the evidence from multiple experiments, using different methods, different experimental designs and different subjects. Future findings may still render many results to which I refer throughout this text obsolete, but that is no reason to adhere to medieval notions of the workings of the mind and brain.

Before we can start our inquiry we still need to overcome one methodological hurdle. Throughout much of this study I will take the results from various experimental studies, sometimes involving laboratory animals, and apply them to dance and choreography. I will not be directly studying the relationship between dance and the brain the way in medicine one might study the relationship between an illness and a pathogen. Doing so requires some form of methodological justification. This issue is not unique to the present inquiry; it is a general problem in cognitive neuroscience. In fact, the problem is common to the entire scientific enterprise. It is generally assumed that results obtained in controlled experiments also hold outside the laboratory, but this is not necessarily the case.

The philosopher of science Nancy Cartwright has argued that causes should be interpreted as capacities and that doing so allows us to transfer them from one context to another. As she writes, ‘if Cs do ever succeed in causing Es (by virtue of being C), it must be because they have the capacity to do so. That capacity is something they can be expected to carry with them from situation to situation’ (Cartwright 1989: 145).

If we *interpret* the results of the various psychological and neurological experiments to which I refer in this book as capacities, we can transfer them from the controlled environment of the laboratory to the messy world of stage performances. If a particular result is true for black dots on a screen, we might surmise that it also holds for identically dressed dancers seen from a distance.

The concept of capacities also gives us a way to talk about the contribution of a particular factor in the presence of causal interactions. For example, a dance performance in which for 45 minutes the dancers repeat the same movements over and over again may be experienced as supremely boring. We will have to explain why this is so (☞ §10), but let’s take it as a matter of fact. Suppose we find that, for some reason, graceful movements are considered beautiful. Does this mean that making the same graceful movements for half an hour on end will produce an intense sense of beauty? We just noticed that repeating the same movement produces a feeling of boredom. Consequently, we cannot formulate a causal relationship of the kind: if the movements are graceful then a feeling of beauty will ensue. What we can say in the present, hypothetical example is that grace has the *capacity* to produce a sense of beauty and that repetition has the *capacity* to produce a sense of boredom, regardless of whether it does so on all occasions and regardless of whether everyone in the audience is equally bored or delighted. In econometrics one might combine two or more relationships in a structural equation model, which would allow for the estimation of their joint effect, but we will have to content ourselves with identifying the individual relationships and collecting them in a diagram.

The term capacity is not unproblematic though. I am also aware that it creates some inconsistencies with the rest of my methodological framework.[17] Cartwright likes to use the example of aspirin, which, in her words, has the capacity to relieve headache, even though it doesn't always do so. But this may merely reflect the fact that the precise workings of aspirin and its interaction with different chemicals under different circumstances are not yet known. Cartwright might claim that, once it has been established that aspirin carries the capacity to relieve headaches, it will be true, even if on occasion there may be contravening factors that block its manifestation (Cartwright 1989: 184). But how is the invariant character of capacities established? And what are capacities anyway? Are they properties of an object or properties of properties?[18] But enough said about methodology. It is high time that we turn to the contents of what I have termed the black box. Let's hope it doesn't turn out to be another one of Pandora's boxes.

1.9 OUTLINE

Standard textbooks in aesthetics typically start with a number of concepts – beauty, art, aesthetic experience, expression – which are then analysed, usually in conjunction with some canonical works of art. The present book starts from an exploration of different cognitive capacities and then shows how each on its own or their interaction may account for either a specific aspect of our experience or a formal aspect of dance. So instead of a top-down approach it takes a bottom-up or building block approach. At various moments in our analysis we will encounter instances where the best we can do on the basis of current knowledge is to ascend one level and give a high-level psychological description. The choice to concentrate on capacities has the advantage that we can consider data from various fields and are not confined to studies that use dance as a stimulus. I don't claim that the capacities covered in the present text offer a complete map of the capacities engaged when one watches a dance performance or that they capture all aspects of dance as a performing art. I also admit that the choice of capacities is a bit arbitrary and given in by heuristic considerations. I do believe that, like any map, it is a good starting point for further investigation.

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[17] For an extensive discussion of the similarities and differences between Cartwright and Woodward, see Woodward (2008).

[18] To this Cartwright responds that component features have capacities and that their mode of operation is described by laws. The result of the joint operation of various capacities is what actually happens (Cartwright 2008: 196).

The present book is a map or a diagram more than it is a story. Each chapter zooms in on a particular node in the network. When seen together a picture emerges. Throughout the book I will use terms such as perception, attention, emotion and aesthetic experience, which will be analysed in more detail in the relevant chapters. In principle the different chapters could be read in any order, although by placing them in the present, not altogether arbitrary, order I do enforce a certain accumulation. Some topics are embedded in a discussion of another subject. For example, evolutionary psychology is discussed in a paragraph on basic emotions. There is some structure in that everything starts with perception, but as I will argue in chapter 17, one is always in a mood and any number of events contribute to one's state of anticipation, which is covered in chapter 13. To facilitate cross reading I have inserted cross-references in the form of a '☞ §' sign. I am sure you already noticed them.

The book is divided into six parts, five of which are named after a particular mental capacity. Part 1 reviews the neural mechanisms associated with the perception of the human body in motion. Part 2 addresses one of the central challenges in the performing arts: how to capture and hold the audience's attention. Part 3 reviews the neural and cognitive basis of different forms of prediction. Part 4, which is by far the longest chapter, develops a conceptual framework for analysing the feelings spectators experience during and after watching a dance performance. Part 5 discusses the relationship between dance and language and addresses the question of how meaning emerges in dance. Part 6 concludes the project with a discussion of aesthetic experience and aesthetic properties. To make this book somewhat self-contained I have included an ultra short introduction to the brain as an appendix. I have also included a brief survey of the methods and tools cognitive neuroscientists use to study the neural substrates that endow animals and humans with their distinct capacities, abilities and dispositions.

Part 1

Perception

2

INTRODUCTION

Imagine that you're in a theatre to see a dance performance. You don't know what to expect, you just bought a ticket at the box office and wandered into the theatre, as you like to do whenever you are in London, New York, Paris or Berlin and are looking for a way to spend the evening. You were only just in time and in your hurry you forgot to pick up the program notes. It is a modern theatre so you have enough room for your legs. You carefully place your shoulder bag underneath your seat and take out your still half-full water bottle just in case. The people seated next to you are chatting about a mutual friend who apparently broke up with her boyfriend and within days booked a six week backpacking trip to India, which one of them disapproves of but which the other wishes she had done herself the last time her relationship ended. You don't actually want to know all this but you cannot shut your ears. A person in front of you is checking messages on his iPhone. You hope he'll remember to switch it off before the show begins.

When everybody in the audience has taken their seats the lights in the audience dim. For a moment your eyes adjust to the darkness. You look intently in the direction of the stage, but all you see is darkness. All of a sudden the stage lights come on. Dispersed across the stage are a number of objects. You recognize a Herman Miller Aeron™ office chair and what must be either a 46 or a 55 inch LCD High Definition screen. On the screen it says with large white letters against a black background CHERRY. As your eyes scan the stage and return to the television screen, you notice the word has changed to LOVE. Somewhere on the left side of the stage two persons are sitting on the floor. Another person on the right side of the stage is going through some broken, jagged but fluid movements. The dancers wear colourful crumpled garments that look as if they have been designed by the Japanese fashion designer Issey Miyake. You become aware of a wonderful fragrance and wonder whether it is one of the dancers' perfumes.[19]

Although it is unlikely that they would be in the audience some people would not be able to recognize the words 'CHERRY' and 'LOVE', not because they are illiterate or because they only know Chinese, Arabic or Hindi characters, but because a focal brain lesion caused a selective impairment in their ability to recognize words. Other people might not be able to see colour or motion because of damage to another part of the brain. They may remain unaware of what happens on the left side of the stage or only notice the

[19] It was Comme des Garçons fragrance no. 71 in case you wonder.

right side of the television screen, that is, the letters ‘RRY’ and ‘VE’. Neuropsychological disorders like these are as disturbing as they are fascinating, because they offer a window into the workings of the brain.

There is a wealth of literature on what are commonly referred to as visual agnosias: a blanket term for neurological disorders which leave elementary visual functions such as seeing brightness and colour unimpaired. Some patients with a particular form of visual agnosia have no problem identifying inanimate objects yet fail to recognize living things. Other patients are unable to perceive more than a single object at a time, a condition called simultanagnosia. When presented with a cluttered visual scene, such as the stage of our performance, they only report seeing one element, the office chair or the dancer to the right.

Neuropsychologists commonly distinguish between apperceptive and associative agnosias. Patients with apperceptive agnosia can still see brightness, colour, motion and line orientation, but fail to recognize shapes and objects. Patients with associative agnosia also have difficulty recognizing visually presented objects, but unlike patients with apperceptive agnosia they are still able to draw a copy of an object. Strangely though they are unable to identify the objects in their own drawings.

In the early 1990s it was discovered that some patients with apperceptive agnosia were able to reach for and grasp objects, which they didn’t report seeing. It had already been known since the mid 1970s that some patients with damage to the primary visual cortex retain a form of vision, a condition referred to as blindsight[20], but since neurological studies tended to focus on what patients could not do, rather than on what they were still capable of doing, spared capacities often remained undiscovered.

In a series of experiments David Milner and his colleagues systematically explored the residual visual capacities of a patient who had suffered brain damage from carbon monoxide poisoning while taking a shower (Milner et al. 1991). The lesion had severed the connection between the primary visual cortex and the inferotemporal cortex, but had spared the fusiform gyrus and the primary visual cortex itself (James et al. 2003). As a consequence the patient, who is known in the literature as D.F., was unable to recognize objects or discriminate between simple geometric forms. To the researchers’ surprise she had no difficulty inserting a card into a slot, even though she was unable to describe its orientation. She was also unable to indicate with her fingers the size of a rectangular block placed in front of her, but when grasping the block she correctly shaped her fingers into the appropriate position in the course of reaching. Her performance deteriorated considerably as the objects became more complex. For example, she had great difficulty inserting a T-shaped object into a similarly shaped hole.

The impairments of D.F. contrast sharply with those of patients with a condition known as optic ataxia, which is caused by damage to the posterior parietal cortex. These

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[20] A recent experiment, in which a cortically blind patient was able to find his way through a maze of obstacles, provided a dramatic example of this phenomenon (de Gelder et al. 2008).

patients are generally impaired at reaching for visually presented objects. Their impairment does not originate in the motor system since they can move their limbs at will. It must therefore stem from a lesion at the intersection of perception and motor control. Patients with optic ataxia fail at the tasks at which D.F. is unimpaired. They cannot insert a card into a slot, yet unlike D.F. they are able to describe its orientation (Jeannerod et al. 1994). The impairment of patients with optic ataxia therefore appears to be the opposite of patients with visual form agnosia.

In the 1970s it had been proposed that the visual system consists of two processing streams: a ventral 'what' stream, extending from the primary visual cortex 'down' to the inferotemporal cortex, subserving the identification and recognition of objects, and a dorsal 'where' stream, extending from the primary visual cortex through the middle temporal area 'up' to the posterior parietal cortex, subserving object localization (Ungerleider and Mishkin 1982). However, this model does not conform to the data obtained in neuropsychological studies in patients with visual form agnosia and optic ataxia. Patients with visual form agnosia such as D.F., which is caused by damage to the ventral stream, are unable to recognize objects, yet retain the capacity to perform some rudimentary visually guided actions. Patients with optic ataxia, which is caused by damage to the dorsal stream, are impaired at visually guided actions, but can still recognize objects. Milner and Goodale (1995) therefore proposed that the dorsal stream is required for visually guided actions, while the ventral stream enables the formation of a perceptual and cognitive representation of an object's visual characteristics.

The dual model of vision initially put forward by Ungerleider and Mishkin (1982) and elaborated by Milner and Goodale (1995) is arguably one of the most important results in cognitive neuroscience and an example of what is truly innovative about cognitive neuroscience as a scientific discipline. No amount of phenomenological inquiry would have led to its discovery. It was only through systematic empirical experiments in combination with lesion data from CT and MRI scans that the two distinct modes of visual processing were revealed.

In the years since its publication the dual model of vision has been refined, but the basic dichotomy is uncontested. It is currently thought that there is extensive crosstalk between both visual pathways. There has to be. Object knowledge determines how the hand is adjusted during a goal directed action. When picking up a knife you will reach for the handle and take care not to touch the cutting edge. The fact that D.F. had difficulty inserting a T-shaped object into its designated hole also shows that shape recognition is necessary for more complicated visually guided actions. As we shall see dance perception is another instance where object features, which are processed in the ventral stream, and motion signals, which are processed along the dorsal stream, combine.

The two visual systems model challenges the standard paradigm of perception. As Milner and Goodale (1995) emphasize, vision evolved for action, not for cognition or perceptual experience. The primary mode of interaction with the environment is participation, not observation. Sitting in the dark and *watching* a dance or theatre performance is a derivative activity both from an anthropological and a behavioural neuroscience perspective. In live performance, as opposed to cinema, there is still a sense in which the spectators are participants in an event, rather than silent witnesses of a situation. In principle they can interfere with the performance and their physical presence influences the performers, who may be slightly nervous about going on stage, because they did not have sufficient time to rehearse the new triple A section. The knowledge that the actors are real and that, if a dancer falls she really does fall, may be one reason for the enduring popularity of the performing arts in the age of digitally manipulated cinema.

It is through vision that, as spectators, we perceive dance and so an analysis of visual perception is a good place to start our examination of the cognitive and neural underpinnings of dance and choreography. This is not to say that dance cannot be perceived through other sensory modalities. You can hear a dancer's footsteps as she trips around the stage in her point shoes and you can smell a whiff of perfume as she twirls by in her colourful silk sari. Nothing prevents a blind person from dancing and interacting with other dancers through movement either. For his production *Her Body Doesn't Fit Her Soul* (1993) the Belgian choreographer Wim Vandekeybus used a cast of blind and normal sighted dancers. The Moroccan dancer Saïd Gharbi was one of the stars of the show and he would have been so regardless of his blindness. But, to state the obvious, a blind person or a blindfolded normal sighted person seated in the audience will not be able to distinguish the dancers on stage, will not be able to count the number of male and female dancers and will not be able to identify the movements.

Most dance performances are performed with music and so an analysis of dance as a performing art cannot be complete without an analysis of the relationship between dance and music (☞ §15.2). With the exception of tapdance the goal in dance is not to produce sound. Of course, the fact that breathing and moving around makes noise can be put to creative use, indeed some choreographers have experimented with body sensors that trigger sounds by way of a MIDI interface, but that doesn't make a dance performance into a concert. This justifies a focus on vision, as long as we remain aware that the other sensory modalities are always present in the background and may contribute to the overall experience of attending a staged choreography or a breakdance competition.[21]

A full overview of the visual system lies beyond the scope of this book. If you are interested, Zeki (1999) and Livingstone (2002) have many interesting things to say about colour perception and the visual arts. In what follows I will concentrate on those capacities that are essential to the perception of dance. The emphasis will be on the neural mechanisms that enable us to see human bodies and human bodies in motion. Dance can take place anywhere, on the street, in a theatre or in one's living room, many dance performances are staged in a specific setting and in many dances too the dancers wear

[21] Similarly, the goal in music is to produce sound, but some composers (e.g. Mauricio Kagel) explicitly take into account the performative aspect of musical performance.

colourful costumes, but if we strip away the surroundings and adjust the lighting so that one does not perceive colour we still see the dance. Waves, leaves, balls, cars and other objects move, but one doesn't say of a bouncing ball or a passing car that it dances. It is only metaphorically that objects, animals and kinetic sculptures such as the *Stravinsky Fountain* (1983) by Jean Tinguely and Niki de Saint Phalle, next to the Centre Pompidou, in Paris, are said to dance. What is needed is a body. The body doesn't have to be that of a living human being, it can be a robot, a digitally manipulated figure or an animated avatar, as long as it resembles a human or an animal. When you watch a dance performance you don't just see moving bodies: you see patterns emerge and dissolve and you see dancers engaged in goal-directed activities. And so we will also need to analyse the mechanisms that enable us to see patterns and to recognize intentions in people's actions. I will show how these mechanisms bias our perception and how choreographers implicitly draw upon these mechanisms so as to guide the audience's perception.

3

THE DANCER OR THE DANCE?

'What are you watching, the dancer or the dance?' one of the dancers asks the audience in *Object Constant* (1994) a dance production by the Portuguese choreographer Rui Horta, as the female dancers raise their arms and begin to pull off their shirts, thereby revealing their bare breasts. Rui Horta was not the first to make this remark[22], but I have always liked the way he incorporated it into the performance. As we shall see there is more to this question than just some clever wordplay. After all, what do you see? In chapter 9 we will learn that what you see depends on what you look at, that is, it depends on what you pay attention to. Now in order to pay attention to either the dancer or the dance you would have to be able to discriminate between the two. This in turn requires that you can perceive both the dancer and the dance in the first place. In this chapter I will discuss the capacities that enable us to tell the dancer from the dance: the perception of the face, the body and the body in motion. We will see how in choreographed dance performances each of these capacities are carefully manipulated.

3.1 FACE PERCEPTION

In July 1976, as it circled the surface of Mars while taking pictures of possible landing sites, the Viking 1 sent back an image (#35A72) of what looked like a human face. In the photo caption that accompanied the original NASA press release (P-17384), issued 31 July 1976, the picture was described as showing eroded mesa-like landforms. 'The huge rock formation in the center, which resembles a human head, is formed by shadows giving the illusion of eyes, nose and mouth. The feature is 1.5 kilometers (one mile) across, with the sun angle at approximately 20 degrees.' But was it really a visual illusion as NASA officials claimed or the remnants of an ancient civilization that had once occupied Mars? As documented in an episode of *The X-files* (episode 9, season 1, 1993) not everybody was convinced. To silence sceptics, and to acquire additional data about the red planet, in November 1996 NASA launched a new mission to Mars. Four and a half years later, in April 2001, the Mars Global Surveyor took some high-resolution images of the same

[22] The phrase is often attributed to the Irish poet and playwright William Butler Yeats (1865-1939). It is the last line in his poem *Among School Children*, 'O body swayed to music, O brightening glance / How can we know the dancer from the dance?'

region. By combining the images from various angles it was possible to create a 3D view of the region, which demonstrated conclusively that it was a natural land formation.

Even though you know that it is just a rock formation when looking at the photo you can't help seeing a face. The fact that you know that it is a rock formation means that the knowledge must be available to you. The fact that you see a face means that the neurons that signal that it is a land formation cannot prevent the perceptual system from forming the visual percept of a face. If you are as accustomed to electronic communication as I am, when you see :) you see a smiley, not a colon followed by a bracket. And even though you are perfectly aware that human faces are not the size of the close-ups in cinema you cannot help seeing a face.

It is not just that we see faces where none exist: it is impossible *not* to see a face when you look at a frontal or a side view of a human head. Faces are not unique in this respect. I can usually shut myself off from chatter in a foreign language, but I cannot help hearing conversations in my native language. It is actually quite remarkable that some signals are processed whether you want to or not. All neural processing is energy consuming so why waste it on signals that are in some way redundant? Presumably, discarding a signal after it has been processed is more efficient than deciding whether it needs to be processed on grounds that are contained in the unprocessed or partially processed signal or other contextual signals. If a natural phenomenon seems illogical it usually means we haven't fully understood it yet.

There is converging evidence from both neuroimaging studies and neuropsychology that the capacity for face perception originates in a specialized part of the brain. Neuropsychological case studies suggest that faces are processed in a particular area of the brain, since damage to this area causes a loss of the ability to recognize faces, while recognition of other objects is preserved. It is not that patients with prosopagnosia, as a deficit in the ability to recognize faces is called, don't see differences in colour and luminance that define the contours of the eyes, nose, mouth, lips and eyebrows. Strange as it may sound, they fail to identify the whole image as a face. Neurological patients who have lost the ability to recognize faces rarely recover this ability, which suggests that face perception is bound to a particular region of the brain.

Face perception is remarkably robust. Faces are easily recognized from different angles, under different lighting conditions, from a distance and when partially occluded. A peculiar aspect of face perception is that recognition deteriorates significantly when faces are turned upside-down (Haxby et al. 1999). The effect is much more pronounced for faces than for other objects. It might be argued that faces are mostly seen in an upright position, but then, so are cars, yet images of cars are just as easily recognized when turned upside down, which suggests that faces are processed as faces and not as a collection of parts.

Further support for the hypothesis that face perception is a separate process and not something added to object perception comes from neuropsychological case studies. One study describes the case of a patient who had impaired object recognition, but normal face perception. The patient was able to see a face in the famous paintings by Arcimboldo, yet failed to recognize the fruit, vegetables and flowers that constitute the face (Moscovitch et al. 1997). Another study described a patient who was unable to recognize a face in *Luncheon on the Grass* (1886), a painting by the French impressionist painter Claude Monet, yet instantly identified Picasso's *Weeping Woman* (1937), one of the masterpieces of cubism, as a portrait of a woman (Gazzaniga et al. 1998: 122). One of the striking aspects of the painting by Picasso is that facial characteristics, such as the mouth, the nose and the eyes, are clearly defined. The hair, the eyebrows and the teeth are individually drawn, with stark contrasts delineating their contours. By contrast, in Monet's *Luncheon on the Grass* facial regions gradually blend into neighbouring regions. The differences between the two paintings suggest that the patient may have observed the individual elements in the Picasso portrait and then added them together: eyes + mouth + teeth + nose + hair + eyelids + … = face.

There is an extensive literature on the neural correlates of face perception, since it is relatively easy to study using functional neuroimaging and because the stimuli can be manipulated in a variety of ways (e.g. Kanwisher and Yovel 2006). These studies have identified three regions that show a stronger response to faces than to other object categories. The most consistent and robust activation has been found in a region subsequently termed the fusiform face area (FFA). It responds both to front and profile photographs of faces, to line drawings and to two-tone pictures. The fact that the FFA is found at the same location across subjects suggests that its development is constrained by anatomical factors.

There is an ongoing debate in the cognitive neuroscience literature as to whether the face selectivity in the FFA reflects an evolved domain specific capacity or a form of expertise that has been acquired through the frequent exposure to various stimulus classes, including faces (Bukach et al. 2006). In support of the latter view it has been reported that when car or bird experts identify objects of their respective expertise, the FFA responds more strongly than to other object categories, although still less strongly than to faces (Gauthier et al. 2000). It should be noted though that a subsequent study failed to replicate these findings and found no correlation between expertise and FFA activation (Grill-Spector et al. 2004).

In addition to the neuroimaging studies in humans neurophysiological studies in monkeys have identified neurons in the inferotemporal cortex and the superior temporal sulcus that respond selectively to the presentation of faces (Perrett et al. 1982).

To summarize, the mechanism for face detection appears to be hardwired, domain specific, innately specified, autonomous and informationally encapsulated, meaning that it is only partially permeable by further knowledge. It therefore has all the hallmarks of what Fodor (1983) referred to as a cognitive module. As we shall see in the next two paragraphs the capacity to discern bodies and the movements of animals also constitute a cognitive module.

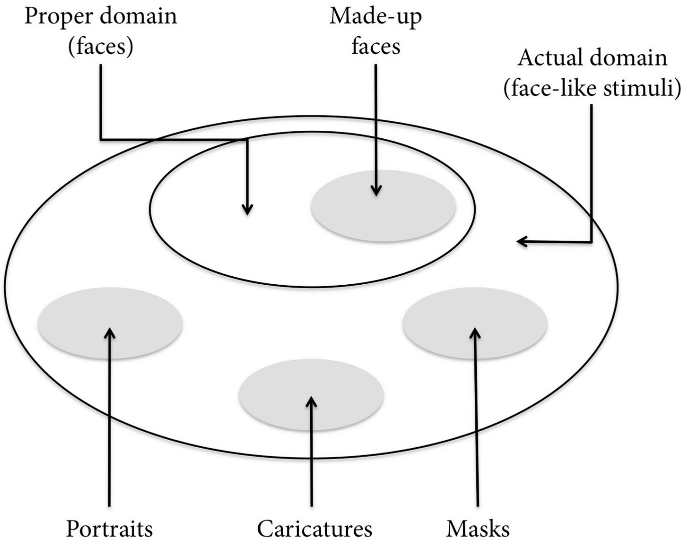

Figure 3.1 Proper and actual domain. Adapted from Sperber and Hirschfeld (2004)

It may be useful to introduce a bit of terminology here. Following Sperber (1996) and Sperber and Hirschfeld (2004) the signals that a cognitive module has evolved to detect can be defined as its *proper domain*. To detect the items that belong to its proper domain a cognitive module uses various criteria in much the same way as your spam filter uses various criteria for detecting spam. The signals that meet a module's input criteria can be said to constitute its *actual domain*. In the language of statistics there will be false positives, signals that belong to the module's actual, but not to its proper domain, and false negatives, signals that belong to its proper, but not to its actual domain. The face detection module might detect a face, even though there is none, such as on the surface of Mars or in a painting or a photograph, and it may fail to detect a face where there is one, for example when it is camouflaged. Effectively, portraits, caricatures and masks expand the actual domain of the capacity for face perception, while make-up invades the proper domain by enhancing the visual features of the face making the mouth, the eyes and the cheeks stand out from the rest of the face (Figure 3.1).

Humans have evolved various other capacities in the domain of face perception. Faces are part of a signifying system and convey information about a person's intentions, emotional state and physical condition (☞ §20.2). Depending on the context one can often tell from a person's face whether he or she is sad, ashamed, excited or cheerful. Gaze direction can hold cues about a person's intention and movements of the mouth, tongue, forehead and eyes can be used as means to communicate. This is what one does when frowning, winking or blowing someone a kiss. Movements of the lips and face also provide cues in everyday conversation about the words people are saying. Of course, each of these ditional capacities is subject to both false positives and false negatives. To infer a person's emotion from his or her facial expression one needs to know his or her baseline face. It's not as if every elderly person is angry or sad.

From a cognitive point of view it makes perfect sense to enhance facial characteristics using make-up. It makes the face more easily detectable from a distance and in poor lighting and it can enhance its attractiveness. The same reasoning applies to masks, which are an integral part of dances in cultures from Korea and New Guinea to Africa and the Americas. Their actual function may vary from one culture to another. A mask may allow the dancer to take on another persona, it may disguise and protect the wearer and it may serve to enhance a facial expression. But all of this is secondary and contingent on the capacity for face perception. Since cultural practices evolve over time, secondary functions may become primary and some artefacts may even lose their primary purpose, for example, when masks that were once intended to portray a spirit become so elaborate that they are no longer distinguishable as a face.

Masks are essentially static and restrict the dynamic flow of changing expressions. In his *Letters on Dance and Ballets* (1760) the French choreographer and dance theorist Jean-Georges Noverre (1727-1810) criticized the Paris Opera Ballet for its use of masks, which in his opinion stood in the way of the dancer using facial expressions to express an emotion and breathe life into a character. I imagine that, had he been able to travel to India, Noverre would have delighted in bharata natyam, the classical dance from Tamil Nadu, a state in the South-East of India, which makes extensive use of facial expressions and shifts in the direction of the eyes and which is renowned for its stunningly made up faces and exquisite facial jewellery.

The fact that the same underlying cognitive capacity can give rise to two contrasting cultural expressions should give us some pause for thought. Enhancing a facial expression through make-up makes it more easily visible, but it also freezes a single expression onto the face, making it more difficult to perceive other expressions. Pierrot is always weeping and a clown is always smiling. To express sadness the clown must therefore resort to other sensory modalities, such as loud crying, or technological artefacts, such as sprinkler glasses. Even so, the range of possible (facial) expressions that clowns are capable of is severely limited.

I would now like to venture the following proposition, whether this proposition will appeal to you depends on whether you are favourably disposed towards a bit of post-structuralist reasoning. Faces are the visually dominant part of the human body. It is precisely *because* faces are easily and readily recognized and *because* the face is the most information rich aspect of the body in communication, that the face itself can become a mask. It can conceal the body and absorb the spectator's attention. As the French philosopher Gilles Deleuze wrote of the painter Francis Bacon: 'as a portraitist, Bacon is a painter of heads, not faces, and there is a great difference between the two. For the face is a structured, spatial organisation that conceals the head, whereas the head is dependent upon the body, even if it is the point of the body, its culmination. (..) Bacon thus pursues a very peculiar project as a portrait painter: *to dismantle the face*, to rediscover the head or make it emerge from beneath the face' (Deleuze 2003: 20-21).

The present proposition gives us a way to approach contemporary dance relative to the indigenous dances of many cultures. Instead of emphasizing the face through masks or make-up, it seeks to divert attention *away* from the face and *towards* the body and the body in motion. Just as Francis Bacon sought to obliterate the face so as to make the head appear, contemporary dance seeks to eradicate the face so as to reveal the body and the movements that animate it. One could also say that it seeks to make the entire body into a face, a dynamic field in which the arms and the legs are as expressive as the eyes and the mouth.

I should hasten to add that I do not want to create an artificial dichotomy between contemporary dance and what, for the sake of brevity, I gather under the heading of indigenous dances. Many contemporary dance performances also use facial expressions and dancers may unconsciously close their eyes or tout their lips as they perform a certain movement. What I identify here are two strategies that define different directions in dance. Within the world history of dance Western theatre dance is a relatively recent and minor tradition. If we compare dances across different historical periods and across cultures what stands out is the *absence* of masks in twentieth century Western theatre dance. As I have argued this difference in cultural practices can be explained by a difference in cognitive strategies: one emphasizes the face, the other de-emphasizes the face, while emphasizing the body.

3.2 BODY PERCEPTION

Despite long-standing evidence for face selectivity in parts of the visual cortex, it is only recently that two brain regions implicated in the visual perception of human bodies have been identified. One reason for this relatively late discovery is that case studies of patients with a selective deficit in body perception are rare. Single cell recordings in monkeys had already revealed that some neurons in the temporal cortex of the macaque monkey respond selectively to the shape of various monkey and human body parts, such as hands and arms (e.g. Wachsmuth et al. 1994), but support for the existence of a body-selective area in the human brain had to wait until it was systematically probed in human neuroimaging studies.

Initially it was found that a particular region on the lateral occipitotemporal cortex, subsequently termed the extrastriate body area (EBA), responds strongly to static images of the human body and body parts, but weakly to faces and objects (Downing et al. 2001). Subsequent studies have identified a second, anatomically distinct region selective for images of the human body, adjacent to the fusiform face area (FFA), which has been termed the fusiform body area (FBA) (Peelen and Downing 2005; Schwarzlose et al. 2005). It should be noted that the possibility that the increased activity in the FBA is a result of co-activation associated with perceptual filling in can't be ruled out. It is also worth pointing out that there were only seven respectively nine participants in the two experiments in the study by Schwarzlose et al. (2005). So the evidence is still flimsy at best.

In an attempt to distinguish the EBA from the FBA in one neuroimaging study participants were shown images of fingers, hands, arms and whole body torsos. It was found that the response in the EBA becomes gradually stronger the more of the body is shown. By contrast, the activity in the FBA, although non-zero, remained relatively constant during the presentation of fingers, hands and arms, but increased when whole torsos were presented (Taylor et al. 2007). Together these findings suggest that a network of areas is correlated with the perception of faces and human bodies. But are they also *causally* implicated in perceptual processing?

As it turns out both the occipital face area and the extrastriate body area (EBA) lie on the lateral surface of the brain and are therefore in easy reach of transcranial magnetic stimulation (TMS). In one experiment TMS was applied over EBA causing a selective impairment in the visual processing of the human body, as measured by an increase in discrimination reaction time, compared with faces and objects, the processing of which was not impaired (Urgesi et al. 2004). In another study TMS was delivered over three category specific areas, as identified by previous neuroimaging studies, while participants performed a series of discrimination tasks involving pictures of faces, objects and bodies (Pitcher et al. 2009). It was found that delivery of TMS over the right occipital face area impaired discrimination of faces, but not objects or bodies, TMS over the right extrastriate body area impaired discrimination of bodies, but not faces or objects, while TMS over the right lateral occipital area impaired discrimination of objects, but not faces or bodies. In the absence of neuropsychological case studies, this triple dissociation caused by a 'virtual lesion' provides support for the hypothesis that the EBA is involved in the perception of human bodies.

These findings suggest that there is a specialized module for body perception. As in the case of faces there is an abundance of behavioural evidence in the form of cultural artefacts, which provides further support for this hypothesis. We recognize bodies in graffiti, paintings and sculptures, in the Nazca lines in Southern Peru and in cartoons such as xkcd.[23]

Some ballets play with the tendency to fill in a body. In the opening scene of *No More Play* (1988) by Jiří Kylián a bare-chested man emerges from backstage and runs towards a black crinoline that is positioned somewhere near the centre of the stage. When he reaches the gown he raises both of his arms. Even though you know he isn't actually wearing the gown for a moment the illusion is perfect as the image of the gown and the face merge into a single image.

[23] Every math, physics and computer science nerd's favourite web comic www.xkcd.com.

3.3 HUMAN MOTION PERCEPTION

When watching dance you see faces and bodies, provided they are not covered by pieces of cloth, and bodies in motion. Visual motion is detected by two different systems. When the eye remains stationary the image of a moving object sequentially activates different receptors in the retina. When the eyes trail a moving object its image remains fixed on the retina, but we still see movement. This is because the motor commands that control eye movements are used to infer the movement of the object. The same mechanism also accounts for the fact that the environment remains stable when the eyes, head and body move.

Motion signals are processed in a specialized part of the brain. More than three decades of single cell recordings in monkeys have demonstrated conclusively that neurons in the middle temporal visual area (MT or V5) are sensitive to the speed and direction of motion of a visual stimulus (e.g. Born and Bradley 2005). MT is interconnected with numerous cortical and subcortical structures. Most of the input that it receives originates in the primary visual cortex (V1), but it also receives feedforward projections from other parts of the visual cortex, as well as direct projections from the lateral geniculate nucleus, the part of the thalamus where visual signals from the retina are processed, and the inferior section of the pulvinar, another region of the thalamus. This may be why some patients with damage to the primary visual cortex may have some residual motion perception. MT projects to both neighbouring and higher-level regions such as the ventral intraparietal area, a subregion of the posterior parietal cortex, which has been associated with multisensory integration and behavioural functions such as object avoidance and spatial navigation. MT is retinotopically organized, meaning that each hemisphere contains an approximate map of the contralateral visual hemi-field. The receptive field of neurons in MT is much larger than that of neurons in V1, which suggests that it integrates signals over a larger spatial range. MT does not appear to actually detect or measure visual motion, this happens in the primary visual cortex. Its main function appears to be the integration and segmentation of local motion signals.

Functional neuroimaging studies using various experimental paradigms have identified the homologue of area MT/V5 in the human brain (e.g. Bartels et al. 2008). Activation in MT/V5 is also consistently found in studies in which participants freely watch a movie while lying inside a scanner (e.g. Hasson et al. 2008). If this sounds like a fun way to participate in a scientific experiment, remember that the movie has to be watched through an angled mirror on a translucent screen, which is not exactly an IMAX experience.

Neuropsychological studies provide further evidence for the involvement of MT in motion perception. In a famous study included in almost every neuroscience textbook researchers at the Max Planck Institute in Munich described the case of a patient who was incapable of visually perceiving motion (Zihl et al. 1983). When pouring tea she reported seeing the cup empty and then suddenly overflowed. When crossing the street she would first see a car in the distance and then suddenly, when she wanted to cross the road, it was very near. The patient had suffered a stroke, which had caused extensive bilateral lesions of the dorsolateral visual association cortex, a region corresponding to MT/V5, but had spared the primary visual cortex (V1). Although she had some difficulty naming certain objects, her form and colour perception were intact. She could still detect some motion, provided the object moved slowly, but when the velocity exceeded 10 degrees/sec she failed to see any motion at all. She could see that an object had changed position and from that infer that it had moved, but she did not report *seeing* the motion. The lesion only affected her perception of *visual* motion, since she was still able to perceive motion elicited by auditory and tactile stimuli.

As we saw in the previous two paragraphs, only very little information is needed to detect faces ☺ ☹ and bodies 🚹 🚹 🐈. The same is true for human and animal motion, as was demonstrated in the early 1970s in a classic experiment by the Swedish psychologist Gunnar Johansson. Following in the footsteps of the nineteenth century French scientist Étienne-Jules Marey, Johansson filmed an actor as he walked about in a darkened room with light bulbs attached to some key joints (Johansson 1973). Still frames from the resulting video show nothing but a random collection of dots, but when the video is played, the moving actor instantly pops out from the screen. In a second experiment a dancing couple was filmed under the same conditions and again observers had no difficulty in identifying the moving pattern of lights as that of a dancing couple.

Johansson's experiment has since been replicated in a variety of settings with the actor performing all kinds of actions, the markers placed on other parts of the body, with animals instead of a human actor and with the display as a whole turned upside-down or masked with a cloud of random noise (Blake and Shiffrar 2007). It has thus been demonstrated that people can identify horses, camels, elephants and other animals from a point-light display of their movements (Mather and West 1993), as well as the gender of a moving person (e.g. Troje 2002) and the identity of familiar persons (e.g. Loula et al. 2005; Troje et al. 2005). As with faces recognition of biological motion deteriorates significantly when the display is inverted (e.g. Sumi 1984). It has also been experimentally verified that elderly people aged 60 and over retain the ability to recognize all forms of biological motion (Norman et al. 2004).

In *Biped* (1999), a ballet by Merce Cunningham with stage design by multimedia artists Paul Kaiser and Shelley Eshkar, a similar technique is deployed to great artistic effect. At the time of the rehearsals some movement phrases were recorded using motion-capture technology. The data files were subsequently transformed into dot figures, stick figures and blurred pencil-drawn figures. As Paul Kaiser explains, 'we took care never to lose the underlying perception of real and plausible human movement. When our stick figure leaped, its various lines were flung upward in the air, then gathered back together again on landing. While no human body could do this, you could still feel the human motion underlying the abstraction' (Kaiser 2001). During the performance the animation sequences were projected on a transparent scrim covering the entire front of the stage, with the dancers performing behind it. The visual effect is breathtaking as real and virtual dancers blend together in one visual image.[24]

Neuroimaging studies have implicated one particular region, the posterior part of the superior temporal sulcus (STS), in the perception of point-light displays of biological motion (e.g. Grossman et al. 2000; Pelphrey et al. 2003; Peuskens et al. 2005). This particular area of the STS is consistently activated during the observation of biological motion, both when people watch point-light displays and whole-body displays, but not when other forms of coherent motion are viewed. Further support for the involvement of the posterior STS in the recognition of biological motion comes from the case of a patient with damage to MT/V5, but intact STS. The patient had difficulty recognizing motion, yet was able to perceive biological motion (Vaina et al. 2000). It has also been found that temporarily disrupting cortical activity in the posterior STS with transcranial magnetic stimulation results in impaired recognition of biological motion displays (Grossman et al. 2005). The activation in the STS is consistent with electrophysiological studies in monkeys (Oram and Perrett 1994). Using single cell recordings it has been shown that some neurons in the superior temporal cortex are selectively activated by arm movements and the direction of walking. Together these findings suggest that the posterior STS plays a central role in the perception of biological motion.

It is often claimed that point-light displays extract the 'pure' kinematics of human motion, but in standard biological motion studies there is still a considerable amount of residual form information. Each individual marker, for instance the marker tied to the right elbow or the left ankle, traces a stationary trajectory through space and not only contains motion information, but also information about the implied body. Beintema and Lappe (2002) therefore created a display in which the location of the markers changes from frame to frame (e.g. the marker that was on the elbow in the first frame moves somewhere between elbow and shoulder in the second frame, then changes again in the third frame, etc.). In subsequent experiments the walking figure was as easily recognized as in standard point-light displays. Since perception of the figure can no longer be attributed to local motion constants Beintema and Lappe (2002) suggest that the perception of biological motion relies on the sequential analysis of body postures. In support of this hypothesis a number of neuroimaging studies investigating the neural concomitants of biological motion perception also report increased activity in either or both the fusiform body area (FFA) and the extrastriate body area (EBA) (e.g. Peelen et al. 2006; Jastorff and Orban 2009).

When browsing the literature on human motion perception it may seem as if explaining the perception of biological motion in point-light displays has become a goal in itself. Evidently, the human brain did not evolve to recognize point-light displays and it

[24] A video recording is available on DVD from French label MK2, http://www.mk2.com.

may be that cognitive neuroscientists are merely chasing an explanation for their own laboratory constructs. Human motion, bodies and body parts are usually seen in conjunction whereby the identification of an eye and a nose may reinforce the detection of a hand, a shoulder and a face. In reality, even if only part of the body is visible, the visible parts are rarely of equal size and shape and evenly distributed as they are in point-light displays. There may be a patch here and a stroke there and another larger patch over there that resembles a face.

From an engineering point of view the recognition of complex body movements is a remarkable feat requiring the solution of a number of non-trivial computational problems. The figure has to be separated from the background, its position, pose and motion characteristics at any given moment in time have to be determined and if the figure is a real person its 3D structure has to be recovered. If part of the figure is hidden from view, the occluded part will have to be filled in. All of this the human brain achieves seemingly without effort. If a woman wears a long skirt the legs are hidden, yet the figure is still recognizable as a walking person. Even women in burqa and men in djellaba are quickly identified as men and women and not as pieces of cloth blowing in the wind.

The last two decades have yielded a wealth of data in the area of visual perception, but as yet there are few computational models which incorporate all of these data into a coherent account of the visual system. An exception is the model for the recognition of biological motion by Giese and Poggio (2003), which integrates a number of experimental findings within a consistent quantitative framework. The model consists of two parallel processing pathways, analogous to the ventral and dorsal stream, for the processing of form and motion. Both pathways consist of a processing hierarchy, which yields an increasingly global representation of the data. It is assumed that at an intermediate stage in the form pathway neurons respond selectively to body configurations, they encode as it were 'snapshots' of the body; while at an intermediate stage in the motion pathway neurons respond selectively to the optic-flow patterns of specific movements. Simulations have shown that despite numerous simplifications the model is capable of identifying biological motion and categorizing different actions from both point-light displays and full-body clips. As the authors acknowledge, one of the main shortcomings of the model in its present form is that it does not incorporate the influence of top-down attention and cognitive control. For instance, in a dance performance spectators know that the performers are humans, which will bias their perception.

3.4 CONCLUSION

The present chapter has reviewed the neural mechanisms that enable us to see faces, human bodies and biological motion. Each of these mechanisms constitutes a cognitive module: they are hardwired, domain specific, innately specified, autonomous and informationally encapsulated. As a consequence you cannot choose to *not* see a face or a human body when shown a face or a human body. As cartoons and drawings demonstrate only very little information is needed to detect a face, a human body or biological motion. Some artists explore the limits of where faces, bodies and biological motion are still visible. Current experimental findings and computational models also suggest that there may be more to the question in the introduction of this chapter. To see the dancer dance the brain combines a series of rapid snapshots of the body and the optic flow of the dance.

When watching a dance performance you see bodies in motion. But you don't just see bodies, you see people of a certain gender and age. If you had the good fortune of seeing *Nelken* (1982) by Pina Bausch ten, twenty or thirty years ago, you will notice that Dominique Mercy's solo is still the same, but that he has aged. Until her untimely death in 2009, if you attended a performance of *Café Müller* (1978) or *Danzón* (1995), you might have recognized one of the dancers as Pina Bausch herself. If you were to see either of these pieces today, and if you have seen them both before, you may notice that 'it is not Pina'.

A difference between contemporary dance and indigenous dances is the absence of masks in twentieth century Western theatre dance. As I argued this difference can be construed as a difference in cognitive strategy: one emphasizes the face and thereby the person or the character, the other de-emphasizes the face while emphasizing the body.

Neurological disorders and psychological experiments reveal that perception depends on the interaction of numerous mechanisms including specialized mechanisms for face, body, motion and biological motion perception. But what does this knowledge add to our understanding of dance? One possible answer to this question can be found in a topic beloved of cognitive scientists and experimental psychologists: visual illusions.

We say of the perception of an object that it is an illusion if it disagrees with physical reality: lines appear to be sloping even though they are straight and figures appear to be moving even though they are just ink on a page. There are various types of visual or optical illusions, as they are also called. Some illusions can be explained by low-level neural mechanisms, others require an explanation that takes into account the discrepancy between 'top-down' knowledge and 'bottom-up' visual signals. In dance visual illusions emerge when the different components of a scene carry insufficient or conflicting information. As a result one may fail to see a whole body or instead see a body even though there is no body to be seen.

Under normal viewing conditions the body forms a coherent whole, but when different bodies move together and body parts are occluded, determining which limb belongs to which body becomes a challenge. In one scene in *As If Never Been* (1992) by Jiří Kylián a man stands behind a woman. The woman stretches her right arm to the left while crossing her left arm in front of her body. The man holds her right arm with his left hand and her left arm with his right hand, thus creating the illusion that her right arm belongs to his body and his right arm to her body. Jiří Kylián appears to be fond of these kinds of configurations as they occur frequently in his work. In one scene in *Stepping Stones* (1991) again a man stands behind a woman. He extends his left arm to the left while she extends her right arm to the right. She has slightly raised her right leg, while he has raised his left leg. She places her left hand on his raised left knee, while he places his right hand on her raised right knee. For a brief moment it is unclear which limb belongs to which body. As a matter of fact, Jiří Kylián is not the only choreographer in love with these kinds of visual illusions. Pina Bausch, Sasha Waltz and David Parsons, to name but a few, have choreographed similar scenes.[25]

In *Noumenon Mobilis* (1953) a short piece by the American choreographer Alwin Nikolais (1910-1993), one of the pioneers of the art-as-psychological-test movement, both dancers are fully enveloped in a stretch fabric, which from time to time makes them look like abstract shapes. One moment you can see some parts protruding, while the next moment the entire figure morphs into a blob. In the final scene the dancers wrap the fabric around their neck, thereby revealing the contours of their head and arms. When watching *Noumenon Mobilis* we know that we are watching a dance performance, so we see two dancers wrapped in a stretch fabric. Yet we don't actually perceive the dancers, if by dancers we mean identifiable human beings, we merely infer their presence. What we see is a combination of top-down knowledge and bottom-up sensory signals from the eyes. At various moments the bottom-up visual signals may temporarily override top-down knowledge. You may forget that there are human bodies inside those sacks and what you see is a moving shape. Indeed, the piece's aesthetic appeal may derive from this ambiguity. If it were an animated movie the effect would be far less striking.

In one scene in *noBody* (2002), a production by the German choreographer Sasha Waltz, a group of about sixteen dancers are lined up in pairs, standing shoulder to shoulder, while holding two dancers horizontally between them. The legs of one dancer protrude from the left side of the cluster of bodies, while the head and shoulders of the other dancer are visible on the right side. The remaining parts of their bodies are occluded from view by the other dancers. The dancers lift and move the two dancers. What is funny is that, even though you know that the legs and the upper body belong to two different dancers and even though you are fully aware that people aren't that tall, it still seems as if they belong to one and the same body. What is more, when the dancers part into two groups the effect is that of a magician sawing a body in two halves. It is a fascinating example of what in the language of statistics would be described as a false positive in body perception.

In *Körper* (2000), another production by Sasha Waltz, we are presented with a different visual illusion when, at some point, a barechested male dancer in a black skirt that reaches to the floor slowly walks onto stage. There is, however, something odd about his walking and when you look closely you notice that the legs and feet point in the wrong direction. You realize that hidden underneath the black skirt is another dancer who is walking backwards. In the next scene the illusion is taken to another level when the 'figure' sits

[25] The trailer for *Pina* (2011), the movie directed by Wim Wenders, contains another striking example.

down and crosses its legs. What is perhaps most striking is that the illusion is impervious to reason. Even though you know that the upper and lower half of the figure belong to two different dancers you still perceive a single body, albeit a body that is anatomically impossible.

But why do choreographers strive to create these kinds of configurations, rehearsing them at length until they are exactly right? Why do they seek to create and perfect these aesthetic properties (☞§30)? Why do spectators spend time and money to watch these scenes? Why do photographers take a photo at the moment when the illusion is perfect? Why do they position themselves right in front of the dancers and not to the side? From a cognitive neuroscience point of view there must be a reward somewhere, there must be something that makes the choreographer and the audience tick (☞ §22). What matters at this point in our analysis is that the reward signal is contingent on the projections it receives from brain regions that process the perceptual features of the stimulus and that each of the specialized modules for face, body and human motion perception may result in false positives and false negatives. In chapter 10 I will argue why these moments are considered interesting (☞ §10.2).

3.5 COROLLARY: THE DANCER OR THE DANCE PHOTO?

It may seem as if there is little ambiguity as to what you see when you look at a dance photo. Obviously what you see is the dancer. It is a still frame after all. Yet the objective of the photographer may well have been to capture the dance and not to portray the dancer. Had that been his purpose he could just as well have asked the dancer to strike a pose.

Dance photographers are aware of the problem of capturing the motion in the dance. For this reason they sometimes experiment with long exposure times, which create the illusion of motion through motion blur, an effect that is also exploited in two famous early twentieth century paintings, *Nude Descending a Staircase* (1912) by Marcel Duchamp and *Dynamism of a Dog on a Leash* (1912) by Giacomo Balla. Cartoonists too sometimes add speed lines to a drawing to give the impression of motion in an otherwise stationary scene. This technique has its origin in the neural mechanisms underlying visual perception. If you move your hand or an object at a high enough speed in front of your eyes, you will notice that the image of your hand or the object blurs.[26] An intriguing question is why it took until the twentieth century before this effect was exploited in visual art. One reason may be that it substantially reduces object and scene recognition, which for many artists and their patrons, is likely to have been the primary objective in depicting a scene.

Whereas many dance photos could just as well have been posed – you can practically hear the photographer say: 'OK, hold it!' – some photos create a distinct sense of motion

[26] It has been conjectured that, since the visual system integrates signals over time, albeit a very short timespan of about 100 milliseconds, it too uses the motion streaks that would occur at high speeds to detect the direction of motion (Geisler 1999).

and contain what has been called 'representational momentum' or 'implied motion' (Freyd 1983). It is almost as if you can see the direction in which the person is moving. This sensation occurs not only with still photos of people in motion, but also with photos of falling objects and high-speed photos of things shattering or exploding. This suggests that the perceptual system extrapolates the direction of motion in the image. Interestingly, it has been found that, when people view images with implied motion, the region of the brain associated with motion perception (MT/V5) shows a stronger response than when people view still lives or landscapes (Kourtzi and Kanwisher 2000; Senior et al. 2000). So, even though a dance photo sounds like a contradiction in terms, some photos may indeed capture the dance.

An excellent example of this phenomenon is a series of photos of street dancers caught in the midst of a jump by the French photographer Denis Darzacq. The dancers seem to be suspended in the air and you fear the moment they hit the ground. Had the photos been taken inside a studio they would have had far less impact, since people would have assumed they had been tricked. Indeed, even now some people think the images have been Photoshopped. But that merely shows that, consciously or unconsciously, they have considered the alternatives: either the person really is jumping and about to hit the ground or he is suspended from some invisible rope. This in turn means that the first option is people's first intuition. It makes more sense to doubt whether something is real than to doubt whether something is faked.

KEY POINTS

- ☞ 'Contemporary dance seeks to eradicate the face so as to reveal the body and the movements that animate it.'

- ☞ 'Only very little information is needed to detect a face, a human body or biological motion. The brain will automatically complete the picture.'

- ☞ 'The mechanisms for face, body and biological motion perception appear to be hardwired, domain specific, innately specified, autonomous and informationally encapsulated, meaning that they are only partially permeable by further knowledge.'

- ☞ 'To see the dancer dance the brain combines a series of rapid snapshots of the body and the optic flow of the dance.'

- ☞ 'In dance visual illusions emerge when the different components of a scene carry insufficient or conflicting information. As a result one may fail to see a whole body or instead see a body even though there is no body to be seen.'

4

MIRROR NEURONS AND KINAESTHETIC EMPATHY

In July 1518 a curious phenomenon occurred in the city of Strasbourg on the French German border. A woman who has been identified as Frau Troffea took to the streets and began to dance in a frenzy that lasted between four and six days. Soon afterwards she was joined by others and within a month some 400 people were dancing wildly in the streets. Numerous people died from exhaustion, stroke or heart attack. They literally danced themselves to death. The case is well documented. Official documents from physicians, the city council and church clergy indicate that the people were dancing and not caught by epileptic seizures or convulsions.

For centuries scientists have sought to explain the event, which is known as the dancing plague of 1518. It has been proposed that the dancing was caused by food poisoning or that the dancers were part of a religious sect. The historian John Waller, who has studied the case extensively, dismisses these explanations for lack of evidence. He also notes that historical documents demonstrate that the people did not actually want to dance, but expressed fear and desperation as they did. Still, many were unable to stop. Waller suggests that the people may have fallen victim to a form of mass hysteria, known as mass psychogenic illness. Even though the condition lacks physical causes, the symptoms, which may include fainting, fever and nausea, are no less real.

At the time the region around Strasbourg had suffered a series of misfortunes, ranging from bad weather and poor harvests to famines and epidemics. As a result people were in the grips of fear, which was exacerbated by various religious beliefs. According to one such belief, if anyone provoked the wrath of Saint Vitus, a Christian saint from Sicily, who died as a martyr in 303 CE, he would send down a plague of compulsive dancing. And thus, according to Waller, when people noticed Frau Troffea, and later others, dancing as if in a state of trance, they believed that Saint Vitus had turned against them (Waller 2008). As a matter of fact, at the time dancing manias were not uncommon in Europe. In 1374, in another well-documented case, in dozens of towns across Germany people were seized by an unstoppable compulsion to dance.

The dancing plague of 1518 was an extreme case, but there are many other, more benign examples of dance crazes. In the 1920s and 30s the charleston and the Lindy Hop became an international rage. In the summer of 1996 a remix of the song *Macarena* by Spanish duo Los del Río became a worldwide hit. More than 10 million copies of the single were sold and the song spent a total of 14 weeks at the number one spot of the U.S.

Billboard Hot 100 singles chart. The song was accompanied by a video, which featured a series of simple dance moves performed in sync with the song's refrain. As the song rose to the top of the charts, the dance became a worldwide hype. More recently, in the months after its release in November 2008, girls around the world felt the urge to imitate the dance in the video for *Single Ladies (Put a Ring on it)* by the American singer Beyoncé Knowles.

A difference between the medieval dancing manias and contemporary dance crazes is that the people who want to dance the Macarena don't just want to dance, they want to learn the exact same steps. Similarly, the girls who upload videos to YouTube in which they dance to Beyoncé, Shakira or Lady Gaga all try to imitate the same moves. These videos therefore reflect not only a desire to dance, but also a desire to imitate.

In recent years there has been an explosion of interest in cognitive neuroscience and experimental psychology in all issues relating to action observation, imitation learning, motor cognition and the gestural origins of language (☞ §27.1). At the roots of this trend, or hype if you wish, lie a number of experimental findings, most notably the discovery of mirror neurons, which led to a flood of speculations and follow-up studies. The relevance of these findings for dance theory is evident (Hagendoorn 2002; 2004b) even as some of the findings themselves remain controversial. The unifying idea is that action observation involves a form of motor simulation: the off-line activation of the neural circuits involved in action execution. Presumably, if you watch a breakdancer perform an airflare or a headspin or if you watch the contortionists of the Cirque du Soleil get into a knot, the neural templates corresponding to these movements are also activated in your own brain. Or well, maybe not, but I'll come back to that later. Before I dive into the theory and the experimental evidence I will first provide some historical background. In dance theory the idea that the appreciation of dance involves a form of motor resonance has a long history.

4.1 KINAESTHETIC EMPATHY

In his book *Introduction to the Dance* (1939) the American dance critic John Martin (1893-1985), one of the foremost advocates of modern dance in the U.S., argued that the response to dance has its roots in what he termed 'inner mimicry' or what subsequent authors referred to as 'kinaesthetic empathy'. As Martin wrote, when watching dance 'we cease to be mere spectators and become participants in the movement that is presented to us, and though to all outward appearances we shall be sitting quietly in our chairs, we shall nevertheless be dancing synthetically with all our musculature' (Martin 1939: 53). According to Martin 'it is the dancer's whole function to lead us into imitating his actions with our faculty for inner mimicry in order that we may experience his feelings. Facts he could tell us, but feelings he cannot convey in any other way than by arousing them in us through sympathetic action' (idem). In assessing Martin's writings it is worth remembering that he was a dance critic, not a psychologist or a philosopher. In fact he was one of the first professional dance critics. Before his appointment by *The New York Times* in 1927, dance performances were reviewed by theatre and music critics. His appointment therefore marked an important moment in the coming of age of dance as an art form.

Martin's arguments sound surprisingly contemporary. To make his case for a sense of 'inner mimicry' Martin mentions the same examples that many authors today still refer to in their analysis of action perception. 'If somebody yawns, we yawn; if somebody laughs, we laugh; if somebody cries, we frequently feel a lump rising in our own throats' (idem: 47). Except, of course, that we don't, but I'll come back to that later (☞ §21).[27] As Martin argues, we understand others because we automatically map their actions onto our own experience.

> 'When, for instance, we see signs of anger or rage in another, we are able to recognize them as such only because we have experienced them ourselves. Translating them automatically into a memory of these personal experiences, we understand at once the state of mind they represent and have warning to protect ourselves against a possible outburst of temper directed against us. Signs of fatigue in another are translated into a sympathetic awareness in our own bodies, and all types of gesture and facial expression convey meaning to us automatically because we have felt similar muscular experiences ourselves and recognize the postural attitudes and their emotional connotations as having happened to us' (idem: 48).

In Martin's view the same principle carries over to inanimate objects. When looking at a building supported by columns we may feel the mass that weighs on them. Our reaction, according to Martin, 'is exactly the same as the familiar sympathetic muscular strain we feel when we watch someone lift a tremendous weight or carry a staggering burden' (idem). Martin admits that, 'all this sounds a little strange and perhaps even esoteric, yet it is simple and eminently familiar in practice' (idem).

In another passage Martin argues that 'when it is recalled that the entire sense mechanism has evolved purely to establish contact with outside objects so that they can be adapted to the use of the organism, it will be readily seen that the only function of sense impressions is to prepare the body for appropriate movement with relation to the objects reported upon' (idem: 42). In *The Visual Brain in Action* Milner and Goodale make a similar claim when they write that, 'vision in the frog, like vision in other organisms, did not evolve to provide perception of the world in any obvious sense, but rather to provide

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[27] This is a popular misconception. In fragment 216 of *Human, All Too Human* (1878) Nietzsche uses the same example: 'Older than speech is the mimicking of gestures, which takes place involuntarily and is even now, despite a general repression of gestural language and a cultivated mastery of the muscles, so strong that we cannot look upon facial movements without innervation of our own face (one can observe that feigned yawning evokes a natural yawning in someone who sees it). The imitated gesture led the person who was imitating back to the sensation that expressed itself in the face or body of the person being imitated' (Nietzsche 2000: 143).

distal sensory control of the movements that the animal makes in order to survive and reproduce in that world' (Milner and Goodale 1995: 11).

A key aspect of Martin's theory is his assumption of a 'movement sense', which registers changes of posture and responds to movements of the body in the same way that the eye responds to light or the ear to sound. This is what in psychology is known as proprioception. Because Martin sees it as a 'movement sense' he can more easily connect it with dance. It also allows him to claim that there are well-established patterns within this sense:

> 'To take a simple example: when we consider the weight of a log that we chance to see lying across the path, there is awakened in us a pattern of movement responses based on memory of previous experiences with the weight of objects (..) we need not actually lift it, therefore, to know that it is heavy (..). The report made by the eye is sufficient to open one of the many beaten tracks in our neuromuscular experience and associate this object with previous objects with which we have had contact. When we pronounce the log heavy, then, we are actually describing not so much the log itself which we have not even touched, as the motor reactions which occur in our own bodies at the sight of it' (Martin 1939: 45).

This passage sounds remarkably similar to what the American psychologist James J. Gibson would argue some three decades later. In Gibson's view, visual perception amounts to seeing affordances: the action possibilities implicated in the environment. As he wrote: 'the affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or for ill' (Gibson 1979: 127). Affordances are resources that the environment offers the animal. The concept is essentially reciprocal, since the animal needs to possess the capacities to perceive and use the resources in its environment. A resource is an affordance only if the animal can use it as such. It follows that, according to Gibson, 'what we perceive when we look at objects are their affordances, not their qualities' (idem: 134).

By referring at length to Martin's theory of inner mimicry I do not mean to imply that his analysis was right, but rather to show that, in the context of dance theory, notions of 'motor resonance' and '(kinaesthetic) empathy' currently popular in cognitive neuroscience, have a long history. Had he been writing today Martin's ideas would no doubt have found a wide audience. As he writes somewhere, 'we are continually attributing our own actions and reactions to the objects about us, and as a result the idiom of daily speech is so full of verbs of action used with inanimate subjects that the dictionaries record the usage as accepted' (idem 49). Fast-forward to the end of the twentieth century and you find the same argument repeated at length in books and articles arguing that cognition is somehow 'embodied' (e.g. Lakoff and Johnson 1980).

Martin does not cite any sources and so it is difficult to judge which ideas he developed independently. Motor theories of cognition were popular at the time he was writing and he may have borrowed his ideas from other writers. In 1910 in a Presidential Address at a meeting of the American Psychological Association the prominent American psychologist Walter B. Pillsbury aimed to give a 'critical if sympathetic survey of the different formulations of the theory and to compare it with the facts' (Pillsbury 1911: 84). As he observed in his speech 'there is nothing in the mind that has not been explained in terms of movement' (idem).

Martin's theories and the more general idea that dance results in a sense of kinaesthetic empathy may appeal to dance enthusiasts looking for a way to justify their fascination to their friends. In so far as a theory makes a claim to describing an actual state of affairs, what matters is not whether it is appealing, but whether there is any empirical evidence to support it. So how does Martin's theory compare with current fidings? Does watching dance involve a form of motor resonance?

4.2 MOTOR SIMULATION 1. THE THEORY

Imagine a choreographer working on a new dance production. As he is lying in his bed after a long and fruitful day in the studio, it suddenly occurs to him what should happen in the middle section, after the double helix trio (don't ask me why it is so called). He turns over to his left side, curls up underneath his duvet and pictures the entire sequence of movements in one go. In his mind he goes through the movements several times so as not to forget them before falling asleep.

The brain activity associated with the act of imagining a series of movements, rather than a beautifully decorated Indian elephant or another word for shrewd[28], is commonly referred to as motor imagery. More formally, it refers to 'a dynamic state during which the representation of a given motor act is internally rehearsed within working memory without any overt motor output' (Decety and Grèzes 1999).

In order to demonstrate that motor imagery is real, initially researchers devised various psychophysical experiments, which aimed to show that imagined movements share the same characteristics as actual movements. One experiment reported that it took people the same amount of time to walk to a target and to imagine walking there (Decety et al. 1989). It was also found that the walking time increased with the distance covered. The researchers also reported a discrepancy between actual and imagined movements. If the participants in the study were instructed to imagine carrying a heavy object it took them longer to cross the distance, but if they actually walked to the other side it took the same time as without the object, because they compensated for the heavy object by putting in more effort.

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[28] Clever, astute, keen, sharp, perceptive, acute, perspicacious, canny, ingenious.

It is unclear though what these experiments actually demonstrate. I can imagine chopping a tree with my hands, putting it on my shoulders, jumping across a river, throwing it into the air and then jumping on top of it to fly to Jaipur. My imagination is limitless. Everything you read in fairy tales, everything you see in cinema, cartoons and the performing arts, is the product of the artist's imagination. The spectacular fight scenes in *Crouching Tiger Hidden Dragon* (2000) defy the laws of gravity and many animation movies defy the laws of physics. All of these scenes were carefully crafted and the directors went over them in their imagination to get them right. There is thus ample evidence that there is *no* simple correspondence between imagining and actually performing a movement. One can only wonder why the researchers never came up with this idea, since a moment of thought reveals that one can imagine whatever one wants.

It is assumed that motor imagery engages the same brain regions as planning and performing a movement, but with the motor output blocked. There is accumulating evidence that motor regions are indeed activated during motor imagery tasks, except that it is impossible to control what a person actually does when mentally rehearsing a movement. Furthermore, some studies have reported a difference in activated brain regions depending on the skill level of the person performing the task, which raises the question of whether any meaningful conclusions can be drawn about the involvement of motor regions in motor imagery in general (Guillot et al. 2008; Milton et al. 2008).

Although I share the methodological reservations that have been raised against current experimental paradigms and while I am sceptical of the use of the term 'representation', the question is what else could happen inside the brain when people imagine themselves moving if not the activation of the same motor regions that are also engaged when people plan or execute a movement. I mean, why would imagining that you are jumping from one rooftop to another involve the auditory cortex or the olfactory bulb? And so, even though the evidence is as yet inconclusive, the hypothesis remains plausible.

The first thing our choreographer does when he arrives in the studio on the following day is to demonstrate the movement sequence he thought up the night before to his principal dancer. The dancer just stands there, her arms folded, but in order to imitate the movements she must memorize the movement sequence as it unfolds in front of her eyes. When the dancer performs the movement sequence the choreographer compares her movements with what he himself had in mind. This means that inside his brain the visual input from the dancer's movements must somehow be matched against the memory of the movements he himself made up. He may realize once again that there is a gap between imagination and reality and that what he imagined is thoroughly lacking in detail. For one thing he failed to imagine what the left arm is supposed to be doing as the dancer brings her right elbow to the floor. He may explain that it should be more like this or like that and he may be pleasantly surprised by an addition the dancer makes. He may offer some comments as she goes through the movements one more time until, after the fifth trial, he is finally satisfied.

Imitating a movement sounds simple, but this apparent simplicity belies a fundamental problem, which is sometimes referred to as the correspondence problem in the literature on motor learning (Heyes 2001; Brass and Heyes 2005). What we observe are another person's movements, but in order to reproduce the movements we have to activate our muscles. In other words, what we see is the outer manifestation of what we would need to copy in order to imitate the movement. So how does the brain manage to activate the right muscles? The problem is in fact more general than this. We could just as well ask how a verbal instruction is translated into a motor command. In the case of imitation at least you see the movements in front of you, not some words on a page.

One possible solution is that the movements or the instructions are somehow mapped onto an already existing motor program. Consider the following simple movement sequence. Stand right up. Raise your right upper leg like you would when placing your foot on a chair. While standing on one leg insert your right hand underneath your right leg, put the back of your right hand against the inside of your right knee and move the leg to the right while holding your hand against your knee. It's a relatively simple movement, although the instructions may make it sound more complicated than it is. You are likely to have reached for your knee when drying yourself with a towel. Doing so with the back of your hand is just a small variation. It is actually quite a nice movement. If you look carefully you can see my dancers do it in some of my performances. In describing the movement I pulled it apart into different building blocks. Even though you may never have performed this particular movement the individual elements will be familiar. Effectively, what you did when you performed the entire sequence for the first time was to combine some known movements into a new configuration.

OK, now let's do the same movement again, but with the left hand and the left leg. If you remember correctly there is no need for me to repeat the instructions replacing right and left. If not, just reread the previous paragraph. In performing or imagining the transposed movement you are actually doing something quite remarkable. For in order to translate what was right to left and vice versa, you need to form an abstract representation of the movement. You need to conceive of the original movement as a specific instance of a movement that can be performed in both a left and a right orientation. Let's call this abstract representation a motor schema (Arbib et al. 1998). You can also call it a motor program or a motor representation if you wish; what matters is the concept, not the wording.

A motor schema only represents the general outline of a movement. It doesn't really matter whether you lift your left or your right leg, whether you lift it as high as you can or just a little and whether you do so slowly or fast. These are all what one might call parameter settings that adjust the basic motor schema. The motor schema is the same whether you initiate a movement and stop halfway or perform it in full. A motor schema for walking may describe a step, but when walking on a steep and treacherous mountain path each step will be individually planned and different in size and direction. Motor schemas are like Lego™: they can be combined to form a composite schema, which in turn can be combined with other composite schemas to form an action sequence, which of course is just another composite motor schema. Alternatively, if you start with a composite schema it can be taken apart into smaller schemas. There are motor schemas for tying a tie, swimming (breaststroke, freestyle, butterfly and backstroke), cycling, switching gear, typing your login name and password, lifting a leg and so on. Together all these motor schemas constitute what one might call a motor vocabulary. The module that gets uploaded to Neo's brain in *The Matrix* (1999) presumably consists of the schemas for a collection of martial arts moves. Unfortunately the mind doesn't work that way, but it's a nice metaphor. Incidentally, I never quite understood why he needed to combat his enemies with martial arts. It did result in some great action scenes though.

Before I settled upon the movement sequence that we just rehearsed I imagined various alternatives. I even got up and performed the movement myself to make sure that it is easy to imitate (I didn't have a dancer at hand to perform it for me). When performing and imagining the movement the relevant motor schemas were activated in my brain. As I sat down to write the instructions I carefully considered whether they were adequate to reproduce it. Basically, what I did was to take the movement apart into a small number of composite motor schemas. It would have been easier for me to just demonstrate the movement. In that case you would have had to disassemble it into different motor schemas yourself. You would have had to observe that the movement comes down to lift leg, insert hand, move leg while carrying hand or something like that. The verbal instructions therefore already match a composite, but identifiable motor schema. By contrast, when watching a movement in order to imitate it, the observer does the matching.

It seems likely that, when you look at another person with the intention to imitate his or her movements, at first only a global motor schema is engaged. If someone demonstrates to you how to operate a machine, you don't have to copy the exact same movements, as long as you get the gist of the actions and know how to achieve the desired goal. If I were to tell you to bend forward and place your hands flat on the ground, you may be able to imagine yourself doing so, but I'm sure there will be readers who will discover to their dismay that they can barely touch the floor with their fingertips if they were to actually try it. So, what matters is that there is a matching *global* schema, such as bending forward, not whether each parameter can be adjusted so that the movement can be copied in every minute detail.

One of the attractive aspects of the motor schema concept is that it can be formalized in the form of a computer model. A popular method in computational studies to represent movements uses a combination of so-called inverse and forward models (e.g. Wolpert and Ghahramani 2000). 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 a forward model predicts how the pointer will move if the mouse is moved; an inverse model forms an estimate of how the mouse should be moved so that the pointer moves in the desired direction. It has been conjectured that forward models could compensate for delays in sensory feedback, anticipate and cancel out the sensory effects of self-produced movements and transform the errors between the desired and actual outcome of a movement into the corresponding errors in the motor command. For instance, one reason why you cannot tickle yourself may be that the effect of the action is cancelled out by a forward model (Blakemore et al. 1998).

The inverse and forward model framework can be extended to account for the imitation of movements (e.g. Blakemore and Decety 2001; Jeannerod 2001; Wolpert et al. 2003). To see how, it may be instructive to once more go back to the example of a choreographer demonstrating a movement sequence to a dancer and interpret it in the context of forward and inverse models.

When the choreographer performs the movement, along with the motor commands that innervate the musculoskeletal system, copies of the motor commands are fed into the corresponding forward models, which simulate the sensory consequences of the movement. These predictions can be compared with visual and proprioceptive feedback and used to update the movement in real-time or to improve its future performance. When the choreographer watches the dancer imitate the movement sequence the relevant inverse models are run 'off-line', without acting on the musculoskeletal system, and their output is sent directly as input to the corresponding forward models. The output of the forward models is now compared with the visual feedback in the form of the dancer's movements, rather than proprioceptive feedback.

If you read carefully you may have noticed that I only spoke of observing in order to imitate. I did so for a reason, since I believe that attention determines which motor schemas, if at all, are engaged when one observes another person's actions. For example, when looking at a grasping movement you can focus on the arm and on the hand. When looking at a guitar player you can focus on what either the left or the right hand is doing, but to reproduce the sounds you need to be able to move both hands concurrently. The choreographer in my example may have observed that on her first attempt the dancer got most of the global shape of the movement right, but missed out on some of the finer details as well as the movement's speed and flow, just as he himself realized he had forgotten to imagine what the left arm should be doing.

In recent years an increasingly popular view, held by numerous researchers, is that a comparable motor representation is activated *whenever* one watches another person move, regardless of whether it is one's intention to imitate the movements or not. Some authors even go so far as to claim that motor representations constrain or bias visual perception (e.g. Viviani and Stucchi 1992; Prinz 1997; Hommel et al. 2001; Jeannerod 2006). Perhaps the best known exponent of this view is the motor theory of perception, according to which the motor commands associated with speech production are also engaged during speech perception (Liberman and Mattingly 1985). A much cited experiment in support of this view is a peculiar phenomenon that has become known as the McGurk effect (McGurk and MacDonald 1976). If a video of a person pronouncing the sounds ‘ga, ga, ga’ is combined with a sound recording of a person saying ‘ba, ba, ba’ what is heard is ‘da, da, da’, suggesting that both visual and auditory modalities are integrated into a single percept. The effect is quite amusing, and I encourage you to look up some sample videos on YouTube. Whether this single observation supports the view that speech perception recruits the motor regions associated with speech production is another question.

To summarize, we can distinguish two hypotheses. The first hypothesis is that watching people move involves a form of motor imagery, which amounts to the co-activation of both visual and motor regions. Let’s call this the weak hypothesis. This is essentially what John Martin (1939) proposed. The second hypothesis is that the processing in motor regions modulates the processing in visual regions and that the perception of human motion is influenced by our own motor experience. Let’s call this the strong hypothesis. To support the first, weak, hypothesis, we will need evidence that the brain does in fact engage in motor imagery when people watch other people move. Lacking that, we would need at least evidence for the involvement of motor regions during action observation. Since we cannot look inside other people’s minds this may be the best we can do. To support the second, strong, hypothesis, we would need evidence that motor regions are activated during action observation, project to visual or sensorimotor regions and bias people’s perception. I am afraid that I will have to bore you with a rather technical discussion, but as we shall see, contrary to the current mainstream in cognitive neuroscience, the evidence for both the strong and the weak hypothesis is slim, so bear with me.

4.3 MOTOR SIMULATION 2. THE EVIDENCE

A curious aspect of the perception of human motion is that people have been shown to be able to recognize acquaintances and even themselves from a point-light display of their movements. In fact, in one of the studies that reported this finding the participants, six students from the Newark campus of Rutgers, The State University of New Jersey, were even better at recognizing themselves than their friends (Loula et al. 2005).[29] Apart from dancers and actors most people don’t often see themselves moving. Presumably then one’s familiarity with one’s own body movements stems from a first person perspective. On the other hand, how often do you need to see something to recognize it later on? Perhaps seeing yourself a couple of times in a lifetime is enough to be able to recognize your own motor style. Apart from that, when moving around you *do* see yourself, except that it’s not

[29] An earlier and much cited study made the same claim (Beardworth and Bukner 1981), however the findings were barely statistically significant. Admittedly, the number of participants in the study by Loula et al. (2005) is nothing to write home about either. As I commented in the introduction this is a general problem in cognitive neuroscience and experimental psychology and worth keeping in mind when interpreting the results.

the same angle as when you see yourself on video. It is also worth observing that recognition rates were higher for dancing, boxing and playing Ping-Pong than for frequently performed actions such as walking and running. Of these dancing was the most easily recognized. This need not be surprising since there is more idiosyncratic content in dancing than in walking.

These findings are often cited as support for the hypothesis that one's motor competence biases perception. A problem with this experiment is that it is based on a small number of participants and a combination of a forced choice design and an inter-subject design. The participants had to choose whether a clip represented a friend, a stranger or themselves during the 2.5-second interval between two clips. They each watched a total of 180 clips in which one of three actors performed six versions of each of the ten actions included in the experiment. It is therefore not impossible that the participants learnt to recognize themselves during the experiment through the constant comparison with a limited set of displays of other people. The authors did not test for improvements in recognition.

Another much cited study in support of the view that motor knowledge constrains perception, makes use of a phenomenon called apparent motion. If two pictures, one with a circle on the left, the other with a circle on the right side, are rapidly interchanged, the circle appears to be moving from left to right and vice versa. One study reported that if the two pictures are of body positions, for example, one in which a hand is held on one side of the knee and one in which it is held on the other side, and if the interval between the two frames is long enough, the hand is seen moving *around* the knee, that is, along an anatomically feasible motion path, rather than along a straight line through the knee, which would be the shortest path (Shiffrar and Freyd 1990).

In the actual experiment nine Cornell undergraduate students 'were asked to view the alternating photos and then to indicate which path(s) of motion they experienced, if any. (..) The answer sheet consisted of simple line drawings of each of the stimuli with two possible paths of motion diagrammed. One path, labeled "A", was always the shortest possible path and physically impossible given the solidity and/or joint constraints of the human body. The other longer path was physically possible and was always labeled "B"' (Shiffrar and Freyd 1990: 260). However, a forced choice paradigm does not allow the conclusion that this is what is *seen* in real-time. The authors claim that their results show that 'at longer time intervals subjects were more likely to report seeing limbs move around a body rather than through it' (idem: 261). Yes well, that was the question they asked, but it does not follow that people actually *see* the limb moving along a certain path. The authors just took it for granted that, if this was the answer the participants selected, then this is what they saw. In fact, there are many anatomically feasible paths. The authors did not present the participants with four different paths, one describing a flat parabola, the other describing a peaked parabola, another describing two straight lines and so on, which would have forced them to select a more accurate description of what they allegedly perceived.

The experiment is easy to replicate and I encourage you to do so to see for yourself whether you agree with the findings by Shiffrar and Freyd (1990). I myself don't. All I see are rapidly switching body positions. I don't see the hand moving around the knee, the head, the torso or wherever it is held. I know that my self-report does not count as scientific evidence, but *neither* does the study by Shiffrar and Freyd (1990).[30] Casting the experiment in the form of a forced choice paradigm only creates the illusion that the study is scientific, because the authors can create some graphs and calculate some fancy, but meaningless statistics. It does not alter the fact that there is no way that one can measure what a person *sees*. Sure, if a person evades a ball thrown at her you may infer that she saw it coming, but that still doesn't tell you what she saw. A ball? A blob? An unidentified flying object? Perhaps I should add that I would like the findings to be true, because it would greatly help my argument, but as I see it, the study is seriously flawed.

If the brain regions that are activated when one performs a movement are the same as those that are activated when one observes a movement, one would expect movement observation to facilitate the execution of a similar movement, and to interfere with the execution of a different movement. This is indeed what has been found in various experiments (e.g. Brass et al. 2001; Kilner et al. 2003). In one experiment participants made arm movements while watching another person making the same or a different movement (Kilner et al. 2003). There was a significantly greater variance in the executed movements while participants watched incongruent movements, suggesting that observation interfered with execution. Now, I won't dispute these findings, but I do wonder whether this isn't just an experimental artefact. If action observation does indeed interfere with action execution one would expect massive interference in a gathering of deaf persons all speaking sign language or between dancers performing a choreography. It may well be that there is some interference, but in everyday situations its effects are minimal.

If motor knowledge biases perception, then learning a novel movement should enhance its recognition. To test this hypothesis one experiment required the participants to report whether they perceived two point-light displays of human motion as identical or not (Casile and Giese 2006). In the next stage the participants were blindfolded as they learnt one of the movements in the point-light display through verbal and haptic feedback. Their movements were recorded on film and transformed into a point-light display and matched with the original displays so as to assess how well the movements had been learnt. It was found that, when they watched the original point-light displays anew, the participants were better at discriminating the learnt movement. The authors also found a (positive) correlation between how well participants had learnt the movement and his or her performance in the visual discrimination task. The authors claim that their experiment 'demonstrates a direct and highly selective influence of motor representations on visual action perception, even if they have been acquired in the absence of visual learning' (Casile

[30] I don't see any point in formally replicating the experiment, because I consider the experimental design flawed.

and Giese 2006: 72). But does it? There are no tests available to determine where in the brain visual perception occurs. I would even go so far as to say that the whole notion of perception occurring somewhere in the brain is meaningless. The fact that people perceive something does not mean that somewhere in the brain there is a matching representation or 'percept'. An alternative interpretation of this and other experiments purported to show that motor representations 'invade' brain regions involved in visual perception, is that both are co-activated in what is essentially a working memory task. The actual matching may happen in a third region, sustained by ongoing projections from a network of regions each subserving a particular subtask.

To investigate the effect of motor knowledge on brain activity during action observation Calvo-Merino et al. (2005) compared the brain activity of professional ballet dancers and professional capoeira dancers as they watched short 3-second videos of each other's movements. They found greater activity in a number of brain regions, when dancers watched videos of movements in their own style, including the premotor cortex, the intraparietal cortex, the right superior parietal lobe and posterior parts of the STS. To rule out the possibility that the findings were the result of visual familiarity, in a follow-up study the authors compared the brain activity of male and female ballet dancers as they watched short clips of standard gender-specific movements from the ballet vocabulary (Calvo-Merino et al. 2006). The idea behind the experiment was that both male and female dancers are equally visually familiar with all movements, because they take class together, but they don't perform all movements, at least not with the same frequency. The authors reported greater activity in the left dorsal premotor cortex, the inferior parietal sulcus and the cerebellum when dancers watched short clips of their own gender-specific movements.[31] These findings therefore suggest that the brain activity when watching dance is influenced by the acquired motor skills of the observer.

While the experimental design is certainly innovative I remain unconvinced that these findings are not a result of visual familiarity. When viewed from above or below even

[31] I find these results slightly puzzling though. If we assume that none of the three groups of movements are known, at first one would find no activity, as in the control group in the first study (Calvo-Merino et al. 2005). If we assume that a motor representation is formed during learning and if a motor representation is associated with activity in a number of brain regions, after learning one would expect to find some activity in those regions for both the gender-specific and the common moves. The assumption behind the study is that ballet dancers have undergone such training. If we now subtract the activity for the common moves from the activity for the gender-specific moves, for which other-gender brain activity would be zero (or random) since it has not been learnt – again this is the assumption – one would expect negative figures when dancers watch movements of the other gender. This is indeed what the authors report. The curious thing is that they also report greater activity when dancers watch movements of their own gender. The effect is most pronounced for male dancers. The authors actually see this as the most relevant result, and are surprised that the effect is not as clear in female dancers (actually near zero). The only way to obtain this result is if the activity for gender-specific (male) movements in male dancers is greater than for common movements. It is unclear why this should be so when both gender-specific and common movements are equally well learnt.

familiar movements are hard to recognize. Indeed, many three-dimensional objects are difficult to identify when viewed from an odd angle. Years ago I played around with a trial version of *Life Forms*, the software package used by Merce Cunningham, but I refrained from purchasing a full copy, because I found it cumbersome to work with. The reason is that, in the absence of visual anchors, it is easy to lose track of which direction an arm or leg is moving, especially if you accidentally rotate the working space. The company still exists, so if you feel like doing an experiment, download a copy, choreograph a couple of movements and drag your avatar around to view it from every odd angle. I predict that, depending on the angle of view, you may not even recognize which direction an arm or a leg is pointing. The fact that the movement is part of your motor repertoire will be of little help in recognizing the movement.

To summarize, the evidence for the strong hypothesis that the perception of human motion is influenced by one's own motor experience, is less conclusive than many authors would like to believe. The same is true for the weak hypothesis that the perception of human bodies in motion leads to the co-activation of both visual and motor regions. There is, however, a whole family of experiments that I have not discussed yet.

4.4 MIRROR NEURONS

When I first read about the discovery of mirror neurons, long before the media hype that erupted several years later, I instantly recognized their potential relevance for an understanding of dance. In recent years my enthusiasm has waned considerably, but I'll come back to that later. One reason for my initial excitement was that mirror neurons might solve the correspondence problem by way of a direct mapping of observed movements onto a motor program. From here it is only a small step to the hypothesis that mirror neurons are also activated when a spectator watches dance (Hagendoorn 2002; 2003b; 2004b).[32] In taking all these small steps we have, in fact, made a big leap, so let's retrace our steps to where we started.

As is by now well-known, in 1992 a group of Italian neuroscientists reported the discovery of a class of neurons in area F5 of the premotor cortex of the macaque monkey (*Macaca nemestrina*) that responded both when the monkey executed an object-directed movement, such as grasping a piece of food, and when the monkey observed the experimenter performing the same movement (di Pellegrino et al. 1992). A follow-up study several years later systematically probed the properties of these neurons (Gallese et al. 1996). It was found that some neurons, which the authors referred to as 'canonical' neurons, discharge only during the execution of an object-directed hand movement, while others discharge both during execution and observation of the same object-directed movements, which the authors coined 'mirror neurons'. It might have been better to call

[32] For the record, these papers were originally written around 1999. I updated the references and rewrote some passages prior to publication in their current form.

them bimodal or sensory-motor neurons, since they do not actually *mirror* anything. The actions were limited to grasping, placing, holding and touching and moving an object with the fingers. The neurons did not respond to the sight of an intransitive movement or if a grasping movement was mimicked in the absence of an object. For instance, a 'grasping neuron' fires when the monkey grasps a piece of food from a tray and when it sees the experimenter grasp the piece of food. Even though it has been interpreted as such, it does not follow from this experiment that it is the *movement* to which the neurons respond.

If we turn to the actual numbers reported in the original paper (Gallese et al. 1996), out of the 532 neurons tested, 92 were found to have the 'mirror' property, 29 of which were categorized as 'strictly congruent', in that 'the effective observed and executed actions corresponded both in terms of general action (e.g. grasping) and in terms of the way in which that action was executed (e.g. precision grip)', while 56 neurons were categorized as "broadly congruent" in that 'there was a link, but not identity, between the effective observed and executed action' (Gallese et al. 1996: 601-2). These numbers were aggregated over two monkeys so that, strictly speaking, any percentages derived from these figures cannot be translated to a neural population in a single monkey brain. It is worth keeping in mind that only 17% of recorded neurons in area F5 of the monkey ventral premotor cortex were mirror neurons.[33]

So far three other neurophysiological studies have reported on hand mirror neurons (Umiltà et al. 2001; Kohler et al. 2002; Fogassi et al. 2005), while one study investigated mirror neurons for mouth movements (Ferrari et al. 2003). In one of these studies 220 neurons were recorded in area F5 of two monkeys (119 neurons in monkey 1 and 101 in monkey 2). The authors reported that of the recorded neurons, 103 (47 out of 119 in monkey 1 and 56 out of 101 in monkey 2) discharged both during hand actions made by the monkey and during observation of similar actions performed by the experimenter (Umiltà et al. 2001). Another study reported that 63 of a total of 497 recorded neurons in three monkeys discharged both when the monkey performed a hand action and when it heard the associated sound such as crushing or ripping (Kohler et al. 2002).

Looking at these data it is again worth noting that a large number of neurons in the selected brain region are not mirror neurons. It should also be observed that these recordings do not say anything about what *causes* the neuron to discharge, or about its *effect* on the neurons it projects to. The recordings only measure a correlation between the monkey's behaviour and the firing of a neuron. For example, the discharge of a mirror neuron during observation does not actually prompt a movement. A study which used fMRI in monkeys to probe the brain regions activated during action observation found that the area in which mirror neurons were originally discovered responded only when a video clip showed the experimenter performing the action in full view. Observation of an isolated

[33] I am aware that, to be consistent, I should mention the number of neurons, participants and so on, for every experiment I refer to. Mirror neurons may be unique in that, in the years since their discovery, an enormous amount of speculative papers have built on a relatively small sample.

hand grasping an object did not result in any activity (Nelissen et al. 2005). This finding therefore reveals another implicit condition in the original experiment.

Turning to the human brain, contrary to what might be thought going by the vast number of publications that mention mirror neurons, there is as yet no direct evidence for the existence of mirror neurons in the human brain. The reason is that there are currently no single cell recordings of neurons in the human equivalent of monkey area F5. There is a growing body of literature, which claims to provide indirect support for the existence of a human mirror system in the form of neuroimaging studies using various experimental paradigms. Several critical reviews have recently questioned whether any of these experiments do indeed provide evidence for a human equivalent of the mirror neurons reported in the monkey (Dinstein et al. 2008; Hickok 2008; Turella et al. 2009) and even some early advocates have become more cautious in their claims (e.g. Arbib 2010).

Neuroimaging studies aiming to identify the brain regions that form the basis of a human mirror system typically assume that if a certain brain region is activated both when a person observes a video of a movement and either imitates or subsequently performs the same movement from memory, it probably represents 'mirror activity'. This methodology does not discriminate between 'mirror neuron activity' and other task relevant processes, such as visual motion perception, working memory, movement planning and so on. Consequently, it cannot tell us whether the activated neurons are indeed mirror neurons. Furthermore, most neuroimaging studies report many regions that exhibit greater activity during either the imitation or observation condition beyond the regions found in the monkey studies. Since it has not been investigated it is of course possible that other regions in the monkey brain are also bimodal. Indeed, perhaps the novelty of the original findings lies in the fact that all previous studies had probed the neurons under investigation with only one class of stimuli.

It is also worth recalling that a typical single voxel in an fMRI study at a resolution of 3T or 4T, the resolution used in most neuroimaging studies, reflects the activity of *millions* of neurons or their synaptic inputs. Taking into consideration that only a small percentage of recorded neurons in the monkey premotor cortex were mirror neurons and that other neurons were either canonical neurons only activated during action execution or neurons whose properties are unknown, the activity found in a neuroimaging study cannot be attributed to mirror neurons. It should also be noted that electrophysiological studies and fMRI studies measure different signals. The BOLD signal measures changes in cerebral blood flow and oxygen consumption, whereas single cell recordings measure electrical activity (☞ §B.3). As Logothetis (2008) points out, the BOLD signal may reflect neuromodulation more than the changes in the spiking rate of a set of neurons measured in electrophysiological studies.

In one of the first neuroimaging studies to investigate the neural correlates of imitation in humans, twelve right-handed participants, nine male and three female with a mean age of 25.42 years[34], were requested to observe and immediately imitate the observed finger movements, to perform the same movements upon receiving a spatial or symbolic cue and to just watch some random finger movements (Iacoboni et al. 1999). The study revealed increased activity in the pars opercularis of the inferior frontal gyrus (BA 44) and the right anterior parietal cortex. These findings were instantly hailed as evidence for the existence of a human mirror system, also and especially, since Broca's region had been conjectured to be the human equivalent of monkey area F5. A subsequent study, which replicated the original experimental design, failed to find increased activation in the inferior frontal gyrus (Jonas et al. 2007). Various other studies using a different experimental set-up also failed to find activation in Broca's area (e.g. Makuuchi 2005). As observed by Makuuchi (2005), in studies examining the neural correlates of imitation, participants are typically asked to first observe and then perform the observed movement. In this case the video may serve as a cue to reproduce a motor program rather than as a visual description of the movement to be imitated.

Mirror neurons found in macaques do not respond to pantomime, but only if a movement is object directed. Strictly speaking neuroimaging studies that use an imitation paradigm therefore measure something else entirely. As various authors have observed, macaques do not imitate, or at least not to the extent that humans do, and so mirror neurons cannot form the basis of imitation. Since humans can and do imitate any explanation for this capacity must originate elsewhere in the brain. As Hickok (2008: 1234) puts it, 'the species that has been shown to possess mirror neurons does not, to our knowledge, possess any of the higher-order cognitive processes [that have been ascribed to mirror neurons], and the species that possesses the higher-order cognitive processes has not been shown conclusively to possess mirror neurons.'

Numerous articles and books speak of mirror neurons and the human mirror system as if it is an established fact that there is such a thing as a human mirror system. Advocates of mirror neurons might point out that, even if there is as yet no conclusive evidence for the existence of mirror *neurons* in humans, many experiments do support the notion of a human mirror *system*. Leaving aside differences in methodology and experimental design, a meta-analysis[35] of 20 neuroimaging studies (Molenberghs et al. 2009) did reveal a network of brain regions commonly involved in imitation tasks, comprising the superior parietal lobule (BA 7), the inferior parietal lobule (BA 40) and the dorsal premotor cortex (BA 6). It would be premature to refer to these brain regions as 'the' mirror system though, as it is not yet known how these regions are interconnected and what the input and output of each of these regions consists in.

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[34] It never fails to amuse me how cognitive neuroscientists and experimental psychologists like to create the illusion of scientific accuracy by mentioning numbers with two or three decimal places, especially when, as here, the information value of the decimals is nil.

[35] Recall that the statistical validity of such meta-analyses is disputable since it is based on published studies. The only proper test is and remains a large randomized sample.

As Hickok (2008: 1236) observes, 'it would be surprising, maladaptive even, if all observed actions resulted in the activation of the exact same motor program in the observer. Indeed, most sports would be impossible to play, as the observation of an object-directed action (throwing a ball) would result in the activation of the same action in the observer when a very different action is required (catching or blocking).' It should be mentioned though that some patients with a frontal lesion show precisely this tendency. They automatically and compulsively copy the movements of another person (Lhermitte 1986). If the person seated in front of the patient raises his arm or scratches his head, the patient instantly performs the same action. It seems as if in these patients the mechanism that normally inhibits 'motor resonance' is impaired. The severity of the condition varies from patient to patient and depends on the location and extent of the lesion. Some patients have a more latent imitative response tendency, which is only revealed in experimental tasks (Brass et al. 2003). These findings suggest that there is a mechanism that facilitates mimicry and another mechanism that blocks its output.

4.5 CONCLUSION

I warned you that this chapter would be hardgoing. Let's go back to how we ended up here. We started from the observation that a choreographer can imagine a movement sequence, perform it and ask his or her dancers to imitate it. The dancers need to remember the movements and figure out how to perform them. This means that, behind the scenes, the brain needs to translate the visual signals into the motor commands that will enable the reproduction of the movements. Various authors have proposed that this translation process happens automatically whenever one observes human movement and that the process is bidirectional. As I have argued, despite a flood of papers there is little experimental evidence to support these claims. Each of the experiments often quoted in favour of a link between action execution and action observation can be given an alternative interpretation. The current evidence for a human mirror system does not survive closer scrutiny either.

The purpose of the present inquiry, let us not forget, is to gain a better understanding of dance and of the neural and psychological mechanisms that shape dance as a performing art. In fact, dance provides a reason to doubt some of the more speculative claims currently made by mirror system proponents.

So far all experimental studies probing the neural concomitants of action observation in humans are based on a single actor performing a single, simple movement. But what about scenes with multiple actors, such as duets, trios and group scenes? There are many situations in dance and in everyday life in which multiple people move in multiple directions within one's field of view. In a typical group ballet such as *The Second Detail* (1991) by William Forsythe at any one moment there may be twelve or more dancers performing different movements each of which derives from the ballet vocabulary. If you're lucky to have an orchestra seat in the middle of row ten or a seat on the first row of the first balcony, you will be able to capture the entire stage in your field of view. Does that mean that for each movement a motor representation is engaged? Is the perception of all these movements simultaneously subserved by entire populations of mirror neurons encoding all kinds of movements? But then there might be many conflicting motor representations since one dancer may be doing a *croisé devant* while another does an *arabesque* and the legs and arms might be pointing in opposite directions. I'm not saying that this isn't possible, you can also perceive many different colours simultaneously, but the idea was that there is an overlap in the motor representation for planning, observing and executing a movement. It would be more efficient and more parsimonious to assume that busy scenes are encoded purely in visual rather than motor terms. But why would there be any difference between quiet and busy scenes? Again, it is more parsimonious to assume that both scenes are processed by the same system, rather than having to assume that the mirror system switches on whenever there's only one person.

Another implicit condition in most studies investigating the link between action and perception is the speed with which actions are performed. Some studies have adopted a 'finger lift' paradigm to study the neural concomitants of imitation. This might show that a particular part of the brain is activated both when a person lifts a finger and sees another person lift a finger. Now a piano player lifts his or her fingers many times, yet I doubt whether a motor representation is formed for every single movement when you watch a television registration of a piano recital every time the camera zooms in on the player's hands.

Obviously, the activation of mirror neurons depends on the presence of the relevant body parts. Belly dancers and striptease dancers can move their breasts both symmetrically and individually. As a man I wouldn't know which muscles to activate since I don't have breasts. The Italian artist Francesco Vezzoli created a video installation, *The Return of Bruce Nauman's Bouncing Balls* (2006), in which a nude actor filmed from behind while standing forward bend in a mountainous landscape, bounces his balls while a Mozart soundtrack plays in the background. I wouldn't know which mirror neurons in a woman's brain would be activated while watching this hilarious video.

It is also unclear how mirror theories account for novel movements and movements not part of one's own motor repertoire. Blake and Shiffrar (2007: 63) claim that the evidence from neuroimaging studies which show that visual perception of human movement is accompanied by activation of motor regions, 'substantiates the idea that what we see depends, in part, on what we can do'. They do not say in which part, but this claim is absurd and makes me wonder whether the authors have ever seen a dance performance or movies such as *Crouching Tiger, Hidden Dragon* or *The Matrix*, in which human characters perform movements that are beyond ordinary human capabilities. Seeing depends on the processing of visual signals, not on what one can do.

Imitation requires that a person understands the other person's intention and that she intends to reproduce the other person's behaviour. Mirror system advocates claim that the mirror system forms the neural backbone for the understanding of actions and intentions (☞ §27.1). But the same movement can have multiple goals. When asked to imitate a movement a dancer might ask what she is required to imitate. The shape of the movement? The speed with which it is performed? For instance, I can demonstrate the intensity of a movement with my hands and arms, which the dancers then imitate with their full body and a totally different movement.

Finally, studies that adopt an imitation paradigm fail to discriminate between different instances of the same motor task. Consider the task of kicking one's leg as high as possible. Surely there is a difference between an ordinary, untrained person and a dancer doing so. There is even a difference between male and female dancers and between most dancers' left and right leg. Since the instruction is identical the neural activity pattern at the planning stage, which is supposed to be mediated by the premotor cortex, is also likely to be similar. Yet the dancer will reach much higher and keep her leg stretched and so the resulting movements are different. The motor representation for bending forward is also likely to be to the same across trained and untrained persons. Yet the ballet dancer will instantly place her hands on the floor, whereas an untrained, slightly obese 34-year old software architect may not even reach the floor with his fingertips.

The goal of science is to discover truths about the world. Scientists develop theories and advance hypotheses and they collect data to test their theories and hypotheses. More often than not it turns out that one's theory is falsified. This is no reason to instantly throw the theory into the bin. Perhaps one's hypothesis only applies under certain circumstances. The hypothesis that the brain engages in motor simulation when one watches a movement unfold is too good to be false. After all, the dancer in our example *did* imitate the movements of the choreographer and doing so requires a mapping of the movement's visual properties onto the relevant corresponding motor schemas. And so, rather than providing counter-evidence the above observations point at some of the conditions that need to be met for the brain to exhibit 'mirror activity'.

First, the movement has to be known, that is, it should be possible to map the observed movement onto a global motor schema that one has previously acquired. *Second*, one should pay attention to the relevant movement. If only one identifiable movement is visible, as in the studies by Calvo-Merino et al. (2005; 2006), it will automatically capture attention. If more movements are visible, whether of multiple bodies or multiple limbs, only a motor representation for the movement one attends to may be formed. *Third*, for the movement's kinematics to capture attention it has to be performed slowly, but not too slowly or else you observe a pose and not a movement. This is why in dance, if dancers learn an existing choreography, they start with the kinematics or shape, and once they know the movement, they speed it up or slow it down. *Fourth*, since most movements have a sequential and hierarchical organization it should be possible to parse the movement into discrete chunks. When asked to imitate a movement sequence from a video dancers usually stop the video several times in order to decompose the composite movement into distinct motor schemas. *Fifth*, the movements should be visible from a canonical perspective. Seen from above or below the movements may not be recognizable. Each of these conditions can be experimentally tested, since each condition represents a null-hypothesis of no 'mirror activity'.

Now what of the theory advanced by John Martin that watching dance involves a form of 'inner mimicry' or 'kinaesthetic empathy'? It should be clear that there is as yet no experimental evidence to support it in the form Martin originally formulated it. However, I believe that, in a modified form, part of the theory can be saved.

Taking into account all of the above, I would like to propose that, when watching dance just for the sake of watching it and so without the intention to imitate the movements, the steady stream of movements activates *fragments* of motor schemas, *not* a template of an entire motor sequence, unless it corresponds to a known movement, is short in duration, low in complexity and performed in isolation. One moment a leg movement of one dancer might trigger the activation of a corresponding motor schema, while a moment later an arm movement of another dancer might trigger another motor schema. This is why I once proposed that watching dance immerses the observer in motor imagery (Hagendoorn 2002; 2003b; 2004b).

The only evidence in support of this hypothesis is as yet anecdotal. When a person leaves the cinema or gets up from behind his television after being exposed to more than an hour of martial arts he or she may feel like performing the onset of a karate move, because at this moment the proverbial gates that prevented activity in premotor and motor regions from innervating the muscles are opened and some motor signals leak out. I am aware that this account is entirely speculative, but I've always found it amusing that children start doing karate after watching a martial arts movie and are hopping around during the interval of a dance performance. Social conventions make adults more restrained in this respect, but they may secretly desire to do the same. In the privacy of their living room they may lose all inhibitions. Perhaps it might be possible to formalize this notion in the form of an experiment and 'prime' the participants to perform certain movements.

Whether motor simulation involves the activation of mirror neurons or a mirror system is a matter of contention. I am well aware that this is a minority view. I should add once more that I would embrace any evidence for the existence of a human mirror system, as it would make for a good coherent story, but for the moment I am sceptical. I will have more to say about the mirror system and some of the claims it has been alleged to support when I discuss understanding (☞ §27.1) and empathy (☞ §21).

KEY POINTS

☞ ‘When watching dance the steady stream of movements activates *fragments* of motor schemas, *not* a template of an entire motor sequence, unless it corresponds to a known movement, is short in duration, low in complexity and performed in isolation.’

☞ ‘The experimental evidence does not yet support the hypothesis that the perception of human bodies in motion leads to the co-activation of both visual and motor regions and that the perception of human motion is influenced by one’s own motor experience.’

☞ ‘Even though the experimental evidence is as yet inconclusive the question is what else could happen inside the brain when people imagine themselves moving if not the activation of the same motor regions that are also engaged when people plan or execute a movement.’

☞ ‘Imitating a movement requires a mapping of the movement’s visual properties onto the relevant corresponding motor schemas. A lot of experiments notwithstanding it is still unclear which brain mechanisms facilitate this capacity.’

☞ ‘It seems likely that, when you look at another person with the intention to imitate his or her movements, at first only a global motor schema is engaged.’

☞ ‘There is as yet no experimental evidence to support the claim that the pleasure one might derive from watching dance is grounded in some form of kinaesthetic empathy.’

☞ ‘Contrary to what might be thought going by the vast number of publications that mention mirror neurons, there is as yet no direct evidence for the existence of mirror neurons (or a mirror system) in the human brain.’

5

PERCEPTUAL ORGANIZATION

When I first gave some lectures about dance, aesthetics and the brain, to convince the audience that cognitive science has something to contribute to our understanding of dance and choreography I showed some images illustrating some of the principles of perceptual organization first formulated in the 1920s by the psychologists associated with the Gestalt school of psychology.

One of the central concerns of the Gestalt psychologists was how we perceive order in the chaotic stream of data registered by the sense organs. To answer this question the Gestalt psychologists formulated various laws or principles that describe the ways in which the elements in a visual scene tend to be perceived as organized. For example, the dots in figure 6.3 A are of equal size, shape and colour and are equally spaced in the horizontal and vertical directions. If the vertical distance between some of the dots is reduced as in figure 6.3 B the columnar organization will begin to dominate. This is what is referred to as the Law of Proximity, according to which elements close to each other tend to be perceived as a figure. If we change the colour or shape of some of the elements, as in figure 6.3 C and D we again see a vertical pattern emerge. This is an example of the Law of Similarity, which states that similar objects tend to be grouped together.

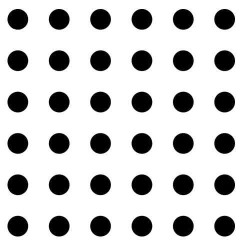

Figure 6.3 A

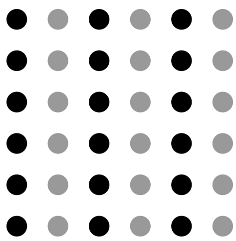

Figure 6.3 B

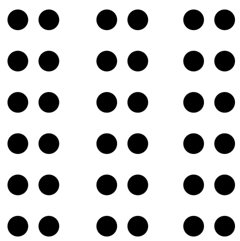

Figure 6.3 C

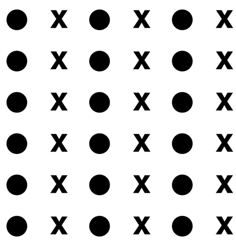

Figure 6.3 D

Each of the above figures resembles a square even if all but the four corner dots are deleted. By rearranging the dots one can create the outline of a triangle, a circle and more complex figures such as a house. This is known as the LAW OF CLOSURE.

If I were to do something as simple as to draw a connecting line between two neighbouring dots as in figure 6.4 A or if I were to draw a line around a number of neighbouring dots as in figure 6.4 B the dots seem to belong together. The latter two examples illustrate two principles that were formulated more recently, a LAW OF COMMON REGION (Palmer 1992) and a LAW OF ELEMENT CONNECTEDNESS (Palmer and Rock 1994).

Figure 6.4 A

Figure 6.4 B

But why do we instantly perceive these patterns? It is not as if you decide to see it this way or that way. Indeed, as in the case of face, body and speech perception, it is difficult, if not impossible, to see these configurations in an alternative way. Just try to ignore the vertical organization in figures 6.3 C and D. There must be something in the brain that determines that we tend to see some figures one way rather than another.

Perhaps one of the most fundamental principles of perceptual organization is the capacity to distinguish between figure and ground. As I'm typing this I can see my keyboard on my desk, I can see the keys on my keyboard and the characters on the keys. The keys form the ground for the characters, the keyboard forms the ground for the keys and the desk forms the ground for the keyboard. The separation of figure and ground is a function of the perceptual system. That this is so becomes clear when you look at an ambiguous figure such as the famous Rubin vase, which can be perceived as a vase and as two faces looking at each other. If the separation were a property of the retinal image it would not be possible to switch between the two interpretations.

The Gestalt psychologists identified several principles that govern figure-ground organization, such as enclosure, size, contrast, convexity, and symmetry. The two scenes from *No More Play* (1988) and *Stepping Stones* (1991) by Jiří Kylián, which I referred to above, essentially combine figure and ground into an ambiguous configuration. In both scenes the dancers are clearly visible as a figure against a black background. This is because the stage setting in a theatre is typically large and enclosing. Since the arm of the person standing at the back appears in front of the person standing in front, we are temporarily confused as to which limb belongs to which body.

The Gestalt laws only hold *ceteris paribus*, that is, all other things being equal. There is no higher order principle, which says which principle will dominate, if several principles are simultaneously present (figure 6.5 A). The Gestalt psychologists claimed that all laws are governed by what they called the LAW OF PRÄGNANZ, according to which the resulting perceptual organization will be as good or as simple as the stimulus conditions allow. But they did not offer any workable definition of what they meant by 'simple', 'stable' or 'good'. In the special case where two or more principles are combined the grouping effect is enhanced. For example, if figures 6.3 C and D were to be combined the pattern would be even harder to miss (figure 6.5 B). Many appliances have this kind of built-in redundancy. Traffic lights switch colour and position. In some countries pedestrian lights have a triple organization: the red stop sign on top features a standing figure and the green walk sign at the bottom features a walking figure. In China there are pedestrian lights with a quadruple organization, since the walking figure is moving.

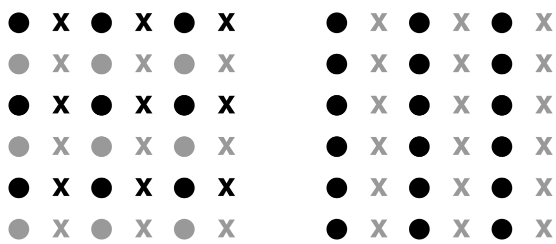

Figure 6.5 A Figure 6.5 B

The Gestalt laws are phenomenological descriptions of what happens in vision, they do not offer an explanation of why these phenomena occur, but as such they can serve as an explanation for phenomena at a higher level of description such as dance. In dance there is a natural perceptual organization across gender lines. If the men all wear trousers and a t-shirt and the women a leotard, as in many works by Balanchine and Jiří Kylián, or a dress, as in the work of Pina Bausch, the contrast between the sexes is enhanced. If the male dancers stand on one side and the female dancers on the other side, any spectator will automatically see a division in two groups. If the male and female dancers stand on a line, man, woman, man, woman, etc. and if the first and the second dancer, and the third and the fourth dancer and so on, hold hands, they will appear to be organized in couples, as in figure 6.4 A.

All of this is fairly straightforward, but once you are aware of these principles you notice how straightforward the organization of many dance performances actually is. In *Sweet Dreams* (1990) by Jiří Kylián four squares are marked out on the stage floor by lighting. In each square a male dancer is lying on the floor. In all but one square a female dancer is standing. Thus we expect that the woman who is standing behind the square in which a solitary man is lying will approach him so as to complete the configuration, as indeed she does. But whereas the other three couples perform the same routine, this couple goes on to perform a different routine. As expected the light changes and their lit square vanishes.

In one scene in *Komm tanz mit mir* (1977) by Pina Bausch a woman is dressed in a red dress, a man in a white suit and a group of men in dark coats and hats. The coherence of the group of men is enhanced by the fact that they stand in line or form a circle and move in synchrony. With very simple means a structure is laid out, which may then be interpreted as a power structure and a battle between the sexes.

Since the Gestalt principles are properties of the perceptual system, a viewer will see a pattern even if it hasn't been intended as such. This can be undesirable since a perceptual pattern that happens by chance can be interpreted symbolically (☞ §27.4). A choreographer may therefore wish to desexualize the body so as to suppress the division across gender lines. The principles that govern perceptual organization therefore work both ways: They can be used to achieve a desired effect, but they can also produce undesired side effects.

The Gestalt psychologists tried hard to formulate similar principles for temporal organization as for spatial organization, but without much success. Perhaps the clearest examples of temporal organization occur in music. When you listen to a piece of music you may hear various rhythms, melodies and a refrain. Of course, each of these musical elements has been composed, but in order to be composed they must be perceived. A melody is a sequence of tones that it is perceived as a single entity. The same melody can be transposed to a different key and it can be played at a faster or slower tempo while still being recognizable. A melody therefore depends on the relationship *between* the elements, not on the elements themselves.

The Gestalt laws are a staple of almost every textbook in psychology or cognitive science, but as a research paradigm Gestalt psychology fizzled out after the 1940s, perhaps because the principles of perceptual organization had been all but exhausted. Surprisingly, the Gestalt laws have so far resisted explanation in terms of more elementary neural mechanisms. It is currently tought that they are an emergent property of how different parts of the brain are organized, but as yet there is no model of the perceptual system that generates them as a by-product.

The art theorist Rudolf Arnheim (1904-2007), who, as a student in Berlin, had studied with Max Wertheimer and Wolfgang Köhler, two of the founders of the Gestalt school, pioneered the application of Gestalt psychology to the arts. Arnheim wrote extensively about the role of unity, balance and other principles of composition. A problem with this approach is that there are innumerable ways to achieve unity or balance, as is evident from a cursory look at the history of art, which may be why his writings didn't catch on. Another reason may be that many people find a Freudian, Marxist or post-structuralist analysis, which focuses on a work's meaning and social context, more satisfactory than a focus on composition.

In recent years there has been a revival of interest in Gestalt principles in art, following the publication of an influential paper by Ramachandran and Hirstein (1999). In their paper Ramachandran and Hirstein propose eight, as they claim, universal laws of aesthetic experience. In short these laws are: enhancement of features that deviate from average (☞ §7), grouping of related features, isolation of a particular visual clue, contrasting of segregated features, a dislike of unnatural perspectives, perceptual problem solving, metaphor and symmetry. The authors concede that 'the notion that art exploits grouping principles is of course not new', but assert that 'what is novel here is our claim that the grouping doesn't always occur "spontaneously"; that out of a temporary binding a signal [is] sent to the limbic system to reinforce the binding, and this is the source of the aesthetic experience' (Ramachandran and Hirstein 1999: 23). The sole claim that perceptual grouping is enhanced by signals originating in the limbic system (☞ §19.3), without specifying how this might occur, is not much of an advance though.

Evidently, contrast, grouping and symmetry are important compositional principles in choreography (Hagendoorn 2004b). Nearly every ensemble scene in the work of George Balanchine, Paul Taylor, Jerome Robbins and countless other choreographers is little more than an exercise in grouping. The third section of Balanchine's *Agon* (1957), a duet for two women, begins with both women moving in perfect mirror symmetry, then changes to perfect synchrony and ends with perfect mirror symmetry. In *IIris* (2004) by the French choreographer Philippe Découflé symmetry is taken to another level as the movements of the dancers are multiplied in cleverly positioned mirrors. But why is one symmetrical grouping better than another? Perhaps the answer is that many groupings are *equivalent* and perhaps this is one of the messages in the work of Balanchine. It doesn't matter if you arrange the dancers this way or that way as long as they form a symmetrical or crystalline pattern.

It is interesting to contrast the work of George Balanchine and Merce Cunningham in this respect. Cunningham's work is as meticulously crafted and rehearsed as Balanchine's. But whereas Balanchine liked to arrange the dancers in all kinds of pretty spatial configurations, Cunningham randomly distributed the dancers across space, sometimes literally, by determining the entries, exits and positions in space with a throw of a dice. In the work of Balanchine the patterns are delivered on a plate; in the work of Cunningham as a spectator you have to actively look for patterns. There is no mistaking the configurations in *Violin Concerto* (1972) or *Agon* (1957), two masterpieces by Balanchine, but if you were to watch two consecutive performances of Merce Cunningham's *Split Sides* (2003) or *Ocean* (1994), on each occasion you may notice different patterns. The work of Balanchine and Cunningham can be taken as exemplary of two different artistic strategies: An artist can either create a pattern or leave it to the audience to discover a pattern.

KEY POINTS

☞ 'It is difficult, if not impossible, to see these configurations in an alternative way. There must be something in the brain that determines that we tend to see some configurations one way rather than another.'

- ☞ ‘The Gestalt laws only hold *ceteris paribus*, that is, all other things being equal. There is no higher order principle, which says which principle will dominate, if several principles are simultaneously present.’

- ☞ ‘In the special case where two or more Gestalt principles are combined the grouping effect is enhanced.’

- ☞ ‘Once you are aware of these principles you notice how straightforward the organization of many dance performances actually is.’

- ☞ ‘Since the Gestalt principles are properties of the perceptual system, a viewer will see a pattern even if it hasn’t been intended as such. The principles that govern perceptual organization therefore work both ways: They can be used to achieve a desired effect, but they can also produce undesired side effects.’

- ☞ ‘An artist can either create a pattern or leave it to the audience to discover a pattern.’

6

THE PERCEPTION OF ANIMACY AND CAUSALITY

In the early 1940s the psychologists Fritz Heider and Marianne Simmel created a short animated movie in which a circle, a small triangle and a big triangle move around a big rectangle with a small opening. If you do a quick search on the internet you are bound to find a copy of the original movie somewhere. Admittedly, it's not exactly Pixar or Walt Disney, but that doesn't matter. When asked to describe the movie people consistently attributed personality traits, intentions and emotions to the moving shapes. They referred to the big triangle as angry and frustrated and to the circle as shy. The big triangle was generally seen as chasing and attacking the circle, the circle as fleeing from the big triangle and the small triangle as protecting the circle. It is in fact quite difficult to describe the film in objective terms. Of course, describing is one thing, perceiving another, but it is hard not to *see* the big triangle as chasing the other two shapes. The experiment demonstrated convincingly that people tend to describe self-propelled moving objects in anthropomorphic terms. It is now considered one of the classic experiments in cognitive psychology.

At about the same time the Belgian psychologist Albert Michotte used even simpler animated movies to study the perception of causality. In its simplest form the experiment consisted of a single frame in which a black circle moves horizontally along a straight line at a constant speed until it makes contact with a grey circle. At this moment the black circle comes to a standstill while the grey circle starts moving in the same direction and with the same speed. When watching the movie people report seeing the black circle as bumping into the grey circle and *causing* it to start moving. Michotte referred to this phenomenon as the 'launching effect'. In his book *The Perception of Causality* (1946/63) he described many variations of his original experiment. In the 'entraining effect' the black circle makes contact with the grey circle after which they move along together at the same speed. In the 'triggering effect' the black circle touches the grey circle, upon which the grey circle is launched at a higher speed than that of the black circle. In the 'tool effect' the black circle is seen as causing the grey circle to start moving by way of an intermediate circle. The effect disappears if there is a spatial gap between both circles or if there is a delay between the moment of contact and the moment the grey circle starts moving.

Subsequent authors have described various other examples of what Michotte referred to as phenomenal causality. If a cluster of objects is dispersed in different directions after being hit by a single object, the single object is perceived as causing the group to disintegrate (White and Milne 1999). If the top figure in a vertical stack of five figures starts moving, followed in descending order by the other figures, the top figure is perceived as pulling the other figures along (White and Milne 1997). I should emphasize that there is no actual causality in any of these examples. They are just animated clips, which create the illusion of causality. If you are familiar with computer animation programs such as Adobe Flash it's easy to reproduce these experiments.

There have also been variations on Heider and Simmel's study of the perception of animacy. One recent study used a game design, which makes it possible to measure the performance of participants, which then provides an estimate of the degree to which the participants perceive animacy. In this study a geometrical figure is seen chasing another identically shaped figure amidst a crowd of identical figures (Gao et al. 2009). In one experimental condition the figures were circles, in another they were arrow like shapes. It was found that the degree to which observers identify the hunter is determined by two visual cues, which the authors term 'chasing subtlety', a measure of the angular deviation from the shortest path connecting the hunter and the target, and 'directionality', which measures the degree to which the hunter is oriented towards the target. The latter is most obvious if the figure is oriented and possesses a head and a tail. The authors concluded that observers failed to *use* the full range of chasing subtlety cues that carry information about the chase, and failed to *ignore* directional cues when they carry *no* information about the chase. You may want to read the previous sentence twice, but basically there was information in the chasing subtlety parameter that the participants didn't use and they erroneously believed some figures were chasing, because they pointed in the direction of what they believed to be the target.

These and other findings suggest that the brain seeks to recover the causal and social structure of the world by inferring properties such as causality and animacy (Scholl and Tremoulet 2000). One would expect causality to depend on higher-level cognitive processing. But people do not *choose* to see any of the above examples this way or that way. This suggests that the inference is reached at an early level in perceptual processing. On the other hand it is not impossible that some causal inferences are made within the milliseconds that it takes for a stimulus to be processed. Besides, it is impossible to draw a sharp dividing line between perception and cognition and so the perception of animacy and causality need not be a function of the visual system.

If people perceive causality and animacy in animated movies with some simple geometric figures in the leading roles we should not be surprised that they also perceive causal relationships in dance, even if the relationships between the dancers have been determined by chance, as in the work of Merce Cunningham, or if the relationships are purely geometrical. In several scenes in *Wälzer* (1982) by Pina Bausch, a dancer starts walking while performing a simple phrase with the hands and arms. She is trailed by the other dancers, who perform the same hand and arm variation. There is nothing to suggest that the first dancer is the leader of the pack – the entire scene was choreographed – and yet she is perceived as leading and the other dancers as trailing.

It is important to observe that attributions of perceptual causality and animacy happen automatically and unconsciously *before* any other interpretive acts. It follows that if we become aware of the rules and principles that guide the attribution of causality and animacy, we may re-interpret our initial and possibly biased response and see the relationships between the dancers or actors in a new light. This then is an example of the *critical dimension* of cognitive neuroscience and psychology that I hinted at in the introduction. By showing that it is our natural inclination to see the world in a certain way, it opens up the possibility to see it differently. Free will exists. We are not slaves of our brain.

I already referred to two possible perceptual rules in the special case of chasing. There also appears to be an asymmetry in attributions of causality (White 2006). Causes are typically attributed to dynamic events and changes in state. One doesn't usually say that the bookend causes the books to remain standing, but one does say that removing the bookend causes the books to fall. Another example of causal asymmetry is that people tend to see the force exerted by the object that has been identified as the cause of an event as greater than that exerted by the object identified as the effect. In general people tend to see the cause of a result as having the greater strength.

Audiences bring to the theatre their own preconceived notions of causality and this will influence how they see the events on stage. People typically think that a dramatic effect must have an equally dramatic cause, but that is not necessarily the case. Chaos theory has taught us that small differences in the initial conditions of a dynamical system can produce large variations in the long-term behaviour of the system. In other words: small causes can have big consequences. This is the infamous butterfly in Brazil that sets off a tornado in Texas. Less prosaic examples can be found in financial markets. People also tend to attribute causes to a known factor regardless of whether there is any basis for doing so. If on a certain day new employment data are made public and if a major stock market index falls, newspapers often write that the index closed x percent lower because of the employment data. A stock market index is made up of between 20 to 500 stocks and prices are determined by supply and demand from numerous market participants. With the exception of market crashes, attributing a minor movement in an index to a single cause is therefore ludicrous.

The asymmetry in the attribution of causality may be a result of how, in some circumstances, cause and effect are determined. If, for example, a moving car crashes into a stationary car, the moving car is typically seen as the cause of the crash. In general we might say that, if one object is in motion and the other is stationary, the moving object tends to be identified as the cause object and the stationary object as the effect object. But what if both objects are moving? White (2006: 133) proposes that in this case objects are distinguished in terms of their kinematic properties: 'when two objects have different degrees of activity, the cause object is identified as the one with the higher degree of activity.' To go back to our example, if one car sways from its course and crashes into a car in the other lane, it will be seen as causing the crash. Knowledge also biases the perception of causality. Consider a crash scene whereby the front of one car has collided with the rear of another car. In this case the car with the crumpled front side is usually seen as the cause, since cars rarely drive backwards into another car.

In the car crash example one would typically say that the effect of car A crashing into car B is not the damage to car B, but the collision, which is something that happens to both cars. As a matter of fact, the collision is but one of the many effects that could be identified. The crash may have caused a roadblock, which may have caused some people to show up late for work and it may have caused the driver to get injured. Had he been wearing his seatbelt he might not have been injured. So in answer to the question of why the driver got injured one might say: 'because he didn't wear his seatbelt'. It follows that what is identified as cause and effect is not just a matter of kinematics, but also of one's practical concerns. Suppose that one of the cars, let's say a Honda Civic, is total loss while the other, a big Mercedes-Benz SUV, is only slightly damaged. In this case people tend to see the heavily damaged car as the effect of the collision and the big, slightly damaged car as the cause. In general, the object that undergoes the greater apparent change is favoured as the effect.

Once one object has been identified as the cause and another as the effect, a causal asymmetry can occur, because the importance of the cause object is overestimated, while the importance of the effect object is underestimated or ignored altogether. Furthermore, once the cause and effect object have been identified the effect of the latter on the former is often neglected (White 2006).

I am aware that this sounds a bit technical and opaque, but for one thing it explains why in the 'launching effect' the (moving) black circle is seen as causing the (stationary) grey circle to start moving. It also explains why the latter is never reported as causing the black circle to *stop* moving. Of course, we can infer that this is what happened, but we don't *see* it as such. When pushing against a wall few people would think of the wall as pushing back, even though this is what Newton's third law implies.[36] Similarly, when pushing a box people don't think of the box as pushing back. After all, it is the box that moves, but of course that is because the mass of the person pushing the box is greater than that of the box, causing it to accelerate away from the person pushing it.

In so far as the dancers are human beings and not animated figures dance is just an exercise in classical mechanics. As I argued above Newton's laws of motion do not correspond to the way people *perceive* causal relations between objects. What is more, when we look at a dance performance we don't see some objects moving around in space. We see *dancers*. We see intentional human beings. Falling, for instance, is unintentional, while kneeling and lying down are intentional (☞ §26.2). To make it seem as if a dancer

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[36] The Third Law states that forces always occur in equal and opposite pairs. If object A exerts a force on object B, an equal but opposite force is exerted by object B on object A.

falls it may be necessary for her to actually fall or else the movements will seem too polished and *unnatural*. It will just appear as if she is lying down. This is because we recognize the kinematic properties of someone who is actually falling as opposed to someone who is merely sinking to the floor.

Pushing, pulling, leaning and supporting are relative terms that describe a relationship between two objects or two persons. In dance cultural traditions and gender roles may define which dancer is seen as active and which as passive. In much classical ballet the male dancer may do a few jumps and turns, but for the most part his role is that of providing support for the female dancer. To this day choreographers seem to be unaware of how they implicitly distribute movements along the lines of gender politics. It is not just the choreographer who may be biased in this respect. The spectator may see things in a certain way regardless of the choreographer's intentions.

In one scene in *Café Müller* (1978) by Pina Bausch a man is standing on stage amidst a sea of chairs, while a woman in a nightgown embraces him, her head leaning against his shoulder. A man in a suit approaches the couple and removes the woman's arms from behind the man's back. He takes the woman's head from the man's shoulder, repositions his head and places them face-to-face. He adjusts both of the man's arms, puts the woman's left arm behind the man's neck, lifts the woman and places her in the man's arms after which he walks away. The woman drops from the man's arms, instantly gets up and embraces him again. The man in the suit returns and the scene is repeated several times. At some point the scene changes and now the man and the woman go through the hold and drop routine without the intervention of the man in the suit. What is going on here? Is the man dropping her? Is the woman letting her grip on him go? Does she fall because the man remains passive? In a way the whole scene is just a play with gravity. Everything that is not explained by gravity, all the questions that it raises and the interpretations that it gives rise to, is what makes it art.

KEY POINTS

☞ 'Attributions of perceptual causality and animacy happen automatically and unconsciously *before* any other interpretive acts.'

☞ 'If we become aware of the rules and principles that guide the attribution of causality and animacy, we may re-interpret our initial and possibly biased response and see the relationships between the dancers or actors in a new light.'

☞ 'Audiences bring to the theatre their own preconceived notions of causality and this will influence how they see the events on stage.'

☞ ‘The way people *perceive* causal relations between objects does not correspond with Newton’s laws of motion.’

☞ ‘To make it seem as if a dancer falls it may be necessary for her to actually fall or else the movements will seem too polished and *unnatural*.’

7

HYPERSTIMULI

Shortly after emerging from its shell a newly-hatched chick of a herring gull begins pecking at the beak of its parent, causing the parent gull to regurgitate food into the chick's open beak. But why does the chick peck at the parent's beak and not at its feet or its body? In the mid 1940s, shortly after the Second World War had ended, the Dutch ethologist Niko Tinbergen began researching this question. Together with his co-workers he constructed a number of models in which various features of the adult gull's head and beak were manipulated. Through trial and error he discovered that the chick responds to the red dot on the tip of the parent's yellow beak (Tinbergen and Perdeck 1950). In the experiments the chick would still peck at a spotless model, but far less vigorously than at a beak with a spot. Varying the colour of the patch revealed that chicks pecked most at a red patch.[37]

It had been known from earlier studies that in some cases an artificial super stimulus elicits an even stronger response. For example, an oystercatcher, when given the choice between a normal sized egg and an artificial model about four times larger, will try to settle upon the fake large egg. In order to construct a supernormal stimulus Tinbergen first decided to vary the width and length of the model parent beak. Through trial and error he found that when the artificial beak was long and thin, chicks responded most vigorously. Having determined that red, contrast, elongation and thinness were the essential factors in attracting a pecking response, Tinbergen took a long, thin red rod and adorned its tip with three white lines. This super beak yielded the highest score of all experiments they carried out. Following Tinbergen stimuli of this type are referred to as supernormal stimuli or superstimuli for short.

Various human cultural artefacts are aimed at a particular capacity for which a special predisposition has evolved. Perfume taps into the capacity for olfaction and portraits, masks, caricatures and make-up tap into the capacity for face recognition. As Sperber and Hirschfeld (2004) have argued, the effectiveness of these cultural artefacts at triggering a response helps explain their cultural recurrence. Some of these artefacts may constitute superstimuli in the same way as Tinbergen's supersized egg and super beak. Make-up, for

[37] The original data showed that chicks pecked more at a model with a black patch, but in the 1950 paper Tinbergen ascribed this to a methodological error and adjusted his data to reflect this error. For a discussion of the publication history of Tinbergen's findings, see Ten Cate (2009). For a replication of Tinbergen's original experiment, which confirms that it is the red dot that elicits the strongest response, see Ten Cate et al. (2009).

instance, enhances the recognition of the eyes, lips, cheeks and face. The reason this works is that cells in the visual cortex respond more strongly to sharp changes in luminance.

Bharata natyam is one of the few dances in which eye movements are choreographed. It is no coincidence that bharata natyam dancers make extensive use of eyeliner and mascara to increase the contrast between the iris, the white of the eyes and the rest of the face. Because of the enhanced contrast, from a distance the face and eye movements are more easily detected under both low and normal lighting conditions. Hand and finger movements are another prominent feature of bharata natyam. Perhaps not surprisingly, sometimes the fingertips are dyed dark red, which may serve to enhance the perception of the hands and fingers. There may be religious motives for this practice that I am unaware of, but from a cognitive neuroscience point of view there are good practical reasons for doing so.

Ramachandran and Hirstein (1999) proposed that art too constitutes a superstimulus in the form of a peak-shift effect, whereby some features are enhanced while others are diminished. It is easy to see how this principle might apply to portraits of the human body. For instance, in cartoons, manga, Indian art and popular culture one finds abundant representations of women with large breasts on the one hand and muscular men on the other. Some forms of abstract art might constitute a peak-shift effect in colour perception. I remember being totally mesmerized when I first saw one of Yves Klein's famous blue paintings. I knew his work from reproductions, but the grain of the paint gives the colour a depth and an intensity that cannot be achieved in print. However, it is not altogether clear if there is a peak shift effect in seventeenth century Dutch landscape paintings or the work of Nicolas Poussin. Indeed, the peak-shift effect may be absent from much of art. If a peak-shift effect were the underlying principle one would expect to find many line drawings and caricatures. Instead, colour photos and paintings are far more abundant than line drawings, black and white cartoons and caricatures.

In an interview Ramachandran (2001) speculated that motion capture displays of biological motion could serve as a hyper-optimal stimulus for brain regions involved in human motion perception and as such could generate a stronger response. As I wrote in the introduction, the stimuli used in neuroimaging studies are usually presented in isolation in highly controlled settings. The reported activity may therefore already represent a peak shift effect. In the case of biological motion studies though, the original idea was to show how *little* information is needed to still observe motion. Point-light displays therefore do not represent a hyper-optimal stimulus but a less-than-optimal stimulus. It is not altogether clear either why an enhanced stimulus would result in a stronger neural response. It could also be argued that, even though a single neuron might respond stronger, at the population level the response should be *weaker* because the neural networks would quickly converge to yield a representation of the scene.

What then would a super normal stimulus in the realm of human motion perception look like? If we take make-up and face perception as an example, it follows that some defining features should be enhanced so that the overall stimulus is more easily recognized. If we go back to the biologically inspired computational model developed by Giese and Poggio (2003), the stimuli should be manipulated in such a way that they create a quick match with both the snapshots of the human body in the form pathway and the corresponding optic flow patterns in the motion pathway.

While it is possible to exaggerate the characteristics of familiar movements such as walking and running and while removing a background does make it easier to detect behavioural sequences, it will be clear that this approach is leading us in the wrong direction. Most choreographed dance performances consist of *novel* movements, body configurations for which there are *no* templates and changes in dynamics that are *not* prototypical. Assuming that the model by Giese and Poggio (2003) is essentially correct, when watching dance the body template in the form pathway would have to be constantly updated and revised, since the image on the retina changes whenever the dancer turns, bends, squats, kneels, lies down and changes the configuration of the body. It is not so much that dancers move at a greater velocity or that they jump higher and elevate their legs more than normal people do, in dance the entire body becomes a field of continuous variation. A computational model would therefore need to do considerably more computations to track a dancing figure than a walking figure. The same would be true of the human brain as well. Accordingly, in my view, dance is not a simpler, but a more complex stimulus, the processing of which is not quicker and easier, but more demanding. It would therefore constitute not a super-stimulus, but a hyper-stimulus.

I should add once more that by dance I don't mean *all* dance forms. Some dance performances lean more towards theatre; others are close to conceptual art. Some dance performances consist of everyday movements, which, for that reason, may constitute a superstimulus. One might say that they reveal the everyday as special. We should also differentiate dance from other activities involving human motion, such as gymnastics, acrobatics and performance art. In acrobatics the emphasis is on the display and exploration of the body's agility. Performance art tests the limits of what a body can endure or seeks to present the body as a physical body devoid of meaning. Gymnastics strives for perfection in the execution of a number of movement exercises. Indeed, one might say that in gymnastics a movement which most closely matches a template is awarded the highest points (☞ §31.1).

There is also an art form which explores the human body in motion and for which there is no better name than dance. There are elements of acrobatics, contortion and theatre in dance and some dance looks like a circus act or an aerobics exercise. I should add that there are also activities which one might label as dance for entirely different reasons, for instance, because they tell a story through movement and not in words (☞§25.2; §27). I never said our inquiry was going to be easy.

There is a sense in which dance *can* be said to constitute a superstimulus. In dance and theatre gestures can be emphasized through lighting effects and by leaving out other visual elements. In so far as the performers appear in isolation, on a mostly empty stage or against a stable background, the figure stands out against the ground and is, for that reason, more easily recognized. In the absence of other stimuli there is more capacity available to process details of the remaining stimuli. Of course, all of this is speculative and it will be a challenge to design an experiment to test it.

Instead of enhancing a stimulus to facilitate or heighten its perception an artist may also mask it so as to suppress, postpone or prevent its perception. It is a perfectly valid artistic strategy to pursue confusion, ambiguity, indifference and boredom (☞ §11). Even though a work can be unsettling independent of the artist's intentions, for example because of adverse lighting conditions, an artist wishing to create a sense of ambivalence will try to perfect the 'stimulus' in much the same way as an artist fine-tuning a work to enhance its visual properties. The same is true of the artist wishing to free his work from any perceptual or emotional biases. To confuse the reader or the spectator an artist would have to create an ambiguous scene that can be interpreted in more than one way. In a dual sense the artist thus needs to know what makes for an easily identifiable scene. One reason Piet Mondriaan sometimes spent weeks or months rearranging lines and colours may lie in the fact that there is no perceptual ground, which favours one composition over another. But this can be interpreted as a *quality* and need not be a source for criticism.

In *Lythic* (1959) by Alwin Nikolais all four dancers wear long, tight, colourful, sleeveless dresses and hats that elongate the body. At times the lighting is such that all you see are black contours. When the dancers put their arms behind their body, their shadows look like some kind of tall vases. If you were to see a single capture from just this one scene you wouldn't know that they are dancers. In one scene in *Liturgies* (1983), another piece by Alwin Nikolais, again the lighting is such that all one can see are the flattened black shadows of the ten dancers. At certain moments the illusion is near perfect: depending on your point of view in the audience what you see are moving shapes. Obviously, none of this happens by chance. Alwin Nikolais carefully manipulated the lighting, the costumes and the movements to achieve the desired effect. His goal was to create a visual illusion or a sense of visual ambiguity, but in order to reach that goal he had to constantly test his own ability to detect faces and bodies (☞§3.1; §3.2).

From the point of view of the person applying make-up it makes sense to do it such that it enhances the perception of various aspects of the face, such as the mouth, the eyes and the cheeks. But why would an observer stop and look at a drawing, a portrait or a mask? Why would anyone buy a poster to decorate a wall in one's living room? Why do people take great care to make sure it hangs straight? Why do people pay to see some people move around on a stage and arrange themselves in different geometric configurations? And why would anyone bother to make the effort to decipher an ambiguous stimulus? Our analysis so far only tells us which mechanisms enable us to perceive patterns in the world around us and how artists manipulate their material in order to enhance or obscure certain perceptual qualities, it does not tell us why people take an interest in complex and ambiguous scenes (☞ §10.2) and why they take pleasure in art in general and dance in particular (☞ §22.1; §29). These are some of the topics that I will address in the next chapters.

KEY POINTS

☞ 'To create a superstimulus some defining features should be enhanced so that the overall stimulus is more easily recognized.'

☞ 'Dance is not a simpler, but a more complex stimulus, the processing of which is not quicker and easier, but more demanding. It constitutes a hyper-stimulus, not a super-stimulus.'

☞ 'An artist wishing to create a sense of ambivalence will try to perfect the "stimulus" in much the same way as an artist fine-tuning a work to enhance its visual properties.'

☞ 'To create an opaque, ambiguous or chaotic scene an artist needs to know what makes a transparent, unequivocal or orderly scene.'

Part 2

Attention

8

INTRODUCTION

So what *are* you watching, the dancer or the dance? What you see depends in part on what you're looking at. It is unlikely that, while reading this text, you noticed the font it has been set in[38], and yet by now you have been reading for quite a number of pages! The reason is that you were not paying attention to the typography, but to the meaning of the words and sentences. If someone were to query you after a dance performance about the colour of the costumes you may be unable to answer, because you didn't pay attention to it.

In a solo there is only one dancer to look at, but in a performance such as *Enemy in the Figure* (1989) by William Forsythe or *Wings of Wax* (1997) by Jiří Kylián you have to choose whether to focus on the duet to the left, the trio to the right or the solo at the rear end of the stage. As you look to the left your attention may be caught by a sudden movement to the right and so you turn your gaze to the right only to instantly turn it back to the left again. During a solo, too, you may concentrate on the hands, the arms, the legs and the spatial patterns. Dance demands an agility of perception equal to the agility of the dancer. At any moment the potential is there for the body to contract or expand and for the movement to stop, accelerate or continue in any other direction. It follows that, in order to gain a better understanding of dance and choreography, we need to study the mechanisms of attention.

A theatre provides an excellent experimental setting to see the mechanisms of attention at work. Shortly after the last latecomers have taken their seats the doors are closed and the lights in the auditorium are dimmed. The repeated exposure to theatrical performances will have conditioned most spectators to automatically stop their conversation, put away the program notes and look in the direction of the stage. Dimming the lights serves to facilitate the visual contrast between the stage and the audience. It removes potential distracting elements – only the contours of the auditorium and the other people in the audience remain visible – and emphasizes the division between the audience and the stage. Some directors and choreographers like to confound the audience's expectations by keeping the lights on. In *Steptext* (1984) by William Forsythe the lights in the audience stay on until well into the performance and after they have dimmed they come on again. There are always a few people in the audience who continue chatting and have to be informed by their neighbours that the performance has started.

[38] Minion.

Once the audience is aware that the performance is about to begin or, for all that they know, has already started, they will be all eyes and ears. As I like to tell my dancers and students, at this moment you can switch on the stage lights and just walk on stage. The audience will look at you no matter what you do. As a matter of fact, you don't have to do anything. You can just stand there if you wish. Your presence alone will suffice to keep the audience's attention, at least for a little while. At some point you will have to do something or else the audience will resume their conversations. If you were to refrain from doing anything long enough they will leave the theatre after expressing their dislike.[39]

But do what? You could start telling a story about that time when you were going to do a performance and didn't know how to begin and started telling a story about that time when you were going to do a performance and didn't know how to begin. If you're a ballet dancer you could lift one leg and balance on point for as long as you can. You could start pacing up and down the stage while looking at your feet, pretending to be thinking, or you could perform some awesome yo-yo tricks that will have the audience drooling. Whatever you do, you have to be aware that at any moment some spectators may feel their attention starting to wane. While this need not be any of your concern, if you don't want to upset the audience, who have given up time and money to attend your performance, you'd better come up with something good for the duration of your allotted time.

The history of dance and choreography can be seen as a wide range of answers to the question of how the movements of one or several persons can be organized so as to attract and sustain the attention of the audience. In the next chapter I will briefly review what is currently known about the mechanisms of attention. I will analyse what these findings tell us about dance and choreography and how they might be applied in a choreographic setting. Attracting attention is one thing, keeping it another. We will therefore need to discuss what makes an object or event interesting. As an addendum I will discuss the neural roots of boredom. It may have happened that during a performance you were so bored that your thoughts wandered off and that you wished to leave the theatre. From a scientific point of view this is an interesting phenomenon.

Attracting and sustaining attention is no simple matter, as Joshua Bell discovered when he played inside a Washington D.C. metro station (☞ §1.5). We are surrounded by objects that have been designed to draw our attention. Consequently, understanding how attention works is an important asset. As an artist it might help you manipulate the audience's attention. As a spectator and consumer it might help you understand how you are being manipulated.

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[39] In Einar Schleef's adaptation of Oscar Wilde's Salome (1998) the ensemble of actors kept standing still for a full 12 minutes, if I remember correctly, at which point they left the stage again for a short intermission. After a few minutes some people in the audience started coughing, others giggled. After some seven or eight minutes some people began to voice their anger. It was a shame that some people couldn't behave themselves, for without the audience's vocal interruptions the tableau vivant would have been even more mesmerizing than it was.

9

ATTENTION

Morning Light (2010), one of my own dance productions, begins with the stage shrouded in darkness. All of a sudden there is a very loud bang. The noise resounds for several seconds and slowly fades away. At this moment, very slowly, the stage lights come on to reveal a dancer. It takes several minutes for the lights to reach full brightness. The change is so slow that most people will only realize after a few minutes that it has become brighter. Starting a piece with a loud noise that breaks the silence may sound like a cliché, and it is, but it works. Indeed, it has become a cliché because it works so well. But why does it work? And what else might have worked instead?

9.1 MECHANISMS OF ATTENTION

Attention is one of the most pivotal, most researched and most elusive concepts in psychology and cognitive neuroscience. It refers both to a general state of alertness, vigilance and readiness and to a diverse set of processes that facilitate the ability to selectively focus on a stimulus and to sustain and shift that focus at will. Alertness and vigilance make up what one might call the *intensity* axis of attention, while focussed and divided attention makes up the *selectivity* axis.

Vigilant attention has a hierarchical structure, at the top of which one can distinguish between being asleep and being awake and within the state of wakefulness between attentiveness (alert states) and inattentiveness (drowsiness). In order to selectively attend to something one has to be awake rather than asleep and attentive rather than inattentive. However, while you are staring blankly out of the window, a sudden salient stimulus such as the ringing of a phone may awake you from your slumber.

Selective attention requires an object. You can be attentive, in the sense of being alert, without attending to anything in particular, but you pay attention *to* something. You can attend to an object, an object feature, and a sequence of events and to your own actions, thoughts and memories. Attention can serve as a spotlight, such as when you look for a friend in a crowded foyer and as a filter, such as when, after finding your friend, you only hear her voice amidst the noise around you. Even so, attending is not an activity. It is something you do when you are doing something else. You can do the dishes while paying attention to a podcast and you can look at a photo on your computer screen while searching for signs of sensor dust.

Attention can be goal-directed and stimulus-driven. Another way of saying this is that attention can be controlled by both top-down and bottom-up factors. Top-down attention can serve to block off unwanted stimuli, such as when you try to concentrate on a book or a difficult task. It can also serve to direct a sensory organ towards the source of a disturbance and to facilitate the perception of a specific object or feature. As a child you've probably played 'I spy' with your parents or grandparents during long car or railroad journeys. If the colour was blue, you would be looking all around you for blue objects and if the shape was round you'd be trying to spot round objects.

In the absence of top-down factors attention is driven by stimulus properties. When you are waiting for a train your attention may be caught by the clouds drifting by or by a crow looking for something to eat. You may notice a scratch on your left shoe and you may become aware of the floaters in the vitreous humour of your eyes.

Most spectators will be attentive rather than drowsy when they attend a dance performance and their attention will be guided by the events on stage. If the stage is diffusely lit and a spotlight switches on, most people will orient their gaze to where the light is. If a dancer runs to the far right of the stage they will trail him with their gaze. As a consequence they won't notice how five dancers enter the stage from the left. Effectively, the audience is in the hands of the choreographer who manipulates what the audience is likely to look at and ignore. Obviously, watching a dance performance involves some form of goal-directed attention, since you pay attention to what's happening on stage rather than to the programme booklet and you try not to worry about what your partner might think of the show.

Under normal circumstances the likelihood that a particular object or event will attract attention is determined by its novelty and behavioural relevance. An event attracts attention if it differs significantly from what went before; an object attracts attention if it differs significantly from its surroundings, but only if it is of some behavioural relevance. After taking a short break a commodities trader may notice that the price of cocoa has jumped, because it is relevant to his portfolio, but it would escape most ordinary people.

In order to study the extent to which people orient their gaze and attention towards surprising events Itti and Baldi (2009) analysed the scene-to-scene transitions in 50 video clips of various television shows. They then compared their findings with eye movement traces of people who watched the clips. Their findings revealed that about 70 percent of all saccades (a rapid movement of the eye) were made to locations which, according to their analysis, were more surprising than average.

To perform their analysis Itti and Baldi (2009) formulated a mathematical definition of surprise based on a Bayesian concept of probability. In Bayesian probability theory probability is conceptualized as a measure of a state of knowledge or belief. It distinguishes between a prior probability, before any data are observed, and a posterior probability, which is an updated probability conditional on the prior probability and the data. Consider the question whether it is going to rain tomorrow. You could, of course, look into the weather statistics of the past century and count the number of times it rained on tomorrow's date, let's say 19 June. If it rained on 23 out of those 100 historical days you might conclude that there is a chance of 23 percent that it will rain tomorrow. As I'm sure you will agree, such an approach is unsatisfactory as it completely ignores today's weather, which might be a good proxy for tomorrow's weather. Suppose that the past few days were nice and sunny. You might therefore assume that the chances that it is going to rain tomorrow are about 10 percent (you never know). The next morning when you open the curtains you notice that it is grey and clouded and that the streets are wet. Accordingly, you adjust your probability that it is going to rain to 60 percent and grab your umbrella on your way out. Basically, what Itti and Baldi (2009) propose is that the difference between the posterior and the prior probability can be interpreted as a measure of surprise. If, upon opening your curtains, you noticed that it was pouring with rain, you would most likely have been very surprised.

It follows that a surprising movement is not necessarily a novel movement, for instance, one that has been digitally manipulated and would be physically impossible, but one that differs radically from a previous movement. Similarly, a surprising scene is one that differs significantly from a preceding scene. In the work of the American artist and director Robert Wilson the actors often move imperceptibly slowly, sometimes freezing into a pose for what seems like minutes on end. As a consequence a tiny movement of the wrist can be enough to draw one's attention. Conversely, if twelve dancers frenetically move around for an hour or more, all internal difference is obliterated. What happens at minute 37 may not differ much from what happens at minute 39 or 14. Of course, this may have been the choreographer's goal. To reiterate once more, in contemporary art anything can be an artistic objective.

If a dancer moves across an otherwise empty stage the audience is likely to follow her with their gaze (☞ §14.1). But what if there is more than one dancer on stage? What if at any one moment there are several solos, duets, trios and so on taking place all across the stage? In pieces such as *Pond Way* (1998) and *Ocean* (1994) by Merce Cunningham or *Limb's Theorem* (1990) and *Eidos:Telos* (1995) by William Forsythe there is a near constant amount of concurrent activity on stage, although the degree of activity varies. Dancers perform in seemingly random groupings and orderings, disappearing into the wings and appearing at another location. There is incessant movement. It is impossible to keep track of everything at once. And so each person in the audience will have to choose what to attend to. But every time you make a choice another event on stage may distract you, a dancer to the right who is performing an amazing solo, two dancers to the left who are performing a duet, a group of dancers entering at the rear end of the stage and so on.

In principle one can only pay attention to one object or event at a time. It is impossible to listen to two or more conversations at once while reading a book and solving the Rubik's Cube™. However, people can track multiple moving objects at once. Early experiments suggested that there was a magical upper limit of four moving objects that can be tracked simultaneously (Pylyshyn and Storm 1988), but subsequent experiments raised this number to eight (Cavanagh and Alvarez 2005). Another experiment whereby the moving dots were divided over two hemispheres suggested that, when several objects are tracked at once, each target acts as a focus of attention and that therefore visual attention is essentially multifocal (Alvarez and Cavanagh 2005). I should add that these findings are all based on experiments whereby the participants watch some dots or lines moving across a screen. Applied to the human body one could think of the arms, hands, legs, feet, head and other individually identifiable body parts as equivalent to the dots used in these experiments.

If we apply these findings to dance it follows that, when you are watching a scene in which seven dancers are lined up and perform the same movements more or less in sync, as in the opening scene of *Split Sides* (2003) by Merce Cunningham, you can sort of track all dancers, sort of, because the dancers do not move perfectly in sync, they are humans after all and not robots, and these small deviations may distract your attention away from the group towards a single dancer who is either too late or too fast.[40]

Another experimental study demonstrated that there is an interaction between the number of objects that can be tracked simultaneously and the speed at which they move across the screen (Alvarez and Franconeri 2007). At slower speeds people can track up to eight objects, at higher speeds they can only track a single target. However, a follow-up study suggested that it is not so much the speed as the crowding together that occurs when objects move fast across a screen that causes the number of objects that can be tracked simultaneously to decrease at higher speeds (Franconeri et al. 2008). When objects are too close it becomes difficult to tell them apart.

Based on my experience as a frequent visitor to dance performances I would like to make another prediction: when the motions become more erratic, it becomes harder to track a moving object, but when the motions of one object are qualitatively different from that of other objects, for instance, because one moves in straight lines and the others in curves, it becomes easier again. In the final minutes of *The Second Detail* (1991) by William Forsythe, a female dancer sways across the stage amidst a group of about a dozen dancers. Whereas the movements of the group are all straight lines and classical variations, the solo dancer's movements are wild and loose. The contrast between the solo dancer and the group is further enhanced by the fact that she has her hair loose and wears a white Issey Miyake dress, whereas the other dancers are dressed in tight grey body suits. While this makes the performance unsuitable as a scientific experiment, which requires all other factors to be kept constant, there is a reason that these contrasting elements are combined: together they make it easier to separate competing visual elements (☞ §5). It would have been even easier to make out the solo dancer had she been wearing a blue dress, but it would also have been too prominent and indeed distracting.

But why does a single blue object stand out among several white objects? Obviously this is because of the contrasting colours, but for cognitive neuroscientists and

[40] A video of this particular fragment can be found online as a trailer for the DVD of *Split Sides*.

experimental psychologists nothing is obvious. For why does it immediately pop out? And how much of a contrast is necessary for the object to pop out? And which other attributes pop out? A big object will stand out among a group of identical smaller objects. But how big a difference in size does there have to be for an object to stand out? I think you will understand why every year more than 2,500 papers are published about the mechanisms of attention (Raz and Buhle 2006).

All of this research has led to the identification of a number of object attributes that might guide the deployment of visual attention. Some of these factors, such as colour, motion, orientation and size, attract attention under a wide range of circumstances, others, such as shape, curvature and topological status, grab attention only under some circumstances.[41] It has also been demonstrated that it is easier to find a moving object among stationary distracters than vice versa (Royden et al. 2001) and that receding objects capture attention less than approaching objects, perhaps because an object, which suddenly appears might require urgent action, whereas an object that slowly disappears doesn't (Franconeri and Simons 2003). In one scene in *Communications from the Lab* (2004), one of my own dance productions, at some point one of the nine dancers disappears into the wings. I'm pretty sure that it is only when he reappears in the next scene that the audience realizes that he must have left.

There is accumulating experimental evidence that emotionally charged stimuli capture attention more effectively than neutral stimuli. In visual search tasks emotionally salient stimuli such as snakes, spiders and guns are more easily detected than neutral stimuli such as flowers and mushrooms (Ohman et al. 2001; Fox et al. 2007). These emotional biases are probably strongest for behaviourally relevant stimuli, such as faces and expressions of fear and anger. Indeed, it has been found that in a visual search task responses to faces and body parts are faster than to other object categories (Ro et al. 2007). The processing of emotionally salient stimuli also interferes with other attention demanding tasks, which suggests that they have a higher priority in the competition for attention.

The attributes that guide attention are typical capacities in the sense defined in the introduction (☞ §1.6). Their characteristics have been determined in artificial laboratory settings in which all other features are kept constant. Transposed to the real world these attributes can be said to have the capacity to guide attention, but they don't do so at all times, in all circumstances and to the same degree. A red object will stand out among several identical yellow objects, a large object will stand out among small objects, a tilting object will immediately pop out if all surrounding objects are straight and a moving object will stand out against a stationary background. If all other objects are also moving it will only stand out if it has a different colour or moves in a different direction or at a different speed and so on.

[41] Wolfe and Horowitz (2004) provide a classification of undoubted, probable, possible and doubtful categories or features that guide attention.

These capacities work both ways. If you want an object to stand out, try giving it a contrasting colour, give it a different shape and so on. If you *don't* want something to stand out, remove all attributes that might guide attention.

It is no coincidence that in dance both the costumes and the stage design tend to be simple, the lavish set designs and costumes in classical ballet and bharata natyam notwithstanding. In the absence of any other attributes that might attract attention, attention is automatically guided by the one remaining highly salient feature: motion.

Once a particular feature, whether an object's colour or its motion characteristics, has been identified, attention tends to turn to another object or feature. If attention is to remain focused on an object's motion characteristics, rather than to shift to its shape, its movement parameters should be such that this tendency is suspended. In the case of the human body, motion can be seen as a change of the body's location or a change in its configuration, whether in the position of the limbs relative to each other or the expansion of the stomach or the cheeks. It follows that, to keep attention focused on the body's motion characteristics, we should change how the body moves and in which direction it moves.

This leads us to what one might call the first law of choreography: to draw the audience's attention to the dance, rather than the costumes or the dancers' facial expressions, the choreography should focus on ways of creating ongoing novelty and diversity in the movement material and the displacement of the dancer(s) across space. I am aware that the present thesis and its deduction are not exactly revolutionary. However, it shows that the basic mechanisms of attention form the basis of choreography.

I would like to add once more that attracting and keeping the audience's attention need not be an artist's ultimate goal or concern. Some artists are proud if part of the audience leaves. Art does not need to be entertaining. If the audience leaves early it is seen as proof that the work is Art and not 'mere' entertainment. But to repeat, in selecting their material these artists will have to make sure that it does *not* catch and hold the audience's attention, which, in a dual sense, implies knowledge of what *does* capture attention.

Our analysis so far has a surprising corollary. The audience will usually see a piece only once. If they really like it they may go and see it a second or third time. The choreographer will see the piece grow under his or her eyes. He or she will have to monitor whether a dancer does what he or she is supposed to do and whether a section lives up to his or her ideas. In doing so a choreographer will apply top-down attentional control. In fact it is impossible for a choreographer to watch his or her own piece with innocent eyes and let the stimuli guide his or her attention. This is one reason why the choreographer's experience will be different from that of the audience. Because choreographers know their own work by heart they will focus on ever-smaller details that *have* to be adjusted in the next performance. They may also grow bored of their own work and feel compelled to change sections, that do not need changing, only because the change will appeal to their own eyes. One might therefore expect a difference in the extent to which choreographers continue adjusting their work between, on the one hand, choreographers who attend each and every performance of their own work, such as William Forsythe and Sasha Waltz, and on the other hand, guest-choreographers who stage a work and leave after the premiere.

9.2 NEURAL MECHANISMS OF ATTENTION

There is a lot to see when you're watching a dance performance, even in a solo: arms, legs, fingers, lines, jumps, accelerations, patterns, despair, loneliness, struggle, references to other dance performances and so on. What any one person sees depends on what he or she attends to which in turn is subject to one's goals and expectations. A dancer who watches the dance so as to imitate the movements afterwards will attend to different features than a person who tries to identify a dancer or a student who is writing a thesis on the choreographer's work. The image on the retina of each person will be similar, give or take the angle of view, yet each person's experience of the dancer's movements will be quite different. As Raymond (2000) argued, if the input is the same and the output is different then the neural processing must be different.

Early cognitive models of attention conceptualized attention either as a bottleneck, a filter or a gating mechanism. There is a limit to the amount of data that the brain, or indeed any system, can process at any one time. Consequently, some kind of selection mechanism must be in place that controls the flow of information and prevents the system as a whole from overflowing. It would be convenient if you could just look at this page and instantly see what it says, but unfortunately reading is essentially linear. From an engineering point of view the question is at what stage incoming data are selected and what the selection process itself consists in. Do unattended sensory inputs still register? Are they discarded or attenuated? And are attended stimuli enhanced or are unattended stimuli inhibited? And if attention functions as a gate or a filter is there an executive mechanism that controls its operation? And what lies at the other side of the gate?

Current models of attention have moved away from the bottleneck and filter metaphor and view attention as the outcome of neural competition at different levels of the brain's processing hierarchy (Desimone and Duncan 1995; Itti and Koch 2001; Knudsen 2007). At the top of this processing hierarchy lies working memory, which is defined as the ability to maintain and manipulate information in the absence of incoming sensory or motor stimuli. For example, when solving a Sudoku you sometimes need to remember one or two digits in order to infer which digit should go where, but of course you forget as soon as you've filled in the correct digit or dismissed a false one. The relative strength of a signal determines which signals gain access to working memory. These signals may have emerged anywhere in the brain. This is why a fleeting memory or a rapid association may suddenly interfere with whatever you were attending to. While reading this book you may suddenly remember that you had to write an email. What happens at this moment is that, for no apparent reason, some neurons somewhere in the brain gain the upper hand in the competition with other neurons. Before you know it twenty seconds have passed and you have to reread the sentence you just read. When you do so you may have a vague recollection of having read it, it's just that the signals were momentarily blocked from entering working memory.

In the neural competition framework salient stimuli can be said to have a competitive advantage and top-down factors that increase a neuron's sensitivity can be said to bias the competition in favour of a particular feature or location. Basically, the idea is that within a group of, say, ten neurons the one that has the maximum output enters into a competition with the ten neurons that emerged as winners in ten other groups of neurons and so on until a global maximum over all neurons within a given population emerges (Koch and Ullman 1985).

If attention were based on such a winner-take-all strategy it might lock onto a single salient feature or location. Obviously, this would be undesirable. To prevent this from happening neurons at a currently attended location would have to be temporarily inhibited, which would cause them to lose out in the subsequent competition, causing attention to shift to the next most salient location. This is precisely what has been observed in behavioural studies, which have reported that people exhibit a bias against attending to a previously attended location, a phenomenon called *inhibition of return* (Klein 2000). People also tend to respond slower to stimuli at locations where another stimulus has just appeared than to stimuli that appear at novel locations.

Inhibition of return is a phenomenon that emerges at a *psychological* level, it does not explain why attention functions the way it does, but is itself in need of explanation. As a psychological phenomenon it may reflect a bias towards the acquisition of novel information. It may thus explain why choreographers can continue adjusting a work forever. They notice that a dancer's chin should be tilted slightly more upwards and that the intensity is completely *wrong*. It is nothing short of aggravating that even after performing a piece fifteen times in two consecutive seasons a dancer still manages to get it wrong!

There is extensive evidence from single cell recordings in monkeys that, at the level of neural processing, attention modulates the response sensitivity of individual neurons, thereby biasing the processing of a specific attribute or a particular location (Treue 2001). Apart from increasing the sensitivity of neurons attuned to a particular stimulus parameter, top-down signals can also inhibit neurons attuned to different parameters. Top-down modulation can therefore be excitatory as well as inhibitory.

Functional neuroimaging studies in humans have implicated a network of regions in the top-down control of visual attention, including the posterior parietal cortex, the frontal eye field and the anterior cingulate cortex (e.g. Corbetta and Shulman 2002; Pessoa et al. 2003). Functional neuroimaging studies have also found evidence for attentional modulation of the visual cortex, for instance, when attention is directed at the direction of motion (Saenz et al. 2002) or at a specific point in space (McMains and Somers 2004). But, to reiterate once more, essentially fMRI studies show little more than a correlation between the activity in some part of the brain and the execution of a task. They do not reveal a causal mechanism.

A new research paradigm, which combines functional neuroimaging with the application of transcranial magnetic stimulation (TMS), has the potential to show direct causal influences (Driver et al. 2009). One study demonstrated that applying TMS at different intensities to a part of the parietal cortex that previous neuroimaging studies had shown to be associated with attention elicits a distinct pattern of activity changes in visual cortex (Ruff et al. 2008). This experiment therefore provides support for the hypothesis that part of the parietal cortex modulates functional activity in human visual cortex. What it does not yet show is whether it also enhances attention.

Findings from clinical studies of patients with focal brain lesions can be used to supplement the conclusions that can be drawn from neuroimaging studies with normal subjects. It has been known for more than a century that patients with a unilateral brain lesion often have difficulty in detecting stimuli presented in the contralesional hemisphere, a condition known as neglect. Patients may ignore food on the left side of the plate and forget to chew and swallow food in the left side of their mouth.

Neglect is a complex, heterogeneous phenomenon. It can be egocentric, in which case a patient ignores stimuli to the contralesional side of the body and allocentric, in which case a patient ignores the contralesional side of objects. Some patients exhibit neglect for stimuli presented in the space immediately surrounding the body, but not for stimuli presented further away, while others exhibit the exact reverse impairments. As Mesulam (1999) puts it: 'neglect is not a disorder of seeing, hearing, or moving but one of looking, detecting, listening and exploring.' Traditionally, visual spatial neglect has been associated with lesions of the posterior parietal cortex, but it may also result from unilateral lesions in different parts of the brain, including the superior temporal gyrus, the frontal lobes and the thalamus (Mesulam 1999). Given the heterogeneous nature of neglect it is perhaps not surprising that its neuroanatomical substrates are diverse.

Together these findings suggest that attention is the result of the coordinated activity of a distributed network with three cortical epicentres: the posterior parietal cortex (centred around the intraparietal sulcus), the frontal eye field and the anterior cingulate cortex. Lesions to either of these local circuits can result in attentional deficits and neglect, while attention demanding tasks result in increased activity at each of these sites, both at the level of brain regions, as demonstrated in neuroimaging studies, and at the level of individual neurons, as demonstrated by single cell recordings in monkeys.

9.3 INATTENTIONAL BLINDNESS

I still remember how halfway into one of my performances one of the stage lights exploded. It rarely happens and is caused by a light overheating. The performance had to be interrupted to clean the floor, but thankfully none of the dancers got injured. Strikingly, some people in the audience hadn't noticed anything as they had been concentrating on the dance, or so I hope, and wondered why the show was temporarily halted. Others thought that the explosion was a special effect that was part of the show, or so they said afterwards, even though a cloud of tiny glass splinters could be seen descending onto the stage.

In everyday life it regularly happens that people fail to notice a significant object or event. In the midst of a conversation drivers may overlook a traffic sign, even though it was specifically designed to draw attention. This phenomenon is known in cognitive psychology as inattentional blindness. In one famous experiment, which was later made into a television commercial about traffic safety, the participants had to watch a video of a group of people playing a ball game and count the number of passes by either of the two teams (Simons and Chabris 1999). At some point during the game a woman with an open umbrella appeared from out of nowhere and walked from one side of the screen to the other. Yet afterwards, when asked whether they had seen anything unusual, only half of the participants responded that they'd noticed the woman with the umbrella, the other half didn't report seeing anything unusual. In another experiment the woman with the umbrella was replaced by a person in a gorilla costume. In this experiment half of the viewers didn't notice anything unusual either. Remarkably, even when the person in the gorilla costume stopped in the middle of the players and thumped its chest before walking on and leaving the scene, only half of the observers reported noticing the event.

Inattentional blindness is related to what is known as change blindness, a phenomenon frequently exploited in candid camera shows. In a classic version of the trick a person pretending to be a tourist asks a passer-by for directions. At some point, in the middle of the conversation, two men carrying a large piece of wood walk through the scene. With the view of the passer-by obstructed, the tourist is quickly replaced by another person, yet to the amusement of the audience, many people fail to notice the change.

In *Artifact* (1984) by William Forsythe this effect is put to great creative use. If you have never seen the piece the effect is quite dramatic. At some point in the final scene the curtain comes roaring down and it appears as if something has snapped. After the curtain has been lifted it descends another three or four times, although more gently than the first time. Every time the curtain comes down the dancers change into a different configuration. Some people only notice this the second or third time the curtain is lowered.[42] The falling curtain may have come as such a surprise that it temporarily occluded any other events that were happening simultaneously.

Inattentional blindness and change blindness challenge the notion that novel, unexpected and emotionally charged stimuli automatically capture attention. Attention is a scarce resource of which only so much is available at any one time. If the attentional load

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[42] The quantitative analyst in me objects to the use of some and many and would like to know how many, how often and so on. Lacking a proper quantitative analysis you will have to take my word for it that what I assert is the case.

increases people may fail to notice otherwise attention-grabbing events as has been demonstrated in various experiments (Lavie 2005).

In traffic anything that causes inattentional blindness can have fatal consequences. In the performing arts the effect may be more benign. In the above experiments one half of the viewers *did* see the person in the gorilla costume and the woman with the umbrella. What would you do if someone asked you whether you had seen the person in the gorilla costume? If you hadn't seen him, chances are you'd like to see the clip again, just to see what you missed and to make sure your friends aren't poking fun at you. And what if after a dance performance your friends speak enthusiastically about this or that scene, which you don't recall seeing? You may resolve to see it again the next time it is performed, at least, that's what I would hope, if it were my performance.

9.4 CONCLUSION

When you're watching a dance performance you may not care much about who is dancing. But if you were to try and identify a friend or if you were to count the number of dancers, if that is something that would interest you, the dancers' movements would still be processed, but they may be temporarily prevented from reaching awareness. Once you've spotted your friend or counted the dancers, you may become aware that you missed some fragments and scenes.

What we see and hear is influenced by what we pay attention to. Selective attention can be top-down controlled and stimulus-driven. In the absence of top-down factors attention is driven by stimulus properties. Experimental psychologists have identified a number of attributes that attract attention, other things equal. For instance, a moving object will stand out among stationary objects, but not the other way around. This led me to formulate, a bit in jest, what I referred to as the first law of choreography: To draw the audience's attention to the dance, rather than the costumes or the dancers' facial expressions, the choreography should focus on ways of creating ongoing novelty and diversity in the movement material and the displacement of the dancer(s) across space.

Let's put our newly gained knowledge to test. Suppose someone were to challenge us to create a choreography based on what we have learnt so far. Let's assume that we are creating a solo, that the piece is to be performed inside a theatre and that basically we can do whatever we want. Even though this poses some challenges of its own, as we will soon find out, this has the advantage that the people who attend the performance will have come to see it, so we won't have to worry about drawing their attention to the piece as such, we can leave that to the people over at marketing.

At some point during the rehearsals we will have to make up our mind how we want the piece to begin. We could have the dancer dancing on stage before the audience enters or we could have her do a warming up in plain view, leaving it to the audience to decide whether this is part of the performance or a pre-performance warming-up. Let's stick to the conventional beginning whereby the audience takes their seat and at some point the stage lights come on. But now we face another decision. We could switch on the stage lights to reveal the dancer, who may be dancing or just sitting or standing somewhere on stage (but where?) or we could keep the stage empty. If we keep the stage empty we will have to decide from which side to have the dancer enter, from the right, the left, the back or, why not, the audience. We will also have to decide whether to turn on a spotlight at a particular location or whether to light the entire stage and whether to do so from above or from the sides. And then we still have to decide what kind of clothes or costume we want our dancer to wear. If only we could just concentrate on the choreography! But everything we take for granted is a decision, because we failed to make it into a conscious choice. Let's just have our dancer wear a pair of jeans, a dark tank top and matching socks and let's just put the stage lights on so that the stage is evenly lit and let's have the dancer enter from the left.

When she walks on stage the dancer instantly captures the audience's attention. That must be her! The one they've been waiting for and paid to see! From now on the audience will be on alert. They will eagerly await her next move. At this point we will have to show that we learnt something from the present chapter. According to the First Law of choreography, to draw the audience's attention to the dance, the choreography should focus on ways of creating ongoing novelty and diversity in the movements and the displacement across space.

A simple technique for bringing variation into a movement sequence is this: start with a random limb and then keep moving a different limb or part of the body, left arm, right leg, head, left shoulder and so on, one limb at a time. To add some more variation the number of body parts being moved can be alternated, as well as the time span between movements and the speed with which they are performed. This is somewhat similar to musical compositions in which a theme is repeated with different instruments and changes in tempo. You can also imagine drawing figures with the hand, foot, head, elbow or shoulder or imagine avoiding and stepping over imaginary obstacles. You can define a vocabulary of 20 or more movements, which you can then deconstruct and perform in different constellations (Hagendoorn 2003). If you were to practise these techniques yourself, you will notice that what you are doing resembles contemporary dance.

Instead of improvising the movements on the spot we can also rehearse the movements in advance. We can choreograph a phrase such that the likelihood that it will capture and hold the audience's attention is high. Of course, this is something we will have to judge ourselves and there is no guarantee that we will be right. What distinguishes great choreographers from the average person is that they know how to reliably increase this likelihood. For some choreographers this is not enough. With every new production they seek to stretch the limits of what works. After all, why stick to the things you have already tried?

Despite our and our dancer's best efforts there is a risk that after a few minutes the audience will lose interest. The constancy of the new is hardly news. All they may see is a person moving about on a stage, twisting and turning and swinging her arms. They may admire the dancer's virtuosity and bodily agility, but the dance may leave them indifferent. How do we sustain the audience's attention and engage their interest? What would we have to do to make them want to see the piece again or to come and see our next production? That is the question I will address in the next chapter.

9.5 COROLLARY: THE POWER OF THE CENTRE

When looking at something people tend to position themselves such that the object is in the middle of their field of view. In a museum people will stop in front of a painting, not two or three and a half meters to the left or right, unless it's crowded and they can't get any nearer. A fascinating exception and counterexample is, of course, Hans Holbein The Younger's *The Ambassadors* (1533), which hangs in the National Gallery in London, in which the skull is only properly visible when viewed from an angle. Consequently visitors are shuffling around to find the right spot from which to see the skull.

Looking ahead is the most comfortable position for the head to be in. It is also the best starting position for shifting one's gaze since the average distance to either side is the smallest. Since the face, the eyes and the mouth carry the most information, people also want to face people they are interacting with. This is why, when they are free to choose where to stand, people will form a circle around a performer or a half-circle if the performance is directed towards an audience.

It is no accident that in a theatre the seats in the middle tend to be the best and most expensive. On average they offer the best sight lines. It is no accident either that much of the action on stage takes place at or around the centre. When addressing an audience most speakers will implicitly assume the audience's perspective and take centre stage. During rehearsals choreographers and directors position themselves at a point from where they have the best view, which will be somewhere in the middle. Sure, they may walk around, observe a scene from here or there, but on average they will spend most time in the middle. The spatial distribution of most choreographed dance performances therefore follows from practical considerations related to the organization of the visual system.

In *Enemy in the Figure* (1989) by William Forsythe the stage is dominated by a slightly curved wooden panel of about three and half meters high which stands diagonally in the middle of the stage hiding from view whatever happens behind it. Spectators sitting on either the far left or the far right will therefore have a different view and the seats in the middle no longer offer the best sight, indeed there is no longer any 'best' seat. In the third section of *Limb's Theorem* (1990), of which *Enemy in the Figure* is the middle section, invisible to the audience seated on the left, a row of rods is lined up against a wall on the left side of the stage. At some point the rods are tipped over. You can hear them falling, but the source of the noise will remain unknown to part of the audience. Spectators on the far left will be able to see the dancers climbing up the wall on the right side of the stage, of which those seated on the right have no idea. I consider myself lucky to have seen the piece on various occasions and it never fails to captivate me. There is a lot of concurrent activity and wherever you look you always have a sense of missing out on something important.

KEY POINTS

☞ 'To draw the audience's attention to the dance, rather than the costumes or the dancers' facial expressions, the choreography should focus on ways of creating ongoing novelty and diversity in the movement material and the displacement of the dancer(s) across space.'

☞ 'A surprising movement is not necessarily a novel movement, but one that differs radically from a previous movement. Similarly, a surprising scene is one that differs significantly from a preceding scene.'

☞ 'Attention can be goal-directed and stimulus-driven. In the absence of top-down, goal-directed factors attention is driven by stimulus properties.'

☞ 'Attention is a scarce resource of which only so much is available at any one time. If the attentional load increases people may fail to notice otherwise attention-grabbing events.'

☞ 'The attributes that guide attention work both ways: If you want an object to stand out, try giving it a contrasting colour, give it a different shape and so on. If you *don't* want something to stand out, remove all attributes that might guide attention.'

☞ 'It is no coincidence that in dance both the costumes and the stage design tend to be simple. In the absence of other attributes that might attract attention, attention is automatically guided by the one remaining highly salient feature: motion.'

☞ 'It is impossible for a choreographer to watch his or her own piece with innocent eyes and let the stimuli guide his or her attention. Because choreographers know their own work by heart they will focus on ever-smaller details.'

☞ 'Inhibition of return refers to the phenomenon that people exhibit a bias against attending to a previously attended location. It may reflect a bias towards the acquisition of novel information and may thus explain why choreographers can continue adjusting a work forever.'

10

INTEREST

The German writer and philosopher Friedrich Schlegel (1772-1829) noted that 'in the entire realm of the science of aesthetics the deduction of the interesting is perhaps the most difficult and complicated task' (Schlegel 2001: 99). Schlegel considered the predominance of the interesting in modern poetry, as opposed to the Greek poetry of antiquity, which strove for an objective ideal of beauty, to be a 'mere passing crisis of taste' (idem: 36), but as 'that which has provisional aesthetic value' (idem: 100) he allowed for the interesting as 'the necessary propaedeutic for the endless perfectability of the aesthetic disposition' (idem: 99). Henry James, the brother of the psychologist William James, wrote in an essay on *The Art of Fiction*, published three years after *The Portrait of a Lady*, that 'the only obligation to which in advance we may hold a novel, without incurring the accusation of being arbitrary, is that it be interesting' (James 1987: 191). I am not sure how many contemporary readers would consider *The Portrait of a Lady* (1881) *interesting*, but that's another matter.

The concept of interest is roughly synonymous with curiosity and is closely connected with the concept of attention. As a first approximation we might say that something is interesting if it commands our interest, but that is like saying that tautologies are tautological because they express a tautology. We might also say that something is interesting if it sustains our attention. This is what we might call a necessary condition. If something does not sustain our attention we move on to something else. But intuitively there is a difference between objects and events that sustain our attention through a battery of salient stimuli, the way action movies do, and those that invite us to apply attention. I must confess that I enjoyed watching *Pirates of the Caribbean* (2003). Indeed, I was glued to my seat for its entire duration, although perhaps I should add that I watched it on an intercontinental flight. It pushes all the right buttons in terms of attention and arousal. Throughout the movie and at regular intervals there are chases, explosions, fires, fights and all kinds of spectacular visual effects.[43] And yet, I wouldn't call it an *interesting* film. Everything it had to offer was already on the surface and there was nothing about the surface that invited me to dig deeper to see if there was anything underneath.

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[43] A quantitative analysis of 150 Hollywood films showed that over the past 70 years the shot structure has become increasingly uniform. In today's films action sequences are typically a cluster of short shots, while dialogues are likely to consist of a cluster of longer shots (Cutting et al. 2010). The authors suggest a link with attention and mind wandering (☞ §11.1) and argue that over time films have been implicitly entrained to the workings of the human mind.

This then might be a better description, definition is a big word, of interesting: To take an interest in something is to examine it up close and from different directions, to think about it and to contemplate one's own thoughts. Accordingly, interesting is that which invites such examination, reflection and contemplation. It is the result of the dynamic interaction between the pull of bottom-up, stimulus-driven attention and the push of top-down, goal-directed attention. Once attention has been caught top-down factors take over that ensure that attention is sustained. In the case of the interesting attention is primarily governed by top-down factors, in the case of the entertaining by bottom-up factors. But why do people take an interest in something? What is it that makes something interesting? And why do some readers consider *Cloud Atlas* (2003) by David Mitchell an interesting and thoughtful novel, while others give up on it after two chapters?

10.1 INFORMATION GAPS

Interest and curiosity depend on dispositional factors associated with age, gender, social class and culture. Some people are more inclined to figure out how something works or to try out something new, such as a performance by an emerging choreographer, than others. Interest reflects a desire to learn, know and understand. It motivates the exploration of the environment, the learning of new skills and the acquisition of knowledge. Wherever there is desire and motivation there must be an expected reward somewhere (☞ §15.1; §22.2). We desire something because of an explicit expectation of a future outcome. When you see an ice cream vendor you may feel like having an ice cream. The sight alone may make your mouth water in anticipation of that lovely sugary sweet taste. But where is the reward in interest and curiosity?

A recent functional neuroimaging study aimed to find an answer to this question by investigating the neural correlates of curiosity (Kang et al. 2009). In the experiment participants were presented with a number of trivia questions. After reading the question and guessing the answer participants were asked to rate their curiosity and their confidence in the correctness of their answer upon which they were shown the question once more as well as the correct answer. It was found that the level of curiosity was correlated with increased activity in the left caudate, the bilateral prefrontal cortex and the parahippocampal gyri. Increased activity in the caudate is frequently reported in studies investigating anticipated reward. The findings therefore suggest a link between curiosity and anticipated reward. After presentation of the correct answer there was increased activaty in areas associated with learning and memory if the answer provided by the participant had been incorrect, which suggests that curiosity may enhance memory for surprising new information. A second experiment, conducted several days after the first experiment, in which participants were asked to recall the answers they had given during the first experiment, provided support for this hypothesis. It was found that higher curiosity in the first session was correlated with better recall of surprising answers in the second session. In a third, behavioural, experiment participants had to spend scarce resources in the form of tokens or waiting time to learn the correct answer to a question. As expected there was a significant correlation between curiosity and resources spent.

The findings support the theory of interest and curiosity advanced by Loewenstein (1994) according to which curiosity reflects a gap between what one knows and what one wants to know. Interest or curiosity arises when attention becomes focused on a gap in one's knowledge. As Loewenstein writes, 'such information gaps produce the feeling of deprivation labelled *curiosity*. The curious individual is motivated to obtain the missing information to reduce or eliminate the feeling of deprivation' (Loewenstein 1994: 87). However, as Loewenstein (1994: 87) adds, people are not always curious, 'even though they are surrounded by vast regions of ignorance.' For instance, I have got no idea how the electrical appliances in my home function, let alone how they are manufactured, but I'm not really interested in finding out. So why are we interested in one thing rather another? What is it that arouses our interest?

In the second scene of *Blue Velvet* (1986) by David Lynch, as he walks home from the hospital where his father has just been admitted after suffering a near fatal stroke, Jeffrey Beaumont finds a severed human ear lying in the grass. How did it get there? Whom does it belong to? Is the person still alive? Who cut it off? And why? How long has it been lying there? These are but some of the questions that might be going through Jeffrey's mind as he squats to have a closer look. The same questions go through *our* mind when we watch the movie. Both Jeffrey Beaumont and the viewer therefore experience a gap in their knowledge.

The *meta*-question that we, students of art and the mind, should ask, is why David Lynch chose to have the film begin and end with a close-up of an ear. Of course, without the ear there would be no movie and the close-up at the beginning and end signify a form of closure, just as the fire fighters who drive by in the first and last scene, the shot of the white fence with the flowers and the first and last camera movement. They suggest that everything is back to normal and that evil has been expelled.[44] But why an ear? Perhaps the answer is that, had it been a finger, we wouldn't have asked ourselves this question. We might have thought of an accident. Fingers can be bitten off by a dog and they can be cut off when they remain hooked behind an object that moves away with great force. Ears have to be cut off intentionally by oneself or by another person. A finger is therefore more easily accommodated than an ear. The ear not only raises more questions than a finger would, it also calls to mind some potentially disturbing answers.

The interesting therefore does not so much expose a gap in one's knowledge as it provokes a series of questions that bear upon one's life. The reason you don't care how your microwave oven works is that it doesn't matter to you as long as it does what it is

[44] The key scene in the movie occurs when Frank Booth turns around to face Jeffrey who is sitting in the back of the car and says: 'You're like me.' The shot is filmed from the point of view of Jeffrey so that Frank Booth is also addressing the viewer.

supposed to do. The reason you are reading the present text is that you hope to get something out of it. As (Frijda 2007: 7) has said ‘emotions arise in response to events that are important to an individual’s concerns’. The same is true of interest and curiosity.

A counterintuitive implication of the information gap framework is that there is a positive correlation between interest and one’s knowledge in a particular domain. As more information becomes available attention may shift from what is known to what is not known. As Loewenstein (1994) writes, a person who knows the names of 5 of the 50 states in the U.S. may focus on what he knows, whereas a person who can list 47 of the 50 states may be aware of what he does not know. Likewise, my knowledge of molecular biology is rather limited and so a new research finding is unlikely to pique my interest. By contrast, the announcement of a new novel by the French author Michel Houellebecq raised my curiosity as I’ve read and enjoyed his previous novels.

If interest and curiosity arise from a gap between what one knows and what one wants to know, then the question is where the desire to know originates. Loewenstein (1994: 92) claims that ‘curiosity’s intensity is explained by the fact that it is a loss phenomenon; information seeking is motivated by the aversiveness of not possessing information more than it is by the anticipation of pleasure from obtaining it.’ In this view the feeling that accompanies the desire to learn what is unknown is negative. But then why do people go to the trouble of seeking exposure to negative feelings? Why are they hooked to *24* and *The Wire* and not just every episode, but every season? Why do they attempt to solve cryptics? Loewenstein proposes that people do so because reducing curiosity is enjoyable. However, I don’t believe that interest and curiosity are intrinsically negative. People don’t just enjoy the moment they have solved a Sudoku, they enjoy the process of solving. A striptease show consists of the selective removal of pieces of cloth. If nudity were the objective the stripper could undress in less than a minute. It is the constant delay of fulfilment and the promise that more will be revealed that sustains the spectator’s attention and curiosity. A detective novel holds out the promise that the suspect and the full course of events will be revealed. Perhaps what makes a novel such as *Cloud Atlas* (2003) by David Mitchell, a movie such as *Caché* (Hidden) (2005) by Michael Haneke or a ballet such as *Decreation* (2003) by William Forsythe interesting, is the promise that in the end it will all make sense or that, if one were to try hard enough, one might be able to make sense of it.

10.2 FACTORS OF INTEREST

We are not only interested in what interest is, but also, and perhaps foremost, in what is interesting. The information gap theory proposes that interest and curiosity arise from a discrepancy between what one knows and what one wants to know. However, it is unclear whether all sources of interest can be reduced to a gap in one’s knowledge. What is interesting about musical compositions such as Beethoven’s late string quartets or Bach’s *Well-Tempered Clavier*? Does knowing the score or repeated listening make it any less interesting? Why are some abstract paintings more interesting than others? And why would a ballet such as *Self Meant to Govern* (1994) by William Forsythe or *Biped* (1999) by Merce Cunningham be interesting? What is the relevant knowledge or information in this case?

To understand what arouses people's interest we need to look at the factors that determine whether or not something is potentially interesting. These factors can be broadly divided into four categories: complexity, novelty, uncertainty and incongruity (Silvia 2005c). Novelty refers to whatever is unusual, original or otherwise striking and is therefore contingent on a person's knowledge and previous experience. Complexity refers to the information density and the amount of structure and variety in a stimulus pattern. Uncertainty depends on the number of possible outcomes of an event and the likelihood, frequency and timing with which each of these outcomes can occur. Incongruity refers to the conflict, the inconsistency and the discord between different stimuli. Incongruity can also arise from a violation of one's expectations (☞ §15) and from an incompatibility between one's ideas or one's ideas and one's behaviour.

Whereas complexity refers to an object's *internal* differentiation, novelty refers to its *external* differentiation, that is, how it differs from other objects. Every artwork inscribes itself into a geographic and historical setting. When minimal dance emerged on the dance scene it raised people's interest because at the time it differed radically from other dance forms. Pina Bausch revolutionized dance by merging dance and theatre into a hybrid art form. But what was radical in the mid 1960s or the early 1980s may no longer be so in 2010 and what gets people excited in London or New York may be quite common in Amsterdam or Berlin and vice versa.

When you are watching a dance performance at some point you may begin to discern various recurring patterns, whether they are intended or not and regardless of whether you actively look for them. After seeing several performances by the same choreographer you may lose interest in his or her work, because you notice that he or she is constantly making the same aesthetic choices. You may even lose interest in dance altogether and yearn for something *real*. However, a person who, for the first time, encounters a conceptual work of art or a dance performance in which the dancers repeat the same movements over and over again may wonder whether this is really art or dance. He may adjust his prior beliefs about art or dismiss it as rubbish. And just when he thought he had seen everything and knew what dance is, he may find himself at a performance where, instead of dancing, the dancers are screaming and shouting and telling stories.

It follows that what matters is not so much complexity, novelty, incongruity and uncertainty per se, but one's *appraisal*. There is nothing intrinsically interesting about an interesting object. It is interesting only by virtue of the fact that it temporarily arouses one's interest. The moment one loses one's interest it ceases to be interesting.

Silvia (2005a) therefore proposes to conceptualize interest as an emotion within the framework of the appraisal theory of emotion (☞ §18.3). Interest in this view depends on an appraisal of novelty, complexity, uncertainty and incongruity on the one hand and an appraisal of comprehensibility or coping potential on the other. Coping potential refers to a person's appraisal of whether he or she will be able to understand an object or event. A person's coping potential comprises more than his or her knowledge. It also depends on a person's intelligence and personality traits such as patience and tenacity. Some readers consider *Cloud Atlas* (2003) by David Mitchell interesting because they enjoy the challenge of making sense of the novel; others consider it a horrible read because they don't get it. They get lost in the novel's multiple storylines and are bewildered by the author's verbal wizardry.

Silvia presents various experiments using both experimental artefacts, pieces of modern art and contemporary poems in support of this hypothesis (Silvia 2005b; 2005c). Participants in the experiments tended to spend most time with a picture when it was complex and, in the case of modern art and poetry, when they felt able to understand it. These objective measures were in line with subjective reports of interest. However, as an assessment of what people find interesting these kinds of psychological experiments are of limited value. They do not tell us whether the participants who considered the poems interesting went on to buy a book by the poets included in the experiment and whether those who considered the complex polygons interesting went home to generate some complex polygons on their computer to adorn the walls of their living room.

The appraisal model of interest explains why experts such as art critics and the general public may differ in their opinion as to whether something is interesting. Critics may consider a performance such as *The Show Must Go On* (2001) by Jérôme Bel interesting, because it challenges the notion of dance. A naïve observer may find the same performance of zero interest, because the performers – dancers is too big a word – don't dance. The model also explains why interest appears to follow an inverted U-shape. Simple problems fail to arouse one's interest, but if a problem is considered too difficult or if finding an answer or a solution takes too long one may lose interest in a problem and even feel frustrated. Finally, the model explains why, over the course of a career, the work of many artists becomes more complex and subtle, as is evident in the work of choreographers such as Merce Cunningham, William Forsythe, Jiří Kylián and Sasha Waltz. Whereas the audience will usually only see a performance once or twice, the choreographer builds on his previous work. A choreographer's benchmark for appraising the complexity of his or her own work is therefore likely to shift over time. Similarly, critics whose job it is to watch and review dance performances and who may see more than one performance per week, are likely to have a different benchmark than the average person in the audience.

10.3 CONCLUSION

Interest consists in the dynamic interaction between top-down and bottom-up attention and arises when one becomes aware of a gap in one's knowledge. By this token interesting is that which compels us to think. What happened? How does it work? What is going to happen next? The level of interest is correlated with brain regions associated with anticipated reward. In neurological terms craving for chocolate and craving for knowledge therefore share a neural substrate. A gap in one's knowledge can have various sources. An item can be novel, complex, uncertain or in some way incongruous with one's knowledge or interpretation. However, not every novel or complex object is interesting and not every gap in one's knowledge raises one's curiosity. Interest depends on an appraisal and is relative to a person's concerns and coping potential.

A world devoid of sense, where chaos reigns and randomness is the order of the day, is a dangerous place to live. Humans are predisposed to look for order, patterns and meaning and to integrate their experience into a coherent framework. To facilitate this process humans have evolved the psychological mechanisms that put a premium on curiosity and successful solutions and that motivate the exploration of the environment, the learning of new skills and the acquisition of knowledge. In the absence of situations and events that engage this machinery people may look for them by playing computer games, reading novels, going on urban safaris, solving puzzles, watching game shows and studying the work of Martin Heidegger and Gilles Deleuze.

The foregoing analysis allows us to address the questions with which we ended the last chapter. What does it take to sustain the audience's attention and engage their interest? What might make them want to see the same piece again?

The information gap theory assumes that a small increase in one's knowledge can bring about a sharp increase in one's aspired level of knowledge. However, when one has acquired a certain degree of knowledge, the gap shrinks and one's interest diminishes. It follows that, in order to sustain the reader's or the viewer's interest, provided he or she hasn't already reached a plateau, one would have to supply a steady stream of small doses of information, which bring the reader or viewer ever closer to answering the question *Who did it? How is it going to end?* In neurological terms these small doses of information yield a periodic stream of reward signals (☞§15.1; §22.2). Instead of feeding the audience new pieces of the puzzle one could also provide a steady stream of new puzzles. This is what keeps viewers hooked to television game shows such as *Who Wants to Be a Millionaire?* Viewers want to know the correct answer and they long to know whether the contestant knows the correct answer. In a way most Pina Bausch productions have a similar structure. Each new scene provides a new intellectual challenge, which one may either accept or decline.

Since interest depends on a person's concerns, novels, films and dance and theatre performances that have some kind of behavioural relevance are potentially interesting. I am not saying that people might choose a documentary over a Hollywood drama, but they might agree that the documentary is more interesting. An important characteristic of the work of Pina Bausch is that the dancers look like ordinary people. They wear ordinary clothes and find themselves in recognizable situations. Accordingly, even though the events on stage are fictional, they appear to have a greater behavioural relevance than action movies such as *Pirates of the Caribbean* or *The Dark Knight*, which are instantly neutralized as works of fantasy. Theatre directors such as Ivo van Hove and Frank Castorf also believe that by transposing a classic text to a contemporary setting they thereby make it more interesting because its relevance becomes immediately visible.

As we have seen, whether or not something is potentially interesting depends on four factors: novelty, complexity, uncertainty and incongruity. It follows that, to make a choreography potentially interesting, one could enhance its perceptual complexity, internal organization and information density. One could also divide the work into more or less radically different scenes, which would allow for ongoing novelty and create a sense of uncertainty. Finally, one could create various degrees of discord between the work's compositional elements.

Complexity in dance and choreography involves structure in variation and variation in structure at multiple levels of organization. Constantly moving every conceivable part of the body in every which way may look complex at first, but is in fact quite simple: the task move every part of the body will produce a series of movements that all look more or less the same.[45] Instead of increasing the work's internal complexity a choreographer can also enhance the work's semantic complexity and suggest hidden meanings that compel the spectator to think, for instance, by combining incompatible elements into a novel constellation (☞ §27.4). A production by Pina Bausch or a performance such as *Decreation* (2003) by William Forsythe raises multiple questions. What is that hippopotamus doing there on stage? Why are the dancers dressed in festive eveningwear? Why do they appear to be wiping tears from their eyes and cheeks for minutes on end? Why is the woman dancing alone in the background? Why do those men throw themselves to the ground again and again? Why the contorted faces? What kind of strange ritual is taking place around that round table? Instead of creating the *illusion* of some hidden meaning (☞ §27.4) a choreographer could also play with the audience's desire to know how things work. In *IIris* (2004) the French choreographer Philippe Découflé employs a host of special effects using mirrors and lighting that are not only a visual treat, but also keep one wondering: how did they do that?

I should emphasize once more that whether or not something is interesting depends on each person's knowledge and interpretation, not on the performance itself. What is more, since interesting objects and events are intellectually demanding, some people may prefer to go to an undemanding musical or Hollywood movie rather than to a potentially interesting and much more rewarding arthouse movie or contemporary dance production. If they do attend a performance, which they had read was very interesting, there is no guarantee that they will appreciate it either. Confronted with a range of open-ended questions and allusions one person may dismiss the performance as pretentious nonsense;

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[45] See also Hagendoorn (2002).

unable to make sense of it aother person may be baffled; yet another person may appreciate the intellectual challenge and refer to it as interesting.

KEY POINTS

☞ 'To take an interest in something is to examine it up close and from different directions, to think about it and to contemplate one's own thoughts. Interesting is that which invites such examination, reflection and contemplation.'

☞ 'Interest is the result of the dynamic interaction between the pull of bottom-up, stimulus-driven attention and the push of top-down, goal-directed attention. Once attention has been caught top-down factors take over that ensure that attention is sustained.'

☞ 'In the case of the interesting attention is primarily governed by top-down factors, in the case of the entertaining by bottom-up factors.'

☞ 'There is nothing intrinsically interesting about an interesting object. It is interesting only by virtue of the fact that it temporarily arouses our interest.'

☞ 'Interest reflects a gap between what one knows and what one wants to know. It arises when attention becomes focused on a gap in one's knowledge.'

☞ 'A recent neuroimaging study demonstrated that the level of interest is correlated with brain regions associated with anticipated reward.'

☞ 'To understand what arouses people's interest we need to look at the factors that determine whether or not something is potentially interesting. These factors can be broadly divided into four categories: complexity, novelty, uncertainty and incongruity.'

☞ 'What matters is not so much complexity, novelty, incongruity and uncertainty per se, but one's appraisal. Interest depends on an appraisal of novelty and complexity on the one hand and an appraisal of comprehensibility or coping potential on the other.'

☞ 'A choreographer's benchmark for appraising the complexity of his or her own work is likely to shift over time. As a result the work of many choreographers tends to become more complex as they mature.'

☞ 'To make something potentially interesting a choreographer can increase the work's internal and semantic complexity.'

☞ 'The information gap theory suggests that, in order to sustain the reader's or the viewer's interest, provided he or she hasn't already reached a plateau, one would have to supply a steady stream of small doses of information, which, in neurological terms, yields a periodic stream of reward signals.'

☞ 'Since interesting objects and events are intellectually demanding, some people may prefer to go to an undemanding musical or Hollywood movie rather than to a potentially interesting and much more rewarding arthouse movie or contemporary dance production.'

11

BOREDOM AND THE WANDERING MIND

I am afraid that many people would find much ballet and modern dance pretty boring and I have to admit that more often than not they are right. I have sat through numerous performances that I thought were a complete and utter bore. There was nothing happening on stage, just people running around, going through various contortions or stretching an arm or a leg. Of all dance forms minimal dance and neo-conceptual dance evoke the strongest reactions. Clement Crisp, dance critic for the *Financial Times*, once wrote of *Rosas Danst Rosas* (1983), a production by Anne Teresa de Keersmaeker and Rosas:

> 'Minimalism, as fellow-sufferers know, is a gaping bore, dreary ideas chasing their own tails ad infinitum, the faux-naif passing itself off as method. (..) The piece is an endurance test (hurrah for the audience members who left before the end), and long past any sell-by date. (..) Rosas denies the power of dance, in the theatre, in society, and turns it to a yawn. It contrives to give tedium a bad name.' (Crisp 2009e).

Boring as an assessment of an object or event is to be distinguished from the feeling of boredom. Objects or events that fail to sustain our attention, that lack salient attributes, that do not differ in any substantial way from their context or surroundings, or that fail to raise our curiosity by any other means, are boring. The feeling of boredom consists in a negative appraisal of one's own state of mind. It can, but need not, be directed at an object and it can, but need not, be caused by the confrontation with a boring object. One can be bored with something, but one can also simply be bored in the absence of anything that causes it. Indeed, if you allow me the wordplay, it is the absence of a cause that may be the cause of one's boredom. If only there were something to be bored with at least one could get rid of it.

Boredom may be uniquely human. When deprived of sensory stimulation and contact with conspecifics caged animals pace around their cage for hours on end and parrots frantically pluck their feathers until they are all but naked, but animals in the wild appear to lack the experience of boredom and the desire for constant sensory stimulation. As E.M. Cioran wrote in *The Trouble with Being Born* (1976):

> 'A zoologist who observed gorillas in their native habitat was amazed by the uniformity of their life and their vast idleness. Hours and hours without doing anything. Was

> boredom unknown to them? This is indeed a question raised by a human, a busy ape. Far from fleeing monotony, animals crave it, and what they most dread is to see it end. For it ends, only to be replaced by fear, the cause of all activity. Inaction is divine; yet it is against inaction that man has rebelled. Man alone, in nature, is incapable of enduring monotony, man alone wants something to happen at all costs - something, anything... Thereby he shows himself unworthy of his ancestor: the need for novelty is the characteristic of an alienated gorilla' (Cioran 1976: 193).

11.1 MIND WANDERING AND THE DEFAULT NETWORK

Above we saw that, when fully engaged in a task, people may fail to notice highly salient events. Another way of saying this is that an increase in attentional load reduces or eliminates the interference of distracting stimuli (Lavie 2005). Distracting stimuli can be external, such as a flashing banner on a website or the noise of your neighbour's electric drill, and internal, such as memories, fantasies, feelings and associations that seem to surface from out of nowhere. When the attentional load is high it doesn't matter whether those stimuli are of high behavioural relevance or not. There is no more spare capacity to process them.

If an increase in attentional load decreases the interference of distracting stimuli, it follows that by the same token a decrease in attentional load will increase their occurrence, regardless of their prominence. In the absence of external distracters we may then expect an increase in the number of task-irrelevant thoughts. The likelihood of this happening is greatest when we are bored. A low perceptual load leaves ample spare attentional capacity for the processing of task-irrelevant thoughts. During a dance performance the interference of possible distracters has been reduced, the lights in the audience have been dimmed, people are requested to switch of their mobile phone and so on. But if the events on stage do not exhaust the brain's attentional capacity, it may happen that, in the absence of external factors that might compete for the residual attentional capacity, internal thoughts gain a competitive edge. One person may become aware of his right leg itching, another person may shift in his seat, five persons may almost simultaneously clear their throat and you may suddenly remember walking through Lisbon's barrio alto.

This phenomenon whereby we experience our attention waning and our mind drifting away is variously known as mind wandering, stimulus-independent thought and task irrelevant thought (Smallwood and Schooler 2006). When the mind wanders you may continue reading, but when you awake from your slumber you realize that you have completely forgotten what you just read. Introspection tells us that, when you go back to where your thoughts drifted off, you may notice that the words and sentences are vaguely familiar. They were processed, but they lost out at a higher level of competition for working memory.

Recently mind wandering has been associated with a set of brain regions known as the 'default network' (Mason et al. 2007; Christoff et al. 2009). Various neuroimaging studies have reported increased activity in a network of brain regions when no explicit task is performed and participants just lie inside the scanner (Gusnard and Raichle 2001; Buckner et al. 2008). This network comprises a number of regions along the midline of the brain including the medial prefrontal cortex, the anterior and posterior cingulate cortices, the precuneus and the inferior parietal cortex. The meaning and relevance of these findings is still a matter of debate though (Morcom and Fletcher 2007). Does it constitute a baseline against which the neural concomitants of all other cognitive tasks should be considered? Does it reflect a specific process of which mind wandering and dreaming are a by-product? Or does it instead reflect enhanced watchfulness toward the external environment (Gilbert et al. 2007)? After all, the person inside the scanner may also be waiting for the next stimuli or listening to the noise of the scanner. Besides, it's not exactly comfortable inside those laboratories, so whether these processes also occur when someone is just sitting in a park watching the grass grow, is as yet unknown.

The location and extent of the default network is another matter of contention. An earlier neuroimaging study in which a simple cognitive task was compared with a state of rest, found increased activity in temporal lobe structures, including the hippocampus and parahippocampus (Christoff et al. 2004). Although the authors did not specifically ask whether the participants had experienced mind wandering they interpreted their findings as the concomitants of spontaneous thought processes. Their results are in line with a study, which actually aimed to explore the implications of using rest periods as a baseline condition in functional MRI studies (Stark and Squire 2001). Based on their findings, which included substantially greater activity in the medial temporal lobe compared with several alternative baseline conditions, the authors advised against using rest as a baseline, but they did not probe further into what is currently considered a phenomenon of great interest.

The paradox of mind wandering is that, when you become aware of it, the mind stops wandering, because now your own thoughts have become the focus of your awareness. Experimental studies have inferred mind wandering by recreating the conditions, which are known to increase the likelihood of its occurrence and by asking participants afterwards whether they had experienced their thoughts drifting. In a recent neuroimaging study participants were specifically asked to provide a self-report about their current mental state while they were lying inside the scanner (Christoff et al. 2009). The self-reports were compared with the incidence of performance errors during the task, which has been linked to mind wandering. The results showed that both mind wandering reports and performance errors were preceded by activation in default network regions, which, as the authors note, suggests a convergence between subjective and behavioural measures of mind wandering. Additionally, mind wandering was associated with increased activity in dorsal anterior cingulate cortex (BA 32) and dorsal lateral prefrontal cortex (BA 9), both of which have been implicated in demanding tasks requiring what has been termed executive control. While these findings may be interpreted in more than one way, one possibility is that they reflect increased competition between neural signals.

I would now like to venture the following hypothesis. A performance consisting of a series of highly salient stimuli may sustain the audience's attention, but will not give rise to many thoughts directly afterwards. The audience's attention has been totally consumed by the visual spectacle. By contrast, a performance in which not much happens and which effectively deprives the audience of sensory stimulation for its entire duration, will cause the mind to wander. Since mind wandering is a highly subjective phenomenon there are no objective methods of measuring its occurrence and extent. One of the defining characteristics of mind wandering is that the thoughts are fleeting. An hour or so later people may have forgotten the thoughts that occurred to them as their attention waned. However, the thoughts people have *during* the show may influence their interpretation *afterwards*. One may thus expect people's interpretations to show a great variance if a performance was uneventful and boring.

In her book *Watching the Dance Go By* (1977) the American dance critic Marcia Siegel discusses an hour-long dance performance by William Dunas, *I Went With Her and She Came With Me* (1973), 'in which Dunas merely walked around a space. Following straight, diagonal, or slightly curving paths, he slowly lifted one foot, then the other, going continuously except for brief rest stops' (Siegel, 1977: 314). Siegel comments that '[she] never lost *interest* in the piece' and that she 'enjoyed *examining* Dunas' movement, which is very complex as to the way he distributes his weight, rearranges his tensions, contains himself in space. Since the step itself changed so little, I could pay full attention to its ingredients and discover new aspects of it…(Siegel 1977: 315; emphasis mine)'. An ordinary person, enjoying a coffee while sitting in an outdoor café, would never examine the manifold ways people distribute their weight as they walk by, unless, perhaps, he or she is utterly bored. As a dance critic Siegel was paid to attend the performance and expected to write about it. And so she had a reason to look for something to attend to. As she continues, 'the piece has a meaning as metaphor. The narration suggested exile and war to me' (idem). But why exile and war? As I will argue in more detail when I discuss meaning and metaphor (☞ §27.4), Siegel's thoughts may have been the product of a random connection between different mental models. To another person the piece might have suggested deep contemplation or the treadmill that is work at the internal revenue service.

11.2 CONCLUSION

Both the interesting and the boring give rise to a stream of thoughts. Whereas in the case of interest the thoughts are conditioned by the object or event of interest, in the case of boredom the stream is mostly random. The paradox of interest is that an object that can serve as a canvas for us to project our thoughts on, such as a monochrome painting or a conceptual dance performance, can be considered interesting, even if it is of little interest.

When the mind is free to wander thoughts appear seemingly out of nowhere. It is as if the doors of consciousness are set ajar and the unconscious creeps in like a fresh draught on a warm summer evening. Boredom is the state most prone to mind wandering. As Nietzsche wrote in fragment 42 of *The Gay Science* (1887), 'for the thinker and for all inventive spirits, boredom is that disagreeable "lull" of the soul that precedes a happy voyage and cheerful winds' (Nietzsche 2001: 57). But when do we ever take the time to let our thoughts wander? Think about it, next time you're bored during a dance performance and be grateful to the choreographer for freeing your mind and giving you access to thoughts you never thought you were capable of thinking.

KEY POINTS

☞ 'The feeling of boredom consists in a negative appraisal of one's own state of mind. It can, but need not, be directed at an object and it can, but need not, be caused by the confrontation with a boring object. One can be bored with something, but one can also simply be bored in the absence of anything that causes it.'

☞ 'If the events on stage do not exhaust the brain's attentional capacity, it may happen that, in the absence of external factors that might compete for the residual attentional capacity, internal thoughts gain a competitive edge.'

☞ 'The phenomenon whereby we experience our attention waning and our mind drifting away is variously known as mind wandering, stimulus-independent thought and task irrelevant thought.'

☞ 'Mind wandering has been associated with a set of brain regions known as the default network.'

☞ 'A performance in which not much happens and which deprives the audience of sensory stimulation, will cause the mind to wander. The thoughts people have *during* the show may influence their interpretation *afterwards*. One may thus expect people's interpretations to show a great variance if a performance was uneventful and boring.'

☞ 'Both the interesting and the boring give rise to a stream of thoughts. Whereas in the case of interest the thoughts are conditioned by the object or event of interest, in the case of boredom the stream is mostly random.'

Part 3

Prediction

12

INTRODUCTION

I still remember how once, during a performance of *Herman Schmerman* (1992), a ballet by William Forsythe, halfway into the second act one of the dancers slipped and fell to the floor. Curiously, even though it happened in front of my eyes, I didn't actually see her fall, it all happened too fast. Some people in the audience let out an audible sigh when they noticed the dancer fall and this actually alerted me to the fact that something had happened. When I caught sight of the unfortunate dancer she was already scrambling to get up. The dancer was a true professional and continued as if nothing had happened. During the curtain call the audience expressed its heartfelt sympathy by giving her an extra long applause.

The reason some spectators were startled was that the dancer's movements constituted a radical departure from the expected motion path and resembled the kinematics of someone slipping and falling. The same happens if in tennis the ball bounces off the net cord and drops dead behind the net. In dance one could take advantage of this phenomenon by intentionally falling to the floor provided that the fall is unexpected. One of ballet's popular legends is that when one of the dancers fell during the rehearsals for *Serenade* (1935), Balanchine liked the effect so much that he decided to incorporate the fall in the ballet.

The startle response is a physiological response that often occurs when people are surprised. It interrupts any ongoing actions and reorients attention to the likely source of the disruption. Feelings of surprise, shock, revulsion, delight, convulsion, excitement, amazement and horror, which can be categorized as agitations (Bennett and Hacker 2003: 201), are short-lived affective disturbances that are typically caused by unanticipated disruptions. Depending on the nature of the event a series of unexpected events can produce a state of shock, horror, delight or excitement. It follows that, to understand why a dance performance can leave some people in the audience thrilled and excited, we will have to analyse the mental processes that underlie feelings of surprise, delight and excitement.

In so far as agitations are caused by unexpected disruptions they are contingent on the capacity to form a prediction, anticipation or expectation. In recent years it is increasingly being recognized that predictions are an essential aspect of perception, emotion, cognition and motor control and that predictive processing reflects one of the fundamental principles of brain function (e.g. Bar 2011; Bubic 2010). We prepare for what's coming and plan ahead. We leave home early when we expect delays. We lower our speed when we see the cars in front of us brake. We grab an umbrella on our way out for fear that it might rain. We buy theatre tickets in advance in order to have good a seat and once we've ordered them we look forward to the performance.

Prediction, anticipation and expectation are heterogeneous concepts and not all predictive capacities are equal. Predictions and expectations can be based on experience, knowledge of fact and the extrapolation of a sequence of events. They can be the result of conscious deliberation and the outcome of automatic brain processes. Bubic et al. (2010) therefore propose to reserve the term prediction for a general orientation towards the future; to use expectation to refer to a representation of what is predicted to occur in the future; to use the term prospection to refer to the consideration of potential future events and to reserve the term anticipation to refer to the state of anticipation and the processes that produce this state.

Literature, cinema, music, dance and theatre build on the capacity to anticipate the future. Dance is special in that it also builds on the specific capacity for detecting, predicting and interpreting human movement. Many novels, films, theatre and dance performances have been carefully crafted by their maker to create a state of anticipation in the reader, viewer or listener. Television episodes often end with a cliffhanger to get the viewer to look forward to the next episode. Stories build up towards a dramatic climax, a logical conclusion or the discovery of who has done it. Jokes are usually based on the fact that the story allows for two different and opposing interpretations. They first create an expectation in the reader or listener and then deliver the punch line, which triggers a switch from one interpretation to another.[46]

To gain a better understanding of dance and choreography we therefore need to analyse the general capacity that enables us to anticipate the future and the specific capacity for motion anticipation. To this end I will first review some of the basic capacities that enable us to predict the future and, however oddly, the present. In the next chapter I will zoom in on the neural mechanisms that enable us to keep track of the dance. Following that I will address the question of why watching dance can be exhilarating and amusing. To end with I will analyse the cognitive and neural mechanisms artists take advantage of to draw things to an end.

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[46] I want to die peacefully in my sleep like my grandfather, not screaming in terror like his passengers.

13

THE PREDICTIVE BRAIN

When you arrive at a theatre to attend a dance performance you will have formed an expectation of what you are about to see. If you have been dragged along by a friend who has been trying to convince you that contemporary dance is cool and if your primary association with dance as a performing art is *Swan Lake* or *The Nutcracker*, you may be pleasantly surprised when you see William Forsythe's *Enemy in the Figure* (1989), Ohad Naharin's *Three* (2005), Jiří Kylián's *Wings of Wax* (1997) or Pina Bausch's *Sacre du Printemps* (1975). If you are already familiar with the work of the company you may be hoping for an experience that rivals the first time you saw them perform. If it is more than a decade ago since you last saw a piece by the same choreographer you may be curious to see her latest work. If you have seen the production before you may be looking forward to seeing it again.

Even if you plan to approach the performance with an open mind and even if you pretend not to expect anything so as to avoid being disappointed, you will anticipate something. If you haven't seen the performance before you may go to the toilet before the beginning of the performance, because you don't know how long it will last and because you assume that you won't be able to leave somewhere in the middle. You may have put on some nice clothes – it is a night out after all – because you don't expect to be drenched in water, as has happened to me on more than one occasion. As we shall see in the present chapter your actions betray your expectations in more ways than you can imagine.

13.1 MEMORIES FOR THE FUTURE

If you are reading this book then I assume you will have seen at least a couple of dance performances. Like me you will be able to name some performances that made a great impression on you. But what do you actually remember of your favourite dance performances? Do you remember the number of dancers? The costumes? The music? Do you remember how they started and ended? Do you remember any particular scenes or sections? This is not an exam so don't worry if you can't answer any of these questions. What matters, is the one thing that you do remember: that it was a great performance and that you enjoyed it.

Memory is one of the most important cognitive capacities of human beings. We rely on our memory to perform daily duties, such as taking money out of an ATM, running an errand and signing in to a computer system. We share memories of a holiday or a celebration with our friends, we remember how to edit a movie in Final Cut Pro and we keep our memories of a beloved one alive.

Memory is also one of the most elusive concepts in cognitive science and psychology. The reason is that it refers to a great variety of phenomena. One can remember seeing, doing and feeling something. One can remember facts about one's surroundings, such as the nearest emergency exits and general facts, such as mathematical theorems and their proofs. One can remember facts about one's past, such as one's wedding date and about one's future, such as a meeting scheduled for next Thursday. One can remember that something is the case and one can remember how to do something. Memory is an ability that can be exercised by recounting what one remembers, by confirming that one remembers it and by demonstrating that one remembers it. The fact that one remembers something can also reveal itself in one's behaviour. Remembering the way to one's office comes down to being able to get there without losing one's way. As Bennett and Hacker (2003: 154) point out, 'memory is the faculty for the *retention* of knowledge acquired. *Recollecting* is the bringing to mind of knowledge retained.' What is remembered when one remembers something does not necessarily involve a memory of the episode on the occasion of which the knowledge was acquired. Remembering the plot of *Hamlet* does not involve a memory of reading the text or attending the play. Cognitive neuroscientists therefore distinguish between episodic memory, the memory of autobiographical events, and semantic memory, the memory of facts and knowledge about the world.

Occasionally our memory fails us. We forget an appointment and if we remember the appointment itself we may forget the location. You probably remember what you did today and yesterday, but it is unlikely that you will be able to recall what you did today two, five or seventeen years ago, unless today happens to be your birthday. I haven't spoken Portuguese for years and as a consequence I can only stammer a few broken sentences and when I look at the advanced mathematics classes I took at university I am amazed I passed the exams. Where did all that knowledge go? The opposite is also the case, since memories can persist despite one's desire to consign them to oblivion. We sometimes try to obliterate events from our memory that we'd rather forget, but that continue to haunt us in our dreams and when we're not paying attention to anything in particular.

The current consensus in cognitive neuroscience is that memory is a constructive process. Recounting something does not amount to replaying a neural record the way you play a cd or a song stored on your hard disk. There are no memory traces in the brain. When one tries to remember something the brain does not seek to retrieve it; when one memorizes something it doesn't store it either, rather, memories are reconstructed from remembered facts, as the following experiment illustrates.

Read the following list of words: painting, drawing, sketch, engraving, cubism, sculpture, portrait, impressionism, still life, museum, artist, fauvism, lithograph, surrealism, water colour, fresco, collage, expressionism. Now, without looking back at the words you just read, answer the following question: which of the following words was not on the list? Painting, lithograph, art, rhinoceros. The correct answer is, of course, rhinoceros, but the other correct answer is art. Surprised? If you are like most people you remembered that the list contained words related to the category of art and assumed that the word art itself probably also featured on the list, except that in this case it doesn't. This is, in fact, an actual experiment and one that has been replicated many times with different words and in various experimental settings (Roediger and McDermott 1995). When the participants in the experiment are asked to write down the words that they remember, many people include the one word that one would *expect* to be on the list, even though it didn't actually occur on the list.

This experiment demonstrates how easily your memory can fool you. It does not mean that you should no longer trust your memories or that all memories are essentially false. After all, you do correctly remember your login name and password; otherwise you would no longer be able to gain access to your email account. You also remember your name, date of birth, bank account, address and telephone number. However, you may have forgotten your previous address and telephone number. The accuracy and veracity of memory therefore appears to depend on pragmatic considerations. There is no longer any need to remember your previous address or the telephone number of your former employer and since you no longer recollect it on a regular basis it slips into oblivion. The imperfections of memory are not design flaws or signs of systemic failure. Depending on the circumstances the same imperfections can be either beneficial or detrimental. Forgetfulness makes room for new memories. This is why in *On the Genealogy of Morality* (1887) Nietzsche called forgetfulness 'positive in the strongest sense of the word' (Nietzsche 1994: 38). The fact that you have fond memories of a particular performance, but have otherwise forgotten all about it, can be a reason to see it another time if it is performed again.

The experiment reveals an important aspect of memory: memory is associative. Facts, concepts, words, ideas and experiences are all connected in a giant multidimensional network. When you see a poster announcing a movie featuring Christian Bale you may instantly be reminded of *American Psycho*, another movie in which he starred, of the novel by Bret Easton Ellis on which the movie is based and of dining at Le Benardin an upscale restaurant in New York. Every stimulus, whether internal or external, is like a pebble thrown into a pond, creating waves in all directions. Most of the memories that are thus activated remain unconscious, but they may generate associations that become conscious at a later stage.

A number of recent neuroimaging studies demonstrate that remembering the past and imagining the future rely on the same network of brain regions. This has led some authors to conjecture that episodic memory provides a source for simulations of the future (Schacter et al. 2007). The idea is that the imagination of a new event that has not been previously experienced involves the flexible recombination of details from past experiences. Of course, imagining need not involve possible future events: it can also involve alternative histories and entirely novel constellations of events, as in fiction. It is currently assumed that this process of flexible recombination is supported by the hippocampus. Traditionally, the hippocampus has been associated with the process of retrieving memories about the past, but recent findings suggest that the hippocampal system may be better understood as a system that facilitates predictions about upcoming events. Neuroimaging studies have reported that the hippocampus and associated cortical structures are active when people envision future events, while damage to the hippocampus impairs this ability (Buckner 2010). I should add that, while these more recent findings suggest that the traditional view of the hippocampus is wrong, this does not mean that the current view is right. Future findings may once again alter our understanding of memory formation and the role of the hippocampus therein.

Just as perception evolved for action and not for cognition or perceptual experience, memory evolved for anticipation and not for reminiscing about the past. The properties of the capacity for memory therefore also constrain the capacity for anticipation. And so it may happen that halfway into the performance you realize how much you had forgotten. You may wonder whether it is your memory that has failed you or whether perhaps the choreographer has changed some sections. After the performance, as you are on your way home it may occur to you that the scene you had been looking forward to seeing again is part of a different production.

13.2 PREDICTING THE PRESENT

Based on neurophysiological studies in monkeys and MEG recordings in humans it has been estimated that there is a lag of about 50 to 100 milliseconds between stimulus presentation and the moment the output signals of the retina reach the primary visual cortex. Even though there are no experimental paradigms to determine where and when in the brain visual perception occurs, these findings demonstrate conclusively that perception takes time. If an object were to change its shape, colour or position within this timeframe, what we perceive would not match the actual state of affairs in the world. This is by no means a theoretical possibility. Some simple arithmetic shows that a car driving at 100 km p/h will have covered an additional 2 to 3 meters by the time the light activates the visual regions of the brain. It is therefore not surprising that patients with damage to V5, the part of the brain that processes visual motion signals, see an approaching car in the distance and then suddenly near (☞ §3.3).

The observation that neural processing takes time leads to the rather obnoxious philosophical question whether what we perceive is present or past. In astronomy the idea that we see into the past is well accepted. The light emitted by the stars we see in the night sky may have travelled for millions of light years before reaching us. The light reflected by the dancers on stage only needs to travel a fraction of a second before hitting the retina and it takes another fraction of a second before the signals relayed by the retina reach the visual cortex, but the principle is the same.

Despite this delay seeing is essentially instantaneous and continuous. When you turn your head to look around, you don't experience a jump or a gap. What is more, you don't see colours, shades and edges that might take a few minutes to process, but objects, scenes and events. When I look outside of my window I see people, houses, trees, traffic signs, and cars and as I turn my head I instantly recognize the words on my computer screen. The reason for this remarkable feat is that the brain has evolved a number of mechanisms to overcome its own processing delays.

Early theories of visual perception regarded visual perception as a bottom-up, feedforward process, whereby low level features are processed in dedicated visual areas, which are then combined into a visual representation of the scene. However, computational models showed that it is impossible to account for all the variations in lighting and angles of view in a purely bottom-up way. What is more, when part of an object is occluded its identity can only be determined with reference to analogies, associations and memories. There is no way of determining on the basis of visual features alone that the dark patch on my desk, which is pretty cluttered despite my ongoing attempts at fighting entropy, is my bookmarker and that the tiny metallic tubular shape is the tip of my Papermate ballpoint. And yet, when I look at my desk I don't see some dark and light shades, I see a bookmarker, several ballpoints and pencils, my keyboard, my camera, my speakers, some pieces of paper with some notes scribbled on it, my external hard disks, some cables and my eraser.

Of course, I look at my desk almost every day, I have put all those objects there myself so in that sense it's not much of a surprise that I recognize what's lying on my desk. However, if I were to look at another person's desk I may still recognize some of the objects, even if they are partially occluded. I may not be able to identify the ballpoint's brand, but I can find it. This is because the context in which objects appear facilitates perceptual processing. Objects don't usually appear in isolation, as they do in a museum display, but as part of a scene. That thing attached to the keyboard is most likely a mouse and that dark rectangle with the aluminium looking edge is probably a computer monitor. When you open a drawer of someone's desk you would be surprised to find the contents of a kitchen drawer inside or the still bloody eye of a cow. Precisely because they are surprising and disconcerting these are the kind of events frequently exploited in horror movies. They reveal a world in which the normal laws no longer apply.

Artists sometimes like to confound the viewer's expectations by presenting something out of context or by making an object larger than its everyday equivalent, but when you walk into a museum you know that the objects on display are all artworks. A museum is just another context. Within the context of art, movements such as dada and genres such as the still life constitute a special kind of context. In a still life you can expect to see a human skull, some fruit and a tablecloth gathered on a table[47], even though you would be unlikely to encounter a similar scene in your own kitchen, unless your partner specializes in vanitas paintings. When you attend a dance performance you will similarly recognize the dancers, even though their bodies are partially occluded. What is more, whatever they do will instantly be neutralized as art.

Various experiments have demonstrated that objects and scenes are recognized far more quickly than might be expected on the grounds of the speed with which signals are transmitted in the brain. In one experiment participants were asked to gauge whether a previously unseen photo that was flashed for 20 milliseconds contained an animal (Thorpe et al. 1996). Now 20 milliseconds is a very quick flash, but even so, participants performed better than chance. Speech provides another example of how quickly stimuli are identified. Just listen to a foreign language and bear in mind that the rapid, continuous stream of sounds is how your own native language sounds to foreigners.

To account for the speed with which objects are perceived and recognized, a number of authors have proposed that perception arises from an iterative process whereby bottom-up signals are fed forward to higher-level regions, which in turn modulate bottom-up processes (e.g. Friston 2005; Bar 2007; Grossberg 2009). It is often pointed out in this respect that top-down feedback connections in the brain are more numerous than bottom-up feedforward connections. And whereas bottom-up projections tend to target a few regions higher in the processing hierarchy, top-down connections tend to target many regions at various levels of the processing hierarchy. For instance, the primary visual cortex V1 receives top-down projections from a great many regions, but projects to only a few regions.

Some authors have proposed that predictive processing is facilitated by one or several specific brain regions, in particular regions in the prefrontal cortex (e.g. Bar 2007; Koechlin and Summerfield 2007; Kveraga et al. 2007). According to one such theory a partially processed, low spatial frequency representation of the input is projected from the primary visual cortex to the medial prefrontal cortex and the adjacent orbitofrontal cortex (Bar 2003; 2007). The orbitofrontal cortex then triggers the activation of the neural circuits that process stimuli that best resemble a coarse representation of the stimulus. These circuits then modulate further processing in lower regions. For example, a black and yellow striped object that flies into your field of view will trigger wasp, bee, fly and insect and not airplane (too big), refrigerator (different category) or ocean. Neuroimaging experiments have provided tentative support for this hypothesis (e.g. Summerfield et al. 2006; Bar et al. 2006), but for the moment the evidence is still provisional at best. For one thing, one would like to know whether patients with damage to different parts of the prefrontal cortex are impaired at prediction tasks and whether selectively applying TMS, if technically feasible, impairs prediction tasks in normal subjects.

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[47] Paul Cézanne, *Still Life with Skull* (1895-1900).

In chapter 9 we saw that a surprise can be mathematically defined in terms of Bayesian probability theory as the difference between a posterior and a prior probability (☞ §9.1). A view that has recently become popular in computational neuroscience is that the brain as a whole engages in some form of Bayesian inference in order to avoid surprises (Friston 2009b; 2010).[48] The details are rather technical, but basically the idea is that the brain functions as a probability machine that constantly makes predictions about the world and then updates them based on sensory input. If an insect flies into your field of view your initial guess might be that it is a fly. However, there may be a discrepancy between the sensory data (it has black and yellow stripes and buzzes at a different frequency) and your prediction. To reduce the prediction error you can either change your prediction (based on the same data) or turn your head to look more closely (and acquire new, additional data). In many circumstances you don't actually have to ponder what to do: you automatically look up, extend your arm, hit the brakes and so on. Anything that happens automatically in so far as the brain is concerned means that some kind of processing must be going on behind the scenes. Since some of our actions reveal an orientation towards the future this means that the brain must somehow form a prediction of what is likely to happen. The theory is attractive because it starts from basic computational principles that can be implemented both at a cellular and a systems level, but as Friston (2010) acknowledges, the challenge is to understand how it manifests itself in the brain.

If you have read that *Lamentation* (1930) by Martha Graham is a solo for a female dancer you know that the shape on stage on that wooden bench is a female dancer in a purple stretch dress. Humans have bodies, faces, limbs, feet and hands, so even though the body is occluded you know that it is a human body, which animates the fabric. You also know that, even though you may not be able to discern them from your place in the audience, those vague contours sticking out from underneath the dress are hands and feet. As a matter of fact, it is hard to trick the visual system into *not* seeing a person. Alwin Nikolais liked to manipulate the dancers, costumes and lighting so as to create an ambiguous scene (☞ §3.4), but even so spectators know that the performers on stage are dancers. It is only during some brief moments that you may experience the illusion of a purely visual configuration.

13.3 PRIMING

How often have you decided not to see a movie or a performance based on a single negative review in your newspaper? How often have you read a book based on the recommendation of a friend or a five-star review at amazon.com by someone whose credentials you don't know? Whether they attend a performance or visit an exhibition, people always arrive armed with a set of prejudices and expectations. After reading a negative review spectators

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[48] Recall that Bayesian inference is a method of statistical inference whereby empirical observations are used to update previously calculated probabilities.

who don't instantly put their tickets on eBay may not expect much. During the show they may actively look to see their expectations confirmed. People who did not like a performance may revise their opinion after reading a positive review. It is not just reviews that bias our judgements and decisions. Numerous experimental studies have demonstrated that the unconscious exposure to a word, picture or event can bias people's subsequent actions, perceptions and emotions.

The technique psychologists use to determine the effect of the unconscious exposure to a stimulus on a subsequent task is called priming. In one classic experiment 34 students who were enrolled in the Introductory Psychology course at New York University were randomly divided into three groups. The participants had to construct a grammatically correct four-word sentence out of five randomized words, which, they were told, was part of an experiment designed to test language ability. One group was presented with a set of words that included numerous 'rude' words such as bold, rude, interrupt and bluntly, while another group was presented with 'polite' words such as respect, appreciate, cordially and sensitively. The third group was presented with neutral words. This, however, was not the actual experiment. The participants were told that after the session they should leave the room and would be shown to another room for a second experiment. Upon leaving the room they would find the experimenter engaged in a conversation with a colleague. The experimenters measured how long each person took before interrupting the conversation and asked to be shown to the room for the second experiment. As it turned out, those in the 'polite' condition waited much longer than those in the 'rude' condition (Bargh, Chen and Burrows 1996), suggesting that reading lots of 'rude' words had biased their behaviour towards rudeness. In a second experiment one experimental condition contained words associated with the elderly, while a control condition contained neutral words. Oddly, participants who had been primed with elderly words walked slower as they exited the room and crossed the hallway.

Another experiment found that people who had surreptitiously been given a warm cup of coffee to hold as they went to the room where the experiment would be conducted, subsequently rated a person as 'warmer' on a standard 10 scale personality trait test than those who had been given a cup of iced coffee. In a variation of the experiment, after holding a cold object participants were more likely to choose a gift for themselves than a gift for a friend as reward for participating in the study. The authors concluded that the experience of physical temperature can affect people's impression of and behaviour towards other people (Williams and Bargh 2008). This finding has later been corroborated in another study, using a different experimental paradigm (IJzerman and Semin 2009).

In everyday life we are constantly exposed to many conflicting messages. Consequently, experimental studies that demonstrate a cognitive or emotional bias in a carefully manipulated laboratory setting may not translate to a day-to-day context. We may hold a warm cup of tea in one hand, but open the cold door with our other hand. We don't usually read long lists of either negatively or positively valenced words in a row or watch a series of pictures of pleasant or unpleasant scenes either. Except that is, when we watch a movie, sit through the advertising block or attend a dance or theatre performance.

Movies, commercials and dance and theatre performances consist of an array of stimuli aimed at systematically biasing the spectator in a certain way. There is no difference in this respect between Hollywood movies and arthouse movies and between musicals and (supposedly) avant-garde dance and theatre performances. As I argued above (☞ §7), if an artist wants to avoid a particular effect, for instance, that the audience is carried away or gets emotionally involved, he or she will need to mould his or her material to that end. A director might interrupt the show by appearing on stage or on screen and explain to the audience that what they are watching is fiction. A musician might stop playing in the middle of a song and address the audience about the threat of overfishing to marine ecosystems. A dancer might stop in the middle of an intricate phrase and just walk away or pretend to sneeze and continue as if nothing happened.

13.4 CONCLUSION

When we watch a dance performance we always look through the fog of our own expectations and implicit assumptions. The name of the company and the choreographer, the title of a piece, the program booklet, reviews, press releases, interviews, the previous piece if it is a combined program, a traffic jam on your way to the theatre, an argument with a friend who arrived late, and who knows, maybe even holding a warm cup of coffee during the interval, all bias our thoughts and feelings and whether we want to or not. It is all a reflection of the brain's workings and internal organization.

The general aim of predictive approaches to brain processing is to determine how previous knowledge influences and guides current processing. Each of these approaches demonstrates that previous knowledge is crucial for facilitating current processing in the domain of perception, emotion, cognition and motor control. Predictive processing occurs at various timescales and has been associated with a number of different brain circuits. Indeed, it has been hypothesized that predictive processing is a general feature of all forms of neural processing.

Even though the brain provides the neural conditions for how we perceive, think, feel and judge, that doesn't mean that we are slaves of our brain. A greater awareness of what influences our thoughts and feelings may enable us to better exercise our judgement and to adjust our judgement for the fact that we had a bad day at the office. Reading about psychology and the workings of the brain may also help us to better understand the fabric of our selves and may thus guard us from prejudices and snap judgements. But of course I am biased.

KEY POINTS

- ☞ ‘Numerous experimental studies have demonstrated that the unconscious exposure to a word, picture or event can bias people’s subsequent actions, perceptions and emotions.’

- ☞ ‘In everyday life we are constantly exposed to many conflicting messages. Consequently, experimental studies that demonstrate a cognitive or emotional bias in a carefully manipulated laboratory setting may not translate to a day-to-day context.’

- ☞ ‘Movies, commercials and dance and theatre performances consist of an array of stimuli aimed at systematically biasing the spectator in a certain way.’

- ☞ ‘The context in which objects appear facilitates perceptual processing.’

- ☞ ‘When you walk into a museum you know that the objects on display are all artworks and when you attend a dance performance you know that the performers are dancers and that what you are watching constitutes a performance.’

14

KEEPING TRACK OF THE DANCE

If you have ever watched tennis, whether live or on television, you may have noticed some of the spectators move their heads from left to right and back again as they track the ball from one end of the court to the other. The players for their part need to keep track of the ball and their opponent. In the early 1980s sports psychologists showed that in professional tennis the serve is generally too fast for an opponent to decide after the ball has been hit in which direction it is going, to the forehand or backhand, and that was before today's power serves, which can reach speeds of up to 200 km p/h. Although, to appreciate just how fast this is, you would have to watch a live tennis match. To return a ball most professional players take cues from the postural orientation and movements of their opponent to gauge where he or she is going to hit the ball, which enables them to move in that direction even before the racquet touches the ball (Williams 2009). The same capacities that enable tennis players to gauge the direction of the ball allow spectators in dance too track the dancers as they move across stage and swiftly go from one body configuration to another.

14.1 SACCADES AND SMOOTH PURSUIT

In the 1950s and 1960s the Russian psychologist Alfred L. Yarbus studied the role of eye movements in the exploration of complex images and natural scenes (Yarbus 1967). His experiments revealed that the eyes are repeatedly drawn towards highly salient features of a picture or a scene and that gaze patterns are task dependent. As a result traces of the eye movements of a person passively looking at a photo of a girl with a headscarf resemble a sketch of the picture. The reason people move their eyes across a scene is to bring the image of the object to bear on the fovea, the region of the retina with the highest visual acuity. But what if the scene is dynamic instead of static? And what if the scene itself changes?

In order to track a moving object the oculomotor system employs a combination of saccades and smooth pursuit eye movements. Saccades are rapid, discrete eye movements that direct the eye towards a visual target so that the image of the object falls on the fovea. Smooth pursuit eye movements are slow, continuous rotations of the eyes that enable the tracking of a moving target by stabilizing its image on the fovea and serve to hold the eye steady on a stationary object during self motion. Since it takes about 100 milliseconds to initiate a smooth pursuit eye movement, when an object starts moving or appears in one's field of view a saccade is needed to catch up with it. There is also a limit to the velocity with which objects can be tracked. If a target moves too fast, every now and then the oculomotor system will initiate a saccade to close the gap so as not to let the gap grow too large.

More than a century of research has revealed many details about the brain regions associated with saccades and smooth pursuit. Neuroimaging studies have revealed largely overlapping networks for both smooth pursuit and saccades involving the frontal eye field (FEF), the supplementary eye field (SEF), the parietal eye field (PEF), the medial temporal area (MT), the medial superior temporal area (MST) and the cerebellum. I should add that the resolution of today's fMRI scanners might be too low to differentiate between different parts of each of these regions that might be associated with either smooth pursuit or saccades (Lencer and Trillenberg 2008). Lesion studies and neurophysiological studies in monkeys have further pointed at the superior colliculus, the brainstem and the basal ganglia as important nodes in the network subserving both smooth pursuit and saccades. It has also been found that, in humans, lesions to the cerebellum may completely abolish the capacity for smooth pursuit, while electrical stimulation of the cerebellum produces smooth eye movements.

There is extensive evidence that the network subserving smooth pursuit eye movements forms a prediction of the motion path and velocity profile of the target being tracked. It has been shown that, when a target temporarily disappears from view, its motion can be correctly tracked for a short duration to the point where it reappears (think of a dancer or a limb disappearing behind the body of another dancer or of a car disappearing behind a truck). It has also been found that patients with Parkinson's disease tend to have difficulty tracking predictably moving targets but perform normally when the target motion is random (Ladda et al. 2008). A possible explanation for this observation is that, in the latter condition the eye movements are guided by an external cue, whereas in the former condition they draw on an internal prediction of the target's motion trajectory. Since patients with Parkinson's disease are unable to build on internally generated cues they are impaired at tracking predictable motion.

Perhaps some of the most compelling evidence for the predictive nature of motion perception has come from the study of fast ball sports such as tennis, baseball and cricket. In one intriguing experiment Land and McLeod (2000) recorded the eye movements of batsmen in cricket as they prepared to hit an approaching ball. They found that the batsmen's eyes tracked the ball shortly after its release, then made a predictive saccade to where they expected it to hit the ground, waited for it to bounce and then tracked its trajectory for 100-200ms afterward. As the authors write, 'information provided by these fixations may allow precise prediction of the ball's timing and placement.'

When watching a scene it may happen that moving the eyes is not enough to trail a moving object. One may have to move the head and, if that isn't enough, the upper body to keep the object within one's field of view. This suggests that tracking a moving object involves a hierarchy of predictions. This is perhaps most evident when tracking a target with binoculars in which case the head and the upper body need to move in concert to keep the target within the field of view of the binoculars.

We are now in a position to answer the question of what happens when we watch a dynamic scene. If you're passively watching a slideshow and are given ample time for each slide, in a serialized version of Yarbus' original experiment that is, the eyes will move across each slide. If you're looking at an otherwise static scene, a landscape, a room or a stage, in which a single object is moving, the eyes will track the moving object. If there are multiple moving objects the eyes may jump from one target to another, unless the objects move close together and in synchrony or in different directions, at different speeds and in different zones in space. If the object has multiple independently moving parts, such as a human body, one can track the entire object's displacement through space or focus on the motion of individual parts.

Depending on whether you're inside a theatre or are looking at a small window on your computer screen, the moving objects are tracked with the eyes or with the eyes and the head. If you're in a theatre it depends whether it is a small, intimate theatre that seats 50 or 80 people or a large modern opera house with good sight lines. It also depends whether you are seated front row or on the second or third balcony and whether you are seated in the middle or to the far left or far right of the audience. All of this determines your angle of view, the relative size of the performers on stage and the degree to which you will have to turn your head and eyes to look from one side of the stage to the other. A person sitting front row will have to turn her head, a person sitting at the rear end of the theatre may just move his eyes.

Even though spectators in a theatre are silent witnesses confined to sitting immobile for the duration of the piece, the ongoing movements and changes of scenery trigger a constant orienting response. If a dancer walks across stage the eyes may trail her in smooth pursuit. If she suddenly falls to the floor, while adjusting the relative position of her arms and instantly gets up again, turning and raising a leg, grasping it with one hand, while drawing a curve with the other hand, the eyes may make saccade upon saccade. With multiple dancers moving across stage, entering and leaving, moving in and out of sync, spectators will have to work hard to keep track of all the activity on stage. Indeed, after watching a dance performance or a movie viewers may feel visually exhausted. Watching dance can be as strenuous as dancing oneself.

14.2 LEARNING PATTERNS AND THE PREMOTOR CORTEX

After listening to the same album or playlist on your mp3-player several times, you may have noticed that, when one track has almost finished, you can hear the beginning of the next track in the back of your mind. This is because through repeated exposure both the individual song structure and the track order are learnt. During the silence between tracks, when the auditory system is not engaged by external input, you may then already hear the first notes of the next song. In the days of the gramophone record and cassette tape this happened more frequently, since you were more or less bound by the record's track order. To skip a track you had to lift the arm of the record player and carefully position it at the interval between two tracks or fast-forward to the next gap between two tracks on your cassette. All of this changed with the advent of the compact disc and more recently mp3-players, both of which include a shuffle mode that plays all tracks in a random order and make it possible to program your own playlist.

When you watch a dance performance you may similarly pick up on various regularities in the choreography. You may notice that at one moment in Jiří Kylián's *Falling Angels* (1989) one by one the dancers spread their arms and that at another moment one by one they slightly bend one leg. When two dancers have spread their arms or bent their leg you actively look for the next dancer to do the same. With every subsequent dancer your prediction is confirmed, although it remains a surprise which dancer will be the next one to spread her arms or bend a leg.

Various neuroimaging experiments have suggested that the ability to learn and predict sequential patterns is subserved by a distinct network of brain regions. In one experiment participants were required to predict the last in a series of 12 sequentially displayed circles of differing size, which created the illusion of regular motion. In another experiment participants had to predict colour transitions and changes in auditory pitch. Each of these conditions resulted in increased activity in the basal ganglia, the parietal cortex and the ventrolateral premotor cortex as well as various other regions (Schubotz and Von Cramon 2002a).

Traditionally, the premotor cortex has been regarded as the part of the brain where goals are translated into action plans, but these experiments suggest that its function may be more general and may depend on the input it receives. Schubotz and Von Cramon (2002b) speculate that, 'when we try to predict how a target will move, the motor system generates a "blueprint" of the observed motion that allows potential sensorimotor integration. In the absence of any motor requirement, this blueprint appears to be not a by-product of motor planning, but rather the basis for target motion prediction.' In support of this hypothesis it has been reported that patients with damage to the premotor cortex showed higher error rates when performing the same sequential prediction tasks than a control group (Schubotz et al. 2004). The activity found in the ventrolateral premotor cortex in studies looking for the human mirror system may also reflect a more general predictive process (☞ §4.4). I should add that these findings leave unanswered the question of how neurons in the premotor cortex process incoming signals and what the output signals consist in. All that has been shown is that the premotor cortex is associated with various kinds of predictions tasks.

It has been proposed that the observed activity in the premotor cortex during prediction tasks amounts to the formation of an internal model of the stimulus pattern (Schubotz 2007). In chapter 4 we encountered internal models when I discussed the neural implementation of motor schemas. As you may recall internal models come in two flavours: inverse models and forward models. Inverse models generate the motor commands that produce a certain movement; forward models predict the sensory consequences of the executed movement. The internal model framework was originally developed in the domain of motor control, but the computational logic can be used to account for a variety of phenomena in other domains. Internal models are, in essence, predictive and may be used to estimate the present state of a system or to predict its future state. Of course, what one would like to know is whether perceptual prediction uses the same models as motor prediction but with different input signals. One would also like to know whether the properties of those models constrain perceptual prediction in any systematic way and if so how and to what extent. How many input signals are needed to form a prediction? How far apart can they be?

The brain is a phenomenal learning device and constantly extracts statistical regularities from the environment. Just as you cannot help seeing a face in a photo of the surface of Mars (☞ §3.1), you cannot help noticing patterns in a series of stimuli. When you are watching a 30-minute choreography you learn the recurring themes and patterns within that particular piece. Unconsciously you may rejoice whenever your predictions are confirmed. After seeing three or more pieces by the same choreographer you will become familiar with his or her choreographic style.[49] As a result you may look forward to his or her next production, but at some point you may also grow bored (☞ §11).

14.3 LEARNT PATTERNS AND THE BASAL GANGLIA

In dance, even in a solo, there is often a high movement density. Bodies turn while legs are raised and arms are twisted. As a consequence spectators may constantly find themselves overtaken by the events on stage. Movements may intertwine without any clear beginning or end. The next movement may already have been initiated before the previous movement has been fully processed. To the uninitiated it may be difficult to discern what is actually happening during a series of *fouettés rond de jambe en tournant*, one of the standard movements in classical ballet. It also frequently happens that some limbs are temporarily occluded from view or that a dancer briefly disappears behind another dancer. But just as scene information facilitates object recognition, contextual information informs the processing of motion. Judges in gymnastics, figure skating and competitive diving know what the contestant is supposed to do and match the movements of the performer against a virtual template (☞ §4.2; §31.1). Breakdance consists of a small repertoire of movements and some movements require a preparation so you can usually tell when a b-boy is going to

[49] Anna Kisselgoff (1985), dance critic for *The New York Times*, once wrote of a new production by Trisha Brown: 'This is an unsettling time to be seeing Miss Brown's work. Just when she had finally trained our eyes and minds to follow her playful but sophisticated formal games, she has decided to shift gears with a vengeance.' Of course, we shouldn't read too much into Kisselgoff's choice of words, but one's experience is a reflection of the underlying mental processes.

do a flare, a windmill or a backspin. A movement's onset may therefore trigger a prediction of its continuation. A key network in the circuit subserving this process is the basal ganglia.

The basal ganglia are a complex network of nuclei deep in the centre of the brain. These nuclei do not form a single anatomical entity, but a functionally organized system. The basal ganglia comprise five intricately connected subregions: the putamen and the caudate nucleus, which together are often referred to as the striatum, the globus pallidus, the subthalamic nucleus and the substantia nigra. The latter is so called because its cell bodies contain neuromelanin, which give it a dark pigment in anatomical sections. Like many other brain regions the nomenclature of the basal ganglia and its components derives from early anatomical studies, which were based on an analysis of their macroscopic shape and not on cell structure or functional considerations.

The basal ganglia receive input from areas across the cerebral cortex and project back to the cortex by way of the thalamus. The striatum is the primary input station of the basal ganglia, while the globus pallidus and the substantia nigra pars reticulata are the main sources of output projections. The basal ganglia are believed to participate in several parallel, functionally segregated loops, whereby the basal ganglia project back to those regions of the cortex providing original inputs to the striatum. The motor loop, associated with the control of voluntary limb movements, connects the premotor cortex, the supplementary motor area, the primary motor cortex, the posterior parietal cortex and the somatosensory cortex with the somatotopically organized motor area of the putamen. Additional loops connect the basal ganglia with the frontal eye field, the superior colliculus, the prefrontal cortex, the orbitofrontal cortex and the anterior cingulate cortex. It is through these circuits that the basal ganglia are associated with oculomotor control and various cognitive and emotional functions.

One of the most peculiar aspects of the basal ganglia is that physiologically its output is inhibitory: in the absence of input the neurons of the two output nuclei, the internal segment of the globus pallidus and the substantia nigra, fire at a constant high rate, thus inhibiting target neurons. Some of the projections to the globus pallidus are also inhibitory, meaning that the firing of the inhibitory neurons is inhibited, causing its target neurons, for example in the premotor cortex, to be *dis*inhibited.

The internal organization of the basal ganglia is extraordinarily complex. It is currently believed that there are two distinct circuits, known as the direct and indirect pathway. The direct pathway consists of a projection from the striatum to the internal segment of the globus pallidus and the substantia nigra. Since the projections to the globus pallidus and the substantia nigra are inhibitory the output from the thalamus to the cerebral cortex is excitatory. The indirect pathway connects the striatum to the internal segment of the globus pallidus by way of the subthalamic nucleus and the external segment of the globus pallidus. Since the output of the latter two regions is excitatory the firing rate of neurons in the internal segment of the globus pallidus and the substantia nigra is increased and so the net effect is inhibitory! What is more, dopaminergic projections from a segment of the substantia nigra, the pars compacta, have different modulatory effects on the activity of striatal projection neurons in the direct and indirect pathways. Dopamine excites striatal neurons in the direct pathway, but it inhibits striatal neurons in the indirect pathway. To make things even more complicated, it has recently been proposed that, in addition to the direct and indirect pathway, there is also a hyperdirect pathway connecting the cerebral cortex directly with the subthalamic nucleus (Nambu 2004). And all of this does not yet take into account the micro-architecture of the different sections of the basal ganglia or the physiological properties of different dopamine receptors.

Through the direct pathway neurons in the output nuclei of the basal ganglia are inhibited, causing target neurons in the thalamus to be disinhibited thus leading to the release of a selected motor program. Signals travelling through the hyperdirect and indirect pathways have an excitatory effect on the output nuclei of the basal ganglia and an inhibitory effect on thalamic and cortical neurons. If we assume that the hyperdirect, direct and indirect pathways have different latencies, the time course of inhibition and disinhibition would be something like: first inhibition through the hyperdirect pathway, then disinhibition by way of the direct pathway and finally inhibition through the indirect pathway. The basal ganglia may thus function as some sort of a gating mechanism, which ensures that only one motor program is executed at a time, while other competing motor programs are temporarily inhibited. The precise time course of activation would enable the initiation and termination of individual motor programs.

A number of neurological disorders, most notably Parkinson's disease and Huntington's disease, and neuropsychiatric disorders such as obsessive-compulsive disorder and Tourette syndrome, have been associated with malfunction of the basal ganglia.

Parkinson's disease, named after an English physician who first described it in 1817, is characterized by what appear to be two opposite symptoms. On the one hand patients with Parkinson's disease have difficulty initiating movements. They may remain stuck in the same position and lack the ability to make a spontaneous movement, whether with the fingers, head or legs. On the other hand patients often exhibit tremor and muscle stiffness, which is the result of the simultaneous activation of agonist and antagonist muscles. Because of a decline in postural reflexes patients often lose their equilibrium. In addition to motor disorders patients with Parkinson's disease may develop a number of cognitive, emotional and perceptual impairments. They may find it difficult to allocate attention and take longer to comprehend problems that require sequential processing.

In the 1950s it was discovered that Parkinson's disease is associated with reduced activity of the dopaminergic neurons in the pars compacta of the substantia nigra, which modulate the activity of neurons in the striatum. It is currently assumed that the gradual depletion of these neurons causes a reduction in the excitation of striatal neurons in the direct pathway and a reduction in the inhibition of striatal neurons in the indirect pathway. The net effect of this imbalance is increased activity in the output nuclei of the basal ganglia, the globus pallidus and the substantia nigra, and decreased activity in the thalamic and cortical neurons to which they project. While this hypothesis explains the observed reduction in voluntary movement (hypokinesia or akinesia), it does not yet explain the tremors that are equally characteristic of Parkinson's disease.

Huntington's disease is a progressive neurological disorder involving degeneration in basal ganglia structures that usually manifests itself between the ages of 35 and 45. The most characteristic symptoms of Huntington's disease are incessant, involuntary, random, jerky movements, known as hyperkinesia or *chorea*. The term chorea is no coincidence, since Huntington's disease is sometimes referred to as the dancing disease. Perhaps Frau Troffea is one of the first documented cases of the disease's most noticeable symptoms (☞ §3.2). Huntington's disease is caused by a genetic mutation, which induces a gradual loss of cells in the striatum. Since the mutation is dominant, children of an affected parent have a 50% chance of inheriting the disease. It is assumed that initially the degeneration of the striatum primarily affects the inhibitory neurons in the indirect pathway, leading to a decrease in the activity of the output nuclei of the basal ganglia, thus producing a greater excitation of target neurons in the thalamus and beyond, which results in random involuntary writhing movements and abnormal body postures. Huntington's disease is also associated with a number of cognitive impairments involving planning and rule acquisition among other things and various neuropsychiatric disorders such as compulsive behaviour.

The basal ganglia play a central role in motor learning (Doyon et al. 2009; Graybiel 2005). Numerous functional neuroimaging studies have demonstrated that the striatum, in conjunction with cortical motor regions, is activated when subjects learn or practice a novel motor sequence, tasks at which patient's with Parkinson's or Huntington's disease are generally impaired. Most studies distinguish between an early, fast learning stage during which performance improves rapidly within a single training session and a later, slow stage, during which improvements are more slowly and take place over various training sessions.

The same process can be observed when dancers learn a novel choreography. The global structure of the piece can usually be learnt in two or three days, depending on the length of the piece, but to get all the details, the timing and the flow of the movements exactly right, can take weeks. During those first few days the gain from every rehearsal hour is directly visible, but once performance reaches an asymptote achieving even infinitesimal changes takes a lot of practice. This is where the hard work comes in. Even after dancers have performed a piece several times and to much acclaim from the audience, the choreographer may still see room for improvement. Once a choreography has been learnt and performed its overall structure can be remembered for a lifetime and dancers may only need a few cues to bring it all back.

There is growing evidence that the process whereby novel movements are acquired and become automatic involves a gradual shift in activity in the cerebral cortex, the basal ganglia and the cerebellum. For example, in one experiment in which participants had to learn a sequence of finger movements brain scans acquired during the first day of learning revealed significant activity in specific parts of the putamen, the striatum, the globus pallidus and the corresponding output nuclei of the thalamus and the subthalamic nucleus. With ten minutes of practice, as performance improved, there was a shift in the activated part of the putamen, which persisted even after one month of daily practice (Lehéricy et al. 2005). It has been proposed that this pattern of activation corresponds with a shift in the spatial representation of the movement. According to this view the anterior region of the putamen is critical for building a 'spatial representation' of the movement, while the posterior area of the putamen is associated with creating a 'motor representation' of the movement (Hikosaka et al. 2002).

It has also been proposed that the basal ganglia participate in habit formation (Graybiel 2008; Yin and Knowlton 2006). A habit is a recurrent, often unconscious pattern of behaviour. A habit implies a regularity, but not every regularity involves a habit. One may have the habit of going to bed at 10:30 pm on weekdays, but sleeping at night itself is not a habit. The fact that most men in Western societies wear trousers is a custom, not a habit. The fact that I always put on my trousers starting with my left leg is a habit. Habits make life easy. If you always put your keys in your right pocket you never have to search for them. Most people get dressed, brush their teeth, start their car and prepare breakfast in a particular order. It is when they deviate from their daily pattern that people make mistakes and wonder whether they closed the window before leaving home. All habits, from mannerisms to rituals, are acquired via learning and become entrenched in the brain through what is technically termed experience-dependent plasticity. Once acquired, habits can become fixed to the extent that they can be difficult to break. If you're used to riding a bicycle with handbrakes you may find yourself grasping air when you're on a bike with a back-pedalling brake. As an experiment you may want to try altering the order in which you normally dress. You will find that it not only takes longer, but you may also notice that everything gets all mixed up and that your hands reach for another pair of socks even though you already have one on. I myself have the habit of shaving and then brushing my teeth. If, for whatever reason, I brush my teeth first, I have more than once found myself reaching for my toothbrush when I'm done shaving to brush my teeth a second time.

Habits usually comprise an ordered action sequence that can be performed automatically and without attention. Habits can also be cognitive and express themselves in patterns of thought. A vicious comment, in an email or on a blog, may automatically elicit a defensive response even though the best strategy might be to just let it pass and move on to something productive or relaxing. Graybiel (2005; 2008) has proposed that the process whereby a novel motor skill becomes habitual, involves the chunking of the motor sequence into boundary-marked units. The same might also apply to other habits. Many people memorize their telephone number (e.g. 212-870-5570) or their IP address as a rhythmic pattern and may have difficulty recognizing their own number when someone repeats it in different chunks (e.g. 21-28-70-55-70 or 21-28-705-570).

Series of words, numbers, places and so on are often learnt in a particular order in much the same way as motor sequences. Most people have learnt the alphabet in an ascending order. Whereas they can just rattle off from A to Z people perform much slower when asked to say the alphabet in descending order. Some people may even have to covertly ascend from A to where they got stuck and then continue. And even though they know the alphabet by heart, reciting it while skipping one letter at a time also proves a challenging task for most people. This suggests that people have learnt the alphabet as a sequence and not as a collection of elements. The basal ganglia may therefore also play a role in the acquisition of cognitive sequences and not just motor sequences. Of course, this hypothesis would need to be rigorously tested, since I'm now committing one of the most prevalent cardinal sins in cognitive neuroscience: a reverse inference (Poldrack 2006; ☞ §1.6).

When you see someone initiate a particular action, unconsciously you will expect it to continue along its course, either because you are accustomed to doing things a certain way yourself or because you are used to seeing other people behave this way. If the person sitting across from you extends her arm towards a glass you might expect her to grasp it and bring the glass to her mouth. If you see someone grab a chair you expect him to sit down. In general, assuming that a certain action sequence can be broken apart into five distinct chunks and that the first chunk is shared by two different actions, observing the first chunk might trigger two possible action sequences. When you observe the second and third chunk the selection will be narrowed down to one particular sequence.

Dancers trained in a particular school of dance or at a particular academy may unconsciously have acquired certain movement patterns by which one can identify their training. They may have a particular way of dropping to the floor and turning around so that, when they initiate a movement, you can tell not just that they will fall to the floor, but also how. A dancer or choreographer may be unaware of the habits that animate her movements, but a spectator may pick up on them within the duration of a single 40-minute piece and whenever a dancer collapses to the floor think: 'here she goes again'.

The present framework can be extended to account for the acquisition and execution of more extensive action scripts. Graybiel (2008) conjectures that the basal ganglia may be crucial for various forms of stereotyped behaviour including personal and cultural rituals. Neuropsychiatric disorders such as obsessive-compulsive disorder and Tourette syndrome are associated with extreme forms of ritualized behaviour and may be caused by dysfunction of the basal ganglia. Overmedicated Parkinson's patients also occasionally exhibit signs of ritualization and stereotyped behaviour.

Action scripts and behavioural routines can be acquired through doing, but also through observation. If a certain event involves a number of steps from A, through B, C, D, E and F to G, then you know that E is followed by F and G, in that order. And so, identifying the event and observing E will entail a prediction of F and G. When you go out for dinner you know how the evening will unfold, from the bread and olives to the waiter asking you if you care for a coffee after you have finished your dessert. And if you are familiar with the work of a particular choreographer or director you may also recognize his or her tics and tricks. You may take pleasure in seeing your prediction confirmed, but you may also feel tired and decide to skip his or her next production.

14.4 CONCLUSION

When your eyes are open you cannot choose *not* to see. Similarly, you cannot choose *not* to hear, *not* to smell and *not* to remember. These are all automatic brain processes. You can work hard to learn something, but you cannot choose *not* to learn something. When you are exposed to a non-random stream of sensory stimuli your brain will extract a pattern, whether you like it or not. After hearing the same song again and again in shopping malls and on the radio, at some point and to your own dismay you may find yourself humming along. Rah rah ah-ah-ah, Romah ro-mah-mah, Gaga Ooh-la-la…

The available neurological evidence suggests that the prediction of sequential visual and auditory patterns involves two distinct circuits depending on whether the sequence is novel or familiar. Novel patterns are learnt by a circuit comprising the premotor cortex, prefrontal and parietal regions, the basal ganglia and, in the case of dance, regions specifically associated with perception of the human body in motion (☞ §3.3): the extrastriate body area (EBA), the posterior superior temporal sulcus and the medial temporal area (MT). Familiar patterns activate the same network, or at least at the global level at which brain regions are named, but the processing builds on learnt sequences that are gated through the basal ganglia.

In support of this dual systems hypothesis it has been reported that patients with Parkinson's disease are impaired at discriminating sound sequences with a simple metric structure (Grahn and Brett 2009). However, their performance did not differ significantly from control subjects when the metric structure was complex. This suggests that patients with Parkinson's disease either have difficulty extracting the rhythmic structure when they first listen to the piece or are unable to use the structure to predict its continuation once it has been acquired. I am aware that a lot more experimental evidence is needed to support the present hypothesis. Indeed, using dance phrases as a stimulus to investigate people's ability to predict movement might be an avenue worth pursuing and might tell us more about dance and the brain.

What is acquired through perceptual learning is the visible or auditory half of the music or the dance, not the motor capacity to actually reproduce the movements. I know how some compositions that I have frequently listened to unfold, but because I cannot play the piano or violin I would be unable to play them myself, and even if I could play the violin I would still be unable to play as Itzhak Perlman or Anne-Sophie Mutter. I cannot physically perform some of the movements that my dancers perform either, but I know how they should be performed, I can instantly tell an error and I can instruct the dancers so as to get them to execute the movements the way I want them to be performed. This is because I know the *visual* structure of the movements (☞ §4.5).

The level of detail of the motion patterns that are visually acquired depends on the visual acuity and the previous training of the observer. A global pattern might take the form turn, turn, turn, turn, contract or first one dancer enters from the left and disappears on the right, then another dancer appears from the left and disappears on the right, then another and after that it's the quartet. A ballet dancer might observe that a ballet dancer on stage is doing a particular sequence because that is the natural thing to do, that is, the movement unfolds according to the implicit rules of classical ballet.

Our analysis so far thus allows us to explain, in broad terms, how a choreography works and why it works. One section of Ohad Naharin's *Minus 16* (1999), a section that is also part of *Anaphaza* (1993), begins with the dancers, all dressed in black suits and white shirts, standing in front of a line of wooden folding chairs arranged in a semicircle that spans the entire stage. When the music starts they slowly sit down. Then, starting with the dancer on the far left side of the stage, one by one they all get up and instantly throw themselves backwards onto the chair. The dancer on the far right is the last to get up, but instead of plumping down on the chair he throws himself to the floor. Slowly he gets up and sits down on his chair. With every wave that ripples through the dancers this scene is repeated. The choreography thus creates a strong sense of a visual rhythm. It also raises a question: why does the dancer on the right fall every time (☞ §27.3) and will he continue doing so with every wave? At some point one of the dancers climbs onto the chair before joining the others in their routine. The first time it happens it breaks the rhythm and introduces a question: will it happen a second time? When it does it creates a novel pattern. Visually it wouldn't have made much difference if the chairs had been arranged on a line facing the audience (☞ §5), but the semicircle suggests that the dancers form a community, an impression that is enhanced by the ritualistic dancing and chanting (☞ §26.2). Since the circle is open towards the audience, the audience becomes part of the community. This idea is reinforced when towards the end of both *Minus 16* and *Anaphaza* members of the audience are invited to join the dancers on stage.

If you regularly attend a dance performance or visit a contemporary art exhibition you may begin to notice certain patterns. You may notice that the work Pina Bausch revolves around the same themes and that the dancers in the work of Merce Cunningham always stand and keep their back straight. You may notice that from a distance all those supposedly radical artworks at the Venice Biennal and the Frieze Art Fair look quite similar and you may grow tired of all the pretty arrangements and entanglements in the work of Balanchine. Don't go to a psychiatrist just yet, you're not clinically depressed, just over exposed to the same type of stimuli.

Everything you noticed is true. All those artworks in contemporary art galleries do look quite similar and so do those ballets by George Balanchine, Jerome Robbins, Mark Morris, Nacho Duato, Meg Stuart, Akram Khan, Angelin Preljocaj, Shiobhan Davies and Anne

Teresa de Keersmaeker. But each artist does what he or she does. An artist may experiment with different themes; different material and different techniques, but there will always be some constants. A choreographer may create solos, duets and ensemble pieces, but within an ensemble piece there will be duets and solos. You cannot blame Trisha Brown for being Trisha Brown and not a bit more Ohad Naharin or Alain Platel, although you can blame theatre programmers for continuing to book artists long past their prime.

As a spectator, a reader, a listener and a viewer you have a choice. Nobody forces you to keep going to every new production by Mark Morris or Anne Teresa de Keersmaeker. If it all looks familiar to you: attend a performance by someone else! If you're tired of yet another neo-conceptual dance performance that promised to explore the notion of dance: stop going to contemporary dance festivals! Go and see some breakdance, flamenco or bharata natyam, stop going to dance performances altogether and read some non-fiction, travel to Mali or Nepal, do volunteer work! The patterns that you see are there, but they are everywhere. They are a function of your phenomenal mind.

KEY POINTS

- ☞ 'The ongoing movements and changes of scenery in a dance performance trigger a constant orienting response.'
- ☞ 'After watching a dance performance or a movie viewers may feel visually exhausted.'
- ☞ 'Whereas dancers learn a choreography through repetitive training, spectators, too, may learn a choreography through repeated exposure.'
- ☞ 'Just as you cannot help seeing a face in a photo of the surface of Mars, you cannot help noticing patterns in a series of stimuli.'
- ☞ 'When you see someone initiate a particular action, unconsciously you will expect it to continue along its course, either because you are accustomed to doing things a certain way yourself or because you are used to seeing other people behave this way.'
- ☞ 'Action scripts and behavioural routines can be acquired by performing the action oneself, but also through observation.'
- ☞ 'What is acquired through perceptual learning is the visible or auditory half of the music or the dance, not the motor capacity to actually reproduce the movements.'

15

INCONGRUITY AND RESOLUTION

After every performance of William Forsythe's *In the Middle Somewhat Elevated* (1987), Jiří Kylián's *Falling Angels* (1989) and Pina Bausch's *Sacre du Printemps* (1975) the audience erupts with loud cheers and applause. I myself must have seen *In the Middle Somewhat Elevated* and William Forsythe's *Enemy in the Figure* (1989) more than a dozen times and every time I am absolutely thrilled. It is hard not to be thrilled. It is also hard not to be amused by Les Ballets Trockadero de Monte Carlo or, for that matter, John Cleese's performance as the Minister of Silly Walks in the Monty Python sketch of the same title. Les Ballets Trockadero de Monte Carlo's parody of Michel Fokine's *The Dying Swan* performed by Ida Nevasayneva (a.k.a. Paul Ghiselin), a socialist real ballerina of the working peoples everywhere who was awarded a plastic medal for Bad Taste at the Varna Festival, is truly hilarious. Even though you may not burst into laughter you have to admit that it is funny. But what is it that makes William Forsythe's *In the Middle Somewhat Elevated* and Pina Bausch's *Sacre du Printemps* so exhilarating? And what is funny about Jiří Kylián's *Sechs Tänze* (1986) or indeed Buster Keaton, *Monty Python*, *Blackadder* and *The Office*? As we shall see both excitement and amusement are based on the same underlying principle and share a common neural substrate.

15.1 THE DOPAMINE CONNECTION

If you have ever played a computer game you will know that it can be pretty addictive. Even when playing something as simple as *Pong* players get excited, become submerged in the game and forget their surroundings. As a matter of fact, it doesn't make much difference whether you play yourself or watch another person play: you can get just as agitated as a bystander. Indeed, when watching another person play you may feel the urge to take over the joystick. Standing by without being able to prevent a friend from losing another life can be downright aggravating.

Watching an action movie or a dance performance can be equally exhilarating. Your heart beats faster and your body temperature rises. These physiological changes don't just happen out of the blue. They are mediated by various neural circuits. One neuroimaging study using positron emission tomography (PET) reported increased release and binding of dopamine in the ventral striatum when subjects played a computer game while inside a brain scanner (Koepp et al. 1998). Another study, using fMRI, reported increased activity in the orbitofrontal cortex, the nucleus accumbens, the dorsolateral prefrontal cortex, the premotor cortex, the precuneus and the insula when participants in the study played a computer game (Hoeft et al. 2008). The increased activity in brain regions associated with reward and the release of dopamine in these experiments is no coincidence. In a much simpler experimental setting it was found that an increase in the uncertainty in a prediction task activates brain regions subserving the release of dopamine (Volz et al. 2003).

Consider a simple computer game in which the task is to hit a target that is moving across the screen. The first target to appear on your screen moves along a straight line. You instantly fire but your shot ends up hitting the empty space behind the object. On your second shot you aim ahead of the target, but you miss by a wide margin, the target is moving slower than you thought and you were firing too fast. On your third shot you again aim ahead of the moving object, but slightly less so. This time you miss by a fraction. On your fourth shot you finally hit the target. There is, however, little time to rejoice about the points scored, because a new target has already appeared on the screen. This one appears to be moving along a straight line, but as you aim you notice that it is curving and so, instead of firing, you decide to wait a little to see how it's going to move. You quickly realize that its path resembles a sinoid curve and so you adjust your aim accordingly. Now suddenly another target appears on your screen that looks different and follows an erratic trajectory across the screen, accelerating and slowing down from time to time. After four quick successive shots you hit it more by luck than by skill, but when the next one appears on your screen you know where to position yourself to hit it. Through trial and error you learn how to obtain a reward in the form of points scored and avoid punishments in the form of lives lost when your avatar gets hit. You learn which targets offer high points and that it is sometimes best to keep firing rather than to fire only once.

This form of learning is often referred to as reinforcement learning. It doesn't make any difference whether you learn how to play *Tetris* or *Call of Duty*, how to serve in tennis or indeed how to perform a new dance move. In each case the person has a goal and needs to select a set of behaviours to attain that goal. Often the environment adds a degree of uncertainty, for instance, because the goal is moving or because it is shooting back at you.

In our example we approached the target by updating our subsequent shot based on the difference between our last shot and the actual position of the target. Mathematically the rule by which predictions are updated can be described by what is known as a temporal difference model. Some years ago it was discovered that the firing rate of dopamine neurons in the substantia nigra (SNc) and the ventral tegmental area (VTA) of the basal ganglia corresponds with the properties of the prediction error in temporal difference models, or to put it in a formula: Dopamine response = Reward occurred - Reward predicted (Schultz et al. 1997). Neuroimaging studies have since reported reward related signals in a number of other brain regions, including the prefrontal cortex, the orbitofrontal cortex and the amygdala. I should also point out that, despite years of research, many details are still missing on how dopamine produces its effects in the brain and so the most we can say at the moment is that dopamine most likely plays a role in the processing of reward. However, since there are multiple brain regions that produce dopamine and since the dopamine neurons in the midbrain project to many sites in the brain, dopamine is thought to be involved in various other brain functions (Schultz 2007). For instance, in addition to carrying a reward signal it has been suggested that dopamine functions as a key neuroregulator that contributes to attention and anticipatory processes necessary for preparing voluntary action (Nieoullon 2002).

The reinforcement-learning paradigm is powerful but limited in scope: as Niv and Schoenbaum (2008) emphasize, it only accounts for one type of learning and one type of prediction error. Imagine, for example, that you are chasing a target and that just when you are about to catch it, it evaporates, explodes or transforms into another object. Obviously, this is the stuff of science fiction and animation movies, but what matters for our present discussion is that in this example the actual outcome lies outside the realm of predicted outcomes, which only pertain to the motion path. Accordingly, even though the event is unpredicted it does not generate a prediction error in the sense of reinforcement learning.

A dance performance is not a computer game, you don't have to shoot the dancer and you don't score any points by tracking a dancer either, but the neural processes that underlie visual perception are just the same. They evolved to facilitate a rapid response to a sudden change in the environment whose effects could be harmful to the organism. A dance performance is an artificial environment in which the spectators are silent witnesses, not active participants. The context has been designed so as to keep the audience at bay. In a studio or at a site specific performance a dancer might misjudge his speed and sway into the audience. To avoid being hit some spectators may have to jump back, thereby bumping into other spectators, unless they anticipated both the action of the dancer and the reaction of the spectators in front of them. So in this situation even as a witness one has to be on guard.

As I have argued before, the neural systems that mediate perception, attention, anticipation, memory and so on cannot be switched off at will. It is for this reason that I once proposed that correctly predicting the unfolding of a movement is intrinsically rewarding (Hagendoorn 2004b). When tracking a moving target a sudden change in speed or direction creates a prediction error, which may be associated with the release of dopamine. At a behavioural level the person tracking the object will try harder to keep track of it, which may have a neural substrate in the form of increased attention and arousal, both of which may be effects of the release of dopamine. I know that this sounds a bit awkward, but what you do (look more closely) and experience (rising body temperature) is the result of a number of underlying physiological processes.

Now that we have analysed what happens when we track a moving object, we can reason backwards to determine what *needs* to happen in order to sustain the release of dopamine and thereby maintain a high level of arousal. The target's motion would have to continue producing a prediction error, that is, it would have to divert from the predicted speed and direction of motion. To go back to our computer game example, if the reward in the form of points scored is forever delayed, if every shot misses, most people would soon give up, but a game in which every shot is a hit, for example, because the target does not move, is not much fun either.

If we apply the same line of reasoning to dance, the movements would have to elicit an interplay of correct and incorrect predictions. The latter keep the observer on edge while the former provide a form of reinforcement. Our analysis of attention led to the conclusion that differentiation has the capacity to attract and hold the spectator's attention (☞ §9.1). Now we see that it also has the capacity to create a high level of arousal. This need not come as a surprise, since arousal and attention, in the sense of a state of alertness, are two sides of the same coin.

We are now in a position to explain why ballets such as *In the Middle Somewhat Elevated* (1987) and *Enemy in the Figure* (1989) by William Forsythe are experienced as exhilarating. Even though there is no *reason* to get excited, the brain systems associated with reward processing *cause* a higher state of arousal, because the events on stage trigger a constant orienting response (☞ §14.1). The constant activity on-stage keeps the viewer alert and on edge. I should add that both *Enemy in the Figure* and *In the Middle Somewhat Elevated* are set to a riveting score by Thom Willems. Accordingly, we cannot take the fact that people are thrilled after watching either of these ballets, which itself is obvious from the bravos and the loudness and duration of the applause afterwards, as evidence for the present thesis. After a dance performance some spectators may think of the dance as exhilarating even though it was the *music* that got them excited and not the choreography, which didn't amount to much. And perhaps some people were aroused by all those gorgeous athletic bodies and the glass of wine they had during the interval.

15.2 STEP TO THE BEAT

The idea that aesthetic pleasure has something to do with the build-up of a sense of anticipation and its subsequent resolution is firmly established in music theory (Meyer 1956; Huron 2006). The common scales in Western music consist of seven notes, C, B, A, G, F, E, D, which repeat at the octave. After hearing the same scales played twice an experienced listener will expect to hear F when C, B, A and G are played a third time. A different note or a different sound will then generate a violation of the expectancy. As a matter of fact, listeners familiar with Western scales will probably expect a G upon hearing the sequence the first time. It is not just the note that is expected, but also its timing, loudness and so on. If every note in our example is played slightly louder, in addition to a scale progression a listener will expect an increase in loudness. What is more, a piece of music may generate different expectations at different hierarchical levels of the composition (Juslin and Västfjäll 2008). And as Meyer (1956) points out, one may also expect *change*. As he wrote, 'after a melodic fragment has been repeated several times, we begin to expect a change and also the completion of the fragment. A change is expected because we believe that the composer is not so illogical as to repeat the figure indefinitely and because we look forward to the completion of the incomplete figure' (Meyer 1956: 26). Obviously, Meyer was writing before the advent of minimal and ambient music.

As a general model of music perception the musical expectancy hypothesis has been highly influential. I should add that musical expectancy only refers to expectations in relation to syntactical relationships within the musical structure and not to a change in, let's say, the lighting conditions. A drawback of the model is that it does not say anything about the content of a person's expectancy. What is more, there are infinitely many ways to create both a sense of anticipation and its violation. It is also fairly easy to create a violation of the expectancy that is everything but pleasing. And of course the model only deals with the temporal organization of music, not its hierarchical organization or pitch structure.

Many people experience chills when they listen to certain sections in their favourite songs or compositions, which may manifest themselves in goose bumps, shivers running down the spine or the spontaneous release of tears. A number of neuroimaging studies have sought to identify the brain regions that are activated during these moments of peak emotional experience. One study, using positron emission tomography, reported that an increase in chill intensity was correlated with increased activity in the ventral striatum, the midbrain, the orbitofrontal cortex, the insula and the anterior cingulate cortex and decreased activity in the amygdala and the ventral medial prefrontal cortex (Blood and Zatorre 2001). Another study, using the neurochemical specificity of [^{11}C]raclopride positron emission tomography scanning, reported endogenous dopamine release in the striatum when participants in the study experienced chills (Salimpoor et al. 2011). These findings therefore support the view that music can be rewarding in a neurological sense. It is worth observing that increased activity in the striatum, especially the nucleus accumbens, has also been associated with eating chocolate, cocaine use and drinking water when dehydrated. It has therefore been hypothesized that the nucleus accumbens is an important node in the neural circuit associated with pleasure (☞ §22.2).

There appears to be an intimate link between dance and music. Around the world people spontaneously synchronize their body movements to music with a strong, regular rhythm and a beat that is neither too slow nor too fast. The common sense view of the connection between dance and music is perfectly expressed by the American composer Steve Reich. As he wrote in an essay, originally published in 1973, 'for music and dance to go together they must have the same rhythmic structure. This common rhythmic structure will determine the length of the music and dance as well as when changes in both occur' (Reich 2002: 72).

Neuroimaging studies have shown that synchronizing one's movements with an auditory rhythm activates motor areas in the brain (e.g. Lewis et al. 2004). This is not exactly surprising since moving engages motor areas. However, motor regions are also engaged during music perception (e.g. Chen et al. 2008; Bengtsson et al. 2009). On the face of it one might expect music to activate the auditory system and perhaps regions involved in emotion. After all, music is just a sequence of sounds. The activation of motor regions is therefore at least curious. It has also been reported that patients with Parkinson's disease are impaired at reproducing simple rhythmic sound sequences (Grahn and Brett 2009), which suggests that the basal ganglia, too, are involved in music perception.

As we saw above, the lateral premotor cortex, one of the regions frequently found to be activated during music perception, has been associated with a number of sequential prediction tasks (☞ §14.2). This suggests that watching a visual stream, such as dance, and listening to an auditory stream, such as music, involve a common brain circuit. Watching dance accompanied by music, on this account, creates a sense of anticipation in both the auditory, visual and motor domain. When combined the expectations engendered in each domain would then become mutually reinforcing. In partial support of this view one recent neuroimaging study examined sensitivity to a beat, as commonly perceived in music, in both auditory and visual sequences (Grahn et al. 2011). It was found that participants were less sensitive to an implied beat in visual sequences than in auditory sequences. However, the beats in the visual sequences were more readily perceived when preceded by auditory sequences with an identical temporal structure. The researchers also reported increases in brain activity in the putamen when visual sequences were preceded by auditory sequences. The results therefore provide further evidence for the role of the basal ganglia in beat perception. Furthermore, if perception of a beat in a visual sequence is enhanced when preceded by an auditory sequence with a similar beat, one might expect perception to be even further enhanced if both sequences are perceived simultaneously. This model therefore provides the tentative neural underpinnings for Steve Reich's claim that, 'for music and dance to go together they must have the same rhythmic structure.'

There are a few problems with this view though. On the one hand music may be too fast to add a movement to every beat. It may also happen that there are no beats at all or that there are multiple beats played by multiple instruments. This problem may be circumvented in a group piece in which each dancer can be assigned to a particular structure in the music. A more serious problem is that perfect correlation, setting a step to every beat in the music, is in fact pretty boring. If the auditory and visual time series are perfectly correlated the music becomes predictive of the dance and vice versa. So in practice one rarely sees dance that is synchronized with every beat in the music. It suffices if the music and the dance combine every now and then. In *Falling Angels* (1989) by Jiří Kylián, set to the first section of Steve Reich's *Drumming*, the first few discrete movements are perfectly synchronized with a beat, but after that the dance and the music unfold on separate planes. However, both dance and music have a similar drive. It is interesting to compare *Falling Angels* with *La Vie Qui Bat* (1999) by the Canadian choreographer Ginette Laurin and her company O Vertigo Dance, which is also set to *Drumming*. Both ballets feature repetitive movements, without ever becoming minimalist, and both ballets follow the pulse of the music instead of stepping to the beat.

Rather than saying that dance and music are correlated, it may therefore be more appropriate to say that they are *cointegrated*, a concept, which has its origin in econometrics.[50] To illustrate this concept think of a dog on a retractable leash. The dog can run around within the range of the leash, but in the long run the owner and his or her dog follow the same path. I should add that I'm only using the term cointegration in a metaphorical sense here, although in principle, if one could derive a measure for each individual time series, it would be possible to determine the degree to which both dance and music are cointegrated.

Only very few dance performances are performed in silence. I've got nothing against music, I enjoy listening to music, or some music sometimes, but as a choreographer I've always found it somewhat disconcerting that dance in itself isn't strong enough as a stimulus to capture and hold the audience's attention for more than a few minutes. I wish I had an answer to this question, but I'm afraid that, as I sometimes say, most people who attend a dance performance have come to watch the music, rather than to listen to the dance. The advantage from the artist's point of view is that good music can save a performance. In other words, if the music is great, you can get away with a rather poor choreography.

15.3 HUMOUR

During the Vivienne Westwood Spring/Summer 2007 fashion show in Paris Polish model Kamila W. fell not once but twice as she strode down the catwalk in her high platform shoes while carrying a large watering can in one of her hands. In a video that has been circulating on the internet ever since the incident was broadcasted, two local news anchors at Washington D.C.'s NBC Channel 4 cannot stop laughing as they watch the unfortunate model stumble and fall. But what is so funny about watching someone fall? We all do it from time to time and while I feel sorry for the model (☞ §21) I have to admit that I too couldn't resist chuckling when she stumbled a second time.

Perhaps I should begin by noting that humour need not result in laughter and that laughter is not only occasioned by humour. We laugh when we are tickled and sometimes we laugh for no reason whatsoever. We laugh out of politeness or to please a person we believe to be telling a joke as in the famous scene from *Goodfellas* (1990) in which Henry Hill laughs about everything Tommy DeVito says until DeVito suddenly gets all serious and presses Henry to explain himself. Laughter appears to have a social dimension, since people tend to be more inclined to laugh about things in company than alone. A person may appreciate something as funny without spontaneously bursting into laughter, but when he or she mentions it to a friend they may both laugh about it, even in the absence of the item that is the object of their laughter. But why do people laugh when they are

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[50] If two or more time-series are non-stationary, but a linear combination of them is stationary, then the series are said to be cointegrated.

amused? And what is funny about the things people consider funny? Theories of humour aim to answer these questions. They can be divided into three main categories: the relief theory, the superiority theory and the incongruity theory.

According to relief theorists, of which Freud is perhaps the best-known proponent, the essence of humour lies in the relief from some form of psychic constraint or the release of some inner tension that has been built up unconsciously. The mention of sex might make some people a little nervous, which might express itself in the form of giggling and shuffling about in one's chair. In the above example the news anchors have to maintain their composure for the duration of the live broadcast. The sight of the falling model may break their defences and cause them to burst into a fit of uncontrollable laughter.

The superiority theory of humour holds that people laugh out of a sense of superiority over the misfortune of another person. Many comedians, from Charles Chaplin to Stan Laurel and Oliver Hardy, put themselves into a position of inferiority to make the audience laugh, while others, such as Blackadder, exude a strong sense of superiority towards the other characters that are the subject of their irony. There is a clear sense of superiority in both news anchors' comments, for example, one remarks that he has more meat on him than the model in question. The model's fall can also be said to bring her down to earth. Her extraordinary beauty, enhanced by the clothes and platform shoes, is undone and she turns out to be human after all.

Advocates of the incongruity theory maintain that humour emerges from the discrepancy between two views, events or interpretations. Aristotle already said so much when he wrote that in a joke '[the] line does not end as the listener expects' (Aristotle 2004: 239; *Rhetoric* 1412a). In *The World as Will And Representation* Arthur Schopenhauer argued that laughter results from the 'suddenly perceived incongruity between a concept and the real objects that had been thought through it in some relation; and laughter itself is just the expression of this incongruity' (Schopenhauer 1966: 59). And in his *Critique of Judgement* Kant observed that, 'laughter is an affect that arises if a tense expectation is transformed into nothing' (Kant 1987: 203). To illustrate this notion Kant, of all people, even tells a joke, which I will not repeat here. If we apply this notion once more to the stumbling model, on the one hand her stumbling creates a radical incongruity between the anticipated and the actual path of motion, while on the other hand her beauty and elegance are at odds with the awkwardness of her movements as she tries to maintain her balance.

The incongruity theory is currently the dominant theory of humour. However, the incongruity between what is expected and what actually occurs is not necessarily a source of amusement. Merely juxtaposing two disparate objects, situations or events need not be funny. It is, for instance, also the basis of much surrealist art. Yet the work of Salvador Dali, André Breton, Paul Éluard, Yves Tanguy and Max Ernst is not appreciated as funny in the way that a cartoon by Sempé or Saul Steinberg is. Amusement requires that the incongruity is somehow resolved. Furthermore, the resolution should be recognized as a *pseudo*-solution. A rational answer to the question of why the golfer wore two sets of pants might be that it was a very cold day. The punch line of the joke is that he had a hole in one. But why is this the source of comedy? As Kant observed:

> 'It is noteworthy that in all such cases the joke must contain something that can deceive us for a moment. That is why, when the illusion vanishes, [transformed] into nothing, the mind looks at the illusion once more in order to give it another try, and so by a rapid succession of tension and relaxation the mind is bounced back and forth and made to sway; and such swaying, since whatever was stretching the string, as it were, snapped suddenly (rather than by gradual slackening), must cause a mental agitation and an inner bodily agitation in harmony with it' (Kant 1987: 204).

Various neuroimaging studies have sought to establish the neural concomitants of humour appreciation and the metaphorical snapping of the string evoked by Kant. One study, in which the participants were exposed to semantic and phonological jokes based on the juxtaposition of an expectation and its resolution, found increased activity in the medial ventral prefrontal cortex and temporal and inferior frontal regions (Goel and Dolan 2001). In another experiment participants were presented with a number of funny cartoons and cartoons in which the funny cue was omitted. The humorous cartoons engaged a network of cortical and subcortical structures, including the left lateral inferior frontal gyrus (BA 44/45), the supplementary motor area (BA 6), the ventral tegmental area, the nucleus accumbens and the amygdala (Mobbs et al. 2003). Another experiment in which participants looked at funny and 'non-funny' cartoons found increased activation of the right inferior frontal gyrus (BA 47), the left superior temporal gyrus (BA 38), the left middle temporal gyrus (BA 21), and the left cerebellum, while activity in the amygdala appeared to correlate with subjective amusement (Bartolo et al. 2006). The increased activity in inferior frontal regions (BA 44/45 and BA 6), which are thought to be involved in generating predictions (☞ §14.2), is consistent with the incongruity-resolution model. However, the temporal resolution of fMRI may be insufficient to identify the neural structures that underlie the process of detecting an ambiguity and understanding the punch line.

As these studies demonstrate, there is no single humour module in the brain. Humour appreciation may well be associated with different brain circuits depending on the type of humour, as suggested by a study comparing activation during the processing of incongruity-resolution cartoons and nonsense cartoons (Samson et al. 2009).

Of interest in the study by Mobbs et al. (2003) is the increased activity in the ventral tegmental area and the nucleus accumbens, both of which have been associated with reward processing. Indeed, what may be surprising about other studies examing the neural concomitants of humour processing is that they did *not* report activity in reward related brain areas. After all, humour is generally considered to be enjoyable and people spend a lot of time and money watching comedy shows, stand-up comedians and funny clips on

YouTube. One might therefore expect humour to engage brain regions associated with reward processing.

Franklin and Adams (2011) reasoned that the absence of reward related processing in most published studies might be a reflection of the fact these studies used either written jokes or cartoons as stimuli, which only take little time to process. They therefore used fMRI to investigate the neural activity while the participants watched video clips of eight stand-up comedians. They found that the funniest clips elicited increased activity in several brain regions associated with reward processing, including the nucleus accumbens, the caudate and the putamen. The activity in these areas might thus provide a neural basis for the subjective experience of mirth that accompanies the exposure to humorous stimuli.

The incongruity theory of humour is probably the best explanation of physical comedy. It draws on an incongruity between the viewer's prediction of how the movement will continue and the actual movement. We laugh when Mr Bean gets entangled in a simple household task, we laugh when a person walks into a lamp post or falls of a ladder and we laugh when we see a clown pretending to make a huge effort to lift a seemingly heavy object and then fall on his back when it turns out to be light. As Jeannerod (2002) explains, 'we laugh, because we have created in ourselves an expectation by simulating the effort of the clown, and we see something that is different from the expectation. The effect we see is at discrepancy with respect to our internal model, and this is the source of comedy' (☞ §4.2; §14.2; §14.3).

Above I argued that, to keep the audience on edge, the dance should elicit a torrent of correct and incorrect predictions (☞ §15.1). But if both dance and physical comedy rely on the same principle then why isn't dance funny? Well, perhaps dance *is* funny. It all depends on the context and on how the actions are framed (☞ §27.1; §13.2). Indeed, one reason many jokes, pranks and cartoons aren't all that funny may be that they are recognized as jokes. Conversely, everyday situations which are not intended as humorous may be appreciated as outright hilarious. The clowns in a Cirque du Soleil show are supposed to be funny and the acrobats and contortionists are not. However, this does not mean that the contortionists cannot provoke laughter when they mould their bodies into an absurd position. When the context is not clear one may not know whether to laugh or not. The music video for Fatboy Slim's *Praise You* features a group of amateur dancers performing a dance routine outside a cinema entrance in Westwood, California. The dancing looks a bit awkward, but it is performed with dedication so the bystanders who are queuing in front of the cinema do not quite know what to make of it. The viewer who knows that it is a prank can freely laugh about the troupe's leader's attempts at some old school b-boy moves.

Given the ambiguity of dance, it is unsurprising that in dance humour often takes the form of a parody of some well-known dance clichés. Jerome Robbins' *The Concert (or the Perils of Everybody)* (1958) essentially consists of a long series of ballet pranks. In one scene, a parody on Balanchine's intricate group arrangements, the dancers get hopelessly entangled. At the end of the scene one of the dancers breaks the symmetry by raising the wrong limb. Jiří Kylián's *Symphony in D* (1976) similarly combines slapstick and parody, with dancers losing their balance, missing an exit, losing track of a partner and ending a pirouette facing the other dancers instead of the audience. Judging by the laughter many spectators consider these ballets funny, perhaps because the piece is framed as comedy or perhaps because they are finally allowed to laugh during a dance performance at all those silly things dancers do.

15.4 CLOSURE

Everybody knows the feeling when the penny drops and you suddenly realize that the name of that 'Russian' dancer from Les Ballets Trockadero de Monte Carlo, when pronounced in English, reads 'never say never'. In the psychological literature this feeling is known as an *Aha-Erlebnis*, a term originally coined by the German psychologist Karl Bühler (1879-1963), usually translated into English as 'Aha' experience or Aha! Effect. It is roughly synonymous with insight, the process whereby a previously opaque and unsolvable problem suddenly becomes transparent. An 'Aha' experience occurs when, unexpectedly, we see a situation in a new light, discover a new connection, have an idea, understand an explanation or find the solution to a problem we had been pouring over for a considerable time, whether a cryptic crossword, the proof of a mathematical theorem or the plot of a novel.

In his book *The Act of Creation* (1964) the Hungarian author Arthur Koestler (1905-1983) proposed that understanding a joke and solving a problem by insight engage the same mental process, which he termed bisociation. A bisociation occurs when two (or more) incompatible frames of thought or mental models are combined to give way to a novel thought. To illustrate this idea Koestler employed a metaphor of two intersecting planes (Figure 15.1). Whereas associations can be thought of as moves along a path on a single plane, a bisociation occurs at the point of intersection where the paths on two planes meet. Within this model humour can be thought of as the collision of two frames of thought whereby one frame undermines the other. Insight and scientific discovery consist in the integration of two frames of thought whereby two (or more) frames of thought are brought together in a new synthesis. The paradigm of this view of scientific discovery is the development of quantum mechanics and its concept of wave-particle duality. In his proof of Fermat's Last Theorem Andrew Wiles also brought together various previously unrelated areas in mathematics, which is why his proof had many ramifications. Koestler's goal in writing *The Act of Creation* was to develop a general theory of human creativity. In his view art consists in the permanent juxtaposition of two (or more) frames of thought, which brings out their analogies, friction and so on. Accordingly, aesthetic experience involves the process through which we come to understand and appreciate this tension. As we shall see later on (☞ §27.4), there is an obvious parallel between what Koestler terms bisociation and what Fauconnier and Turner (1998; 2002) refer to as conceptual blending or conceptual integration.[51] Evidently, this model is just that: a model. However, it offers a way of thinking about what happens when we conceive of a novel thought.

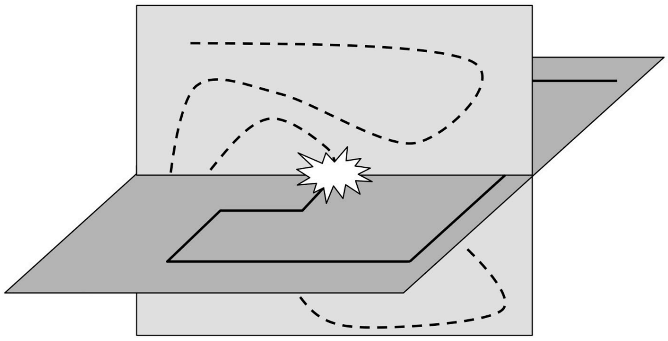

Figure 15.1 Arthur Koestler's way of illustrating the bisociation of mental models or frames of thought. An Aha experience or the sudden discovery of a possible bisociation is depicted by the explosion. Note that there can be multiple bisociations. Adapted from Deacon (2006).

As Ito (2008) writes, when we think we manipulate something in our mind. This something can be thought of as a mental model. Presumably the process whereby thoughts are generated and problems are solved has a neural basis in the brain. Ito (1993; 2008) speculates that this process can be described using the internal model framework originally developed in the domain of motor control. The idea is that thinking and problem solving involve the manipulation of mental models in the same way that moving involves the control of body parts and a corresponding internal model (☞ §4.2). In terms of neural organization Ito assumes that the prefrontal cortex acts as a controller with the parietal and temporal cortex as the controlled object. Just as the repeated exercise of a movement leads to the formation of an internal model in the cerebellum, the repeated activation of a mental model as encoded in the parietal and temporal cortex leads to the formation of a copy of the mental model in the cerebellum.

Ito speculates that a problem-solving task involves an explicit process in the cerebral cortex and an implicit process in the cerebellum. When a problem presents itself, it is held in working memory, presumed to be a function of the prefrontal cortex, which converts the problem into command signals that activate various neural circuits in the parietal and temporal cortex. If the neural circuits in the parietal and temporal cortex converge towards a solution a signal is relayed back to the prefrontal cortex. The prefrontal cortex then issues a series of signals that innervate brain regions associated with reward processing and emotion that translate into an 'Aha' experience. However, if the problem is novel existing mental models may not yield a correct solution. Comparison of the solution generated by

[51] Fauconnier and Turner (2002: 37) acknowledge their indebtedness to Koestler (1964). As Deacon (2006) demonstrates, Koestler (1964) and Fauconnier and Turner (2002) can be 'blended' into a coherent narrative.

the mental model and the problem will then activate brain regions associated with conflict detection, which trigger a number of processes aimed at breaking the mindset that keeps one stuck in the wrong solution space or on the wrong plane in Koestler's model. Several neuroimaging studies investigating the neural concomitants of insight have indeed found increased activity in the anterior cingulate cortex, which is frequently reported in tasks involving some form of cognitive conflict (e.g. Kounios et al. 2006; Aziz-Zadeh et al. 2009).[52] If, despite these efforts, no solution is found, the process may continue implicitly, with an inverse model in the cerebellum taking over the control function of the prefrontal cortex and with forward models in the cerebellum replacing the mental models in the parietal and temporal cortex. The moment a solution is found a signal is relayed from the cerebellum to the prefrontal cortex. Since the original problem was no longer held in working memory the origins of the thought that suddenly pops up in one's mind may seem puzzling.

To illustrate this framework, imagine that you are competing in one of those television game shows in which you have to push a button whenever you think you know the answer. Suppose that the host presents you with the following problem. A hot chocolate with cream costs $1.10. The hot chocolate costs one dollar more than the cream. How much does the cream cost? Upon hearing the question a mental model is activated in your brain, which instantly comes up with an answer: 10 cents! And so you hit the button as quick as you can. As the host waits for you to answer the question you realize that 10 cents cannot be correct, since that would mean that the hot chocolate would cost $1.10 giving a total of $1.20. At this moment alarm bells go off inside your mind. Thankfully your brain worked quickly enough to figure out that the correct answer is 5 cents and so you could proceed to the next round. What is broken every time it is spoken?[53]

In everyday life you don't need to push a button whenever you are presented with a problem, but you do need to act. And so the moment a solution is found or an idea presents itself various parts of the brain are activated, which create a state of action readiness and trigger a physiological response. The nature of the resulting agitation depends on the context. As Koestler (1964: 93) rightly points out, a comedian does not laugh when he conceives a new joke; at most he has an Aha experience. Similarly, a mathematician may smile when he discovers the proof to a theorem, he may feel tears welling up in his eyes, he may feel shivers running down his spine and he may clench his fist in victory, but each of these responses is an expression of his delight in establishing the proof. These temporary agitations should be distinguished from any subsequent emotions (☞ §17.1). Our mathematician may be jubilant for days on end, he may feel proud for weeks to come, but he may also sink into a deep depression: having solved the problem

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[52] It is, however, difficult to assess in a neuroimaging study whether an Aha experience actually occurred. Given the variety of problem sets used in studies examing the neural correlates of insight problem solving the results are difficult to interpret (see also Dietrich and Kanso 2010).

[53] Silence.

he'd been working on for months, if not years, his life suddenly seems empty and meaningless.

When, instead of finding the solution oneself, one is presented with a solution various things can happen. It may happen that one instantly recognizes that the solution is correct because it fits an existing mental model like the missing piece of a jigsaw puzzle. However, it may also happen that one doesn't understand the solution because it does not complement one's own mental model. In order to understand the solution one would thus have to go through the same process that one would go through if one were to solve the problem oneself. One way of thinking about a joke is that what happens when one comes upon the punch line is that the solution complements one's own mental model but simultaneously activates a novel mental model to which it is also a solution.

We not only experience a feeling of finality or resolution when we solve a puzzle or a riddle, but also when, at the end of a novel or a movie, we understand the plot or learn that the villain has been killed, the catastrophe averted, the mission accomplished or that the hero and the heroine have found each other. Of course, the novel or movie has been carefully crafted to produce a sense of closure. In everyday life it rarely happens that events come to an end the way they do in works of fiction. In nature each end is just the beginning of something else. Nothing ever comes to a conclusion. In a novel, a movie or a theatrical production the ending is where mysteries are solved and conflicts are settled or where the character realizes that there is no resolution and that he or she will never know the truth.

People long for an ending, a conclusion and a sense of fulfilment, precisely because an ending activates brain regions associated with reward, the same regions that are activated when one hits a target, solves a problem or understands a joke. If the longed for ending is spoiled people may feel frustrated or even break into tears just as when one misses a target or fails to answer a question correctly. It follows that, whereas the beginning of a novel, a movie or a performance should arouse the reader or viewer's interest and desire to continue reading or watching (☞ §10), the end should provide a sense of completion, even if it means that the character and/or the reader or viewer comes to realize that all that went before was in vain or that, like in nature, there is no conclusion. The intensity of the resulting agitation depends in part on the duration of the moments of anticipation that precede the final resolution. Every good orator knows that, for added drama, one should pause after every few words. If the moment of closure is held back too long, the feeling of suspense wanes, if it is brought on too soon, there is no time for suspense to build up.

With Koestler's bisociation framework in the back of our minds we can provide a tentative classification of different types of endings. The resolution of a mystery consists in the integration of two mental models and produces a form of insight, which may express itself in a feeling of glee. As we have already seen the resolution of a comedy consists in the collision of two mental models and produces amusement, which can manifest itself in the form of laughter (☞ §15.3). The resolution of a drama consists in a different type of collision. Basically the path on one plane that would lead to a happy conclusion is blocked and one is forced to continue on another plane. This rupture produces grief, which typically manifests itself in the form of crying (☞ §23). In a tragedy there is no closure, the two frames of thought in Koestler's model stand in permanent opposition. For instance, Sophocles' *Antigone* does not feature a conflict between good and evil, but between good and good.

To produce a sense of closure the work should allow for a mental model to take hold in the mind of the observer. A mental model could take the form of a known schema (☞ §27.2) the particulars of which are then filled in by the work or it could take the form of an internal model based on sensory cues. Baroque music uses various cues that signal to the listener that the end is forthcoming, including changes in tempo, chord progression and texture. In popular music the music often just fades out, which I have always considered an admission of defeat. Once a model has been established it could then be subverted, disrupted, challenged or brought to a conclusion according to the logic of the mental model, if there is one. A journey ends when one reaches one's destination or when one returns home; a quest ends when the object is found; a love story ends when the lovers find eternal love; a story of revenge ends with the execution of the planned for revenge and so on.

In so far as the movements can be subsumed under a schema, such as man meets woman, the final moments of a dance performance can be interpreted within that schema (☞ §27.2). In fact, most dance performances fit into a generic schema such as rise and fall, struggle and defeat, arrival and departure or a coming together and a parting of ways. William Forsythe's *One Flat Thing Reproduced* (2000) begins with the dancers dragging twenty tables to the front of the stage and ends with the dancers running to the rear of the stage pulling the tables behind. We thus end as we began. The moment the dancers race to the rear of the stage not only signals that the piece is about to end, it also provides a sense of closure. By marking both the beginning and the end the piece also suggests that what happens in between constitutes an event, even though it did not leave any traces.

In the final scene of the original version of *Swan Lake*, when they realize Rothbart's spell cannot be broken because of Siegfried's pledge to Odile, Odette and Siegfried commit suicide by leaping into the lake, choosing to be united in death, rather than to be separated in life. Had Siegfried accepted that you can't always get what you want, had he realized that Odile is also nice and pretty, had he divorced Odile and gone after Giselle or Manon, the effect would have been altogether different. What makes the ending emotionally rewarding is a sense of closure. Of course, the ending is just a trick to get the audience emotionally involved. It capitalizes on the audience's unconscious desire for a sense of completion. There is nothing wrong with that, except that the audience may overlook the fact that Siegfried's suicide is romantic nonsense. The predominance of Endings in the arts might lead people to believe that in real life, too, events should come to completion. But in life there is no plot. Things just stop.

15.5 CONCLUSION

In the previous chapter we saw that the brain automatically generates a prediction of a sequential event. The actual outcome can either match the predicted outcome or deviate from it. A discrepancy can elicit a startle response and draw attention to the source of the surprising event. In the case of dance this means paying closer attention to the movements. If an outcome matches one's prediction one may experience a jolt of pleasure. It follows that, when watching dance the interplay of correct and incorrect predictions keeps the audience on edge.

In what is perhaps one of the most relevant experiments in the realm of neuroaesthetics to date, using a novel technique that exploits the neurochemical specificity of [^{11}C]raclopride positron emission tomography scanning, Salimpoor et al. (2011) were able to demonstrate that the intense pleasure some people experience when listening to music, which is physiologically manifested through 'chills', is associated with endogenous dopamine release in the striatum. Since the participants consistently experienced chills at the same moment in the music the authors were able to show in a second experiment using functional magnetic resonance imaging that the caudate was more involved during the anticipatory stages leading up to the peak emotional experience and the nucleus accumbens during the peak emotional experience itself.

I believe that we can extrapolate these findings to dance performances which leave the audience thrilled. It is no coincidence that William Forsythe's *In the Middle Somewhat Elevated* (1987), Jiří Kylián's *Falling Angels* (1989) and Pina Bausch's *Sacre du Printemps* (1975) are set to loud music with a pulsing beat. On more than one occasion I myself have experienced chills during a performance of both *In the Middle Somewhat Elevated* and *Enemy in the Figure*. If the chills people experience while listening to music are associated with the release of dopamine, then it is likely that the chills when watching a dance performance accompanied by music also involve the release of dopamine. Perhaps I should add that I don't experience chills when I put on a cd of *In the Middle Somewhat Elevated* or *Enemy in the Figure*.[54] This suggests that during a dance performance the music and the choreography are mutually reinforcing and that the chills that I experience are an effect of the combination of dance and music. This hypothesis is, of course, speculative and would require experimental verification. The findings by Salimpoor et al. (2011) also add support to my hypothesis that audiences may be thrilled by the music and attribute it to the performance as a whole. The difference between dance and music is that one can listen to the music in isolation and still be thrilled, but without the music one may soon lose interest in the choreography.

As a corollary our analysis of humour allows us to address one of the biggest taboos in the dance world: that dance can be pretty ridiculous. I myself have sat through many

[54] Perhaps if I were to play the music wearing in-ear headphones I might experience chills as well. At home I cannot play the music as loud as in a theatre.

performances during which I had to struggle not to explode with laughter. It is remarkably easy to do a modern dance parody, but as a matter of fact, there is no need to do a parody, dance can be its own parody. This is because the incongruity at the level of the movements need not be an incongruity at the level of the choreography. That is to say, the choreography, the entire sequence of movements, can be appreciated as a work of art, while the individual movements can be silly. A naïve observer who peeks in at a performance in which a dancer stands in front of an audience while going through the movements of a director directing Stravinsky's *Sacre du Printemps* may find it hard to suppress his laughter. What are these people looking at? Why the solemn silence? The spectators who paid 20 euro to see the performance and who expected to see a conceptual dance performance evaluate the movements both as dance and as art and may consider it a profound, or perhaps not-so-profound, exploration of the notion of dance.

There are only so many ways in which a film, a song, a novel and a dance or theatre performance can end. At the end of a dance performance the dancers could simply stop dancing. At some point the audience will assume that the piece has ended and either applaude or leave. The dancers can bow so as to signal to the audience that the piece has ended, a gesture the audience understands as indicating the end of a performance (☞ §27.1). The dancers could leave the stage one by one, in pairs or all at once. Another possibility is for the curtains to come down or for the stage lights to either gradually dim or to be switched off. A proper ending provides a sense of closure: it puts a dot, an exclamation mark, a question mark or three dots behind the final scene. People yearn for an ending, because it resembles a solution to a problem and produces the same feelings of delight. Many classical ballet productions end with a Bang, which is usually synchronized with music that also ends with a grand finale. For example, George Balanchine's *Theme and Variations* (1947), a homage to the heights of Russian classical dance, set to the fourth movement of Tchaikovsky's *Suite No. 3 for Orchestra in G Major*, ends on a grand polonaise which builds to a climactic finale for the entire cast of 26 dancers. The Bang is essentially a dramatic variation on the dancers suddenly stopping or freezing in mid-motion. Pina Bausch's *Sacre du Printemps* (1975) ends with a different Bang as the woman in the red dress falls face down on the soil covered floor after an exhausting solo during which the rest of the dancers stand by. By this time the audience will have understood that the dance represents a pagan ritual and that the woman in the red dress is the sacrificial victim. And so the audience understands that when the dancer falls to the floor she has metaphorically danced herself to death.

In *Dog Shelter* (2010), one of my own dance productions, the entire stage is covered with plastic bags, newspapers, magazines, empty bottles, clothes and so on. As the lights in the audience dim, dark looming music begins to play. Then somewhere on stage something begins to move. Slowly, very slowly a dancer emerges from underneath the garbage. Even if you have seen the piece before and know what is going to happen, it is a surprise where the dancer will emerge. Some people in the audience who have seen the trailer (or read the present book) may try to spot her (but in vain if I have done my work properly). At some point during the piece the dancer covers her face with a shirt that she finds among the garbage. For several minutes she dances blindfolded. Later on in the piece she finds a white orchid among the garbage. The piece ends with the dancer walking away with the orchid and lying down somewhere on stage, covering herself with some newspapers and plastic bags and placing the orchid on top of her body.

KEY POINTS

☞ ‘To sustain the release of dopamine and thereby maintain a high level of arousal the movements would have to elicit an interplay of correct and incorrect predictions. The latter keep the observer on edge while the former provide a form of reinforcement.’

☞ ‘Watching a visual stream, such as dance, and listening to an auditory stream, such as music, involve a common brain circuit. Watching dance accompanied by music, on this account, creates a state of anticipation in both the auditory, visual and motor domain. When combined the expectations engendered in each domain would then become mutually reinforcing.’

☞ ‘If the auditory and visual time series are perfectly correlated the music becomes predictive of the dance and vice versa.’

☞ ‘Rather than saying that dance and music are correlated, it may therefore be more appropriate to say that they are cointegrated.’

☞ ‘After a dance performance some spectators may think of the dance as exhilarating even though it was the *music* that got them excited and not the choreography.’

☞ ‘Most people who attend a dance performance have come to watch the music, rather than to listen to the dance.’

☞ ‘Dance and physical comedy rely in part on the same principle, which is why dance can seem pretty ridiculous.’

☞ ‘We not only experience a feeling of finality or resolution when we solve a puzzle or a riddle, but also when, at the end of a novel or a movie, we understand the plot or learn that the villain has been killed, the catastrophe averted, the mission accomplished or that the hero and the heroine have found each other.’

☞ ‘People long for an ending, a conclusion and a sense of fulfilment, precisely because an ending activates brain regions associated with reward, the same regions that are activated when we hit a target, solve a problem or understand a joke.’

Part 4

Emotion

16

INTRODUCTION

We will now turn to what most people would consider the principle point of interest in any discussion of dance or indeed art in general: its capacity to express, represent and elicit emotion. Dance can be moving, exciting, thrilling, touching, heartbreaking, poignant and pathetic. The dancing can be passionate, inspired, ardent, eloquent, fiery, witty, spirited, cold, dark, gloomy, dramatic, erotic and steamy. People value a particular dance performance because of its expressive qualities and because of the pleasure they derive from watching it. Years later they may still have fond memories of a performance that, for some reason, touched them somewhere deep down. Other people's emotions may be a cause for wonder, puzzlement, joy, anger and frustration. You may be baffled by a lyrical description of a piece in which you saw nothing but some people aimlessly moving about on an empty stage and you may get angry with a reviewer who had the audacity to write a negative review of a performance that profoundly moved you.

Dance critics often praise a work's expressive qualities. In a review of *Swan Lake* Clement Crisp, dance critic for the *Financial Times*, wrote that, '[Uliana Lopatkina's] Odette is the incarnation of grief revealed in long, eloquent phrasing' (Crisp 2009a). Writing about a performance of *The Sleeping Beauty* Crisp noted that 'the Aurora of the first act was radiant in feeling as in step' that 'Aurora's Vision in the hunting scene was danced with delicately subdued emotion' and that 'the Aurora of the wedding was all assurance and grace' (Crisp 2009b). In a review of *Mayerling*, a ballet by Kenneth MacMillan, Crisp praised the dancer who danced the leading male role, for 'his ability to convey mental anguish, his physique ill-containing his emotions' (Crisp 2009c). In a review of *Lost Action* (2006), a piece by the Canadian choreographer Crystal Pite, Crisp commented that 'you see how ably the dance establishes images of grief and desolation', that 'the dance speaks of emotional tensions, of comradeship among the men, of sorrow and dependency' and that 'the closing sequence as three men lay a companion to rest (..) is heart-tearing' (Crisp 2009d).

In case you think these passages are all carefully chosen, which of course they are, Anna Kisselgoff, dance critic for *The New York Times*, wrote of *Fabrications* (1987) by Merce Cunningham that '[it] is a superb example of Mr. Cunningham's ability, when he desires, to create drama out of movement. The quality of movement, the context in which he places it, the compositional structure in which he presents it – these are all different from dramatic imagery as we usually encounter it in dance.' *Fabrications* has a 'highly emotional resonance', according to Kisselgoff, although she acknowledges that it 'is probably really about a movement problem that interested the choreographer. (..) When at one point, Mr. Cunningham holds a woman by the forearm, the pose becomes menacing, more than a formal gesture' (Kisselgoff 1987).

All of this cries out for an explanation. For how is Odette's grief revealed in those long eloquent phrasings? How did the dancer convey Mayerling's mental anguish? How did the dance establish those images of grief and desolation? What is it about the movements in *Lost Action* that speaks of emotional tensions, comradeship and sorrow? How can a mere sequence of movements be heart-tearing? How can a pose as simple as holding another person by the forearm become menacing? And what does Anna Kisselgoff mean when she writes that *Fabrications* has a highly emotional resonance?

To answer these questions we will have to delve into the psychology and behavioural neuroscience of emotion. We will have to analyse the nature of the emotions. We will have to analyse how facial and bodily expressions of emotion are recognized. We will have to analyse what pleasure consists in and what causes it. We will have to analyse why people concur and differ in their emotions and how people understand the emotions of others.

The present section covers a lot of ground. Emotion is a complex phenomenon and it touches on various aspects of dance. We will also have to deal with a number of philosophical issues. For what do we mean when we say of a dance performance, a novel or a piece of music that it is sad, heart-tearing, joyful, gloomy, boring or furious? Surely, it does not mean that the dancers are sad or furious let alone the notes or the musical instruments. One might argue that, if a work elicits a particular emotion in us, we subsequently attribute that emotion to the object or event. If we feel bored, it is because the piece is boring. However, the dancing can be described as furious even though we ourselves don't feel furious at all. So are these descriptions to be taken literally or metaphorically? This is but one of the issues we will need to resolve.

As I argued in the introduction, aesthetics should be consistent with contemporary research in psychology and cognitive neuroscience. It would make no sense today to ground our discussion of emotion in the theory of the four temperaments, which inspired Balanchine's ballet of the same title. But how different is Descartes' discussion of the pineal gland in his *The Passions of the Soul* (1649) from contemporary psychology and neuroscience? How does it advance our understanding of emotion if we replace the heart by the brain, the brain by the amygdala and the amygdala by its central nucleus? Does greater anatomical precision mark greater conceptual insight? We will need to analyse the extent to which contemporary psychology and cognitive neuroscience have advanced our knowledge and understanding of emotion. For whereas past theories of emotion may be anatomically incorrect, contemporary theories may be conceptually deficient or otherwise incomplete.

As Dixon (2003: 3) points out, our contemporary concept of the emotions as a set of morally disengaged, bodily, non-cognitive and involuntary feelings is a recent invention.

What mattered to Aristotle was the way emotions *function* in daily life and not so much the private feelings we associate with them today.[55] As he remarks in the *Rhetoric* (1378a), anger is always directed at a particular person and not man in general (Aristotle 2004: 142). People don't get angry at a piece of rock either, although it may be a source of frustration when it obstructs one's path. Alone on his desert island Robinson Crusoe may have felt frustration, but not anger, since there was no one to address his anger to, until the arrival of Friday.[56] Aristotle acknowledges that emotions involve physiological changes, for as he writes in *De Anima*, 'the dialectician will say that [anger] is a desire for revenge or something like that, while the natural philosopher will say that it is a boiling of the blood and hot stuff about the heart. And of these the one will be expounding the matter, the other the form and rationale' (403a29-403b2).

Aristotle addresses the *pathê*, which does not map properly onto our current notion of emotion, in *De Anima* and the *Nichomachean Ethics*, but his most extensive discussion can be found in the *Rhetoric*, which is concerned with the art of persuasion. This is perhaps no coincidence given Aristotle's emphasis on the role emotions play in public life. Aristotle's principal interest in the *Rhetoric*, in so far as the emotions or *pathê* are concerned, is how knowledge of the *pathê* can be put to practical use and enables the orator to elicit a specific emotion in the audience. Aristotle recognized that we are always in an emotional state and when delivering a speech the orator should therefore take the audience's mood into account. As he observed, 'things do not seem the same to those who love and those who hate, nor to those who are angry and those who are calm, but either altogether different or different in magnitude' (Aristotle 2004: 141; *Rhetoric* 1377b). To change the audience's mood, to bring it to feel a particular *pathê*[57], the orator needed an understanding of the nature and causes of the *pathê* in general and of each distinct *pathê* in particular. For instance, the analysis of anger may reveal: 'what state men are in when they are angry, with what people they are accustomed to be angry and in what circumstances' (Aristotle 2004: 141; *Rhetoric* 1378a). Equipped with this knowledge the orator could then deliver his speech in such a way as to bring his hearers into a frame of mind that will dispose them to anger (Aristotle 2004: 146; *Rhetoric* 1380a).

The same reason that motivated Aristotle to investigate the *pathê* in the *Rhetoric* also inspires the present section and indeed the inquiry as a whole. A better understanding of the emotions will help choreographers and dancers play to an audience. It will also help the audience understand how they are being played with.

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55 For an introduction to the emotions in classical Greek though I refer to Konstan (2006).

56 He would not have felt shame either until the arrival of Susan Barton in *Foe* (1986), J.M. Coetzee's retelling of the story.

57 In the *Rhetoric* (1378a) Aristotle defines the *pathê* as: 'those things by the alteration of which men differ with regard to those judgements which pain and pleasure accompany, such as anger, pity, fear and all other such and their opposites' (Aristotle 2004: 141).

17

A CONCEPTUAL FRAMEWORK

If we are to gain a better understanding of the role emotion plays in dance and our appreciation of dance we will need to clarify what is meant by emotion. As with all key concepts in science and philosophy the question 'what is emotion?' is difficult to answer and a matter of ongoing debate. Is there anything that anger, fear, shame, joy, pride, regret, happiness, love, melancholy, sorrow, guilt, despair, hate, awe, disgust, greed, envy and shyness not to forget gratitude, sympathy, misery, remorse and delight have in common? It's not only that there are many different emotions, or at least words describing an emotion, some emotions that are usually referred to by a single term, such as fear, may in fact cover a wide range of qualitatively different emotions. A person can be afraid of flying, but not of heights. A dancer may fear the day of the premiere and people in general may be afraid of death. If you fear that it is going to rain you may carry an umbrella, while someone who fears that the stock market is going to crash may buy put options to protect his portfolio. A person who is afraid that he will miss his train may run, while a person who finds a snake crawling through his room, provided it isn't his pet, may freeze. These observations led Pinker (1997: 386) to conjecture that, 'fear is probably several emotions.' We could, of course, leave the whole question of what emotion refers to for what it is and move on with our story and just hope that at the end of our discussion it will be clear what has been meant by emotion and feeling. The question is pertinent though, since the answer will guide our interpretation of research findings and ultimately our analysis. Understanding requires not only knowledge of the facts, but also an analysis of the concepts we use to think about those facts.

17.1 WHAT ARE EMOTIONS?

So what is emotion? The form of the question already orients us towards an answer, it suggests an underlying essence, which corresponds to emotion in all its manifestations and which sets it apart from other mental phenomena, such as cognition and attention. This is not the place for a thorough deconstruction of the concept of emotion and its history, so I will just make this one general remark. One of the central tenets in the work of the German philosopher Martin Heidegger (1889-1976) is that Western thought since Plato has erred on the question of being, treating it as an entity, instead of asking what it means to be. While this may sound like mere sophistry, when Frijda (2008: 74) remarks that emotions are often treated as thing-like states, but that for psychological analysis 'it might be better to treat emotions as the observable results of processes that are better denoted by verbs,' we can hear an echo of Heidegger's critique of Western philosophy. As Frijda adds, '"She is angering" might not be a bad expression, which neatly matches "She has been angered", as well as "She is loving".' Again, this is not much different from Heidegger's notion of space as a verb, *raümen*, for making-space or clearing-away. Unless we invent our own language, we will have to make do with common terms and so I will continue to speak of emotions and feelings in terms of systems and their components, but each of these should be understood as processes, not as fixed entities. I will thus err on the question of being, but knowingly.

In an effort to make the study of emotion amenable to scientific research, it has become current practice in psychology and cognitive neuroscience to distinguish between feelings and emotions (e.g. Frijda 1986; 2007; Damasio 1994; 2003; LeDoux 1996). Feelings in this view refer to the subjective experience of emotion, while emotion itself is regarded as a physiological or neurobiological state or a process. For instance, Damasio (2003: 53) writes that 'an emotion-proper, such as happiness, sadness, embarrassment, or sympathy, is a complex collection of chemical and neural responses forming a distinctive pattern' and that 'a feeling is the perception of a certain state of the body along with the perception of a certain mode of thinking and of thoughts with certain themes' (idem: 86). Izard (2009) defines 'emotion feeling' as a phase of some neurobiological activity that is sensed by the organism.

The implicit assumption behind these views is that, if the somatic and neural concomitants vanish, then so does the emotion. If someone's heart were to stop pounding as he steps away from the edge of a cliff, his fear will have subsided. But this is wrong. The person may still be afraid, but now takes precautions not to get too close to the edge. Dissidents in a totalitarian regime often live in a permanent state of fear, they may fear a car that appears to trail them and they may be suspicious of the friendly smile of a shop assistant. Izard (2009: 6) claims that 'feeling an emotion does not guarantee that it will be labeled, articulated, or sensed in reflective consciousness or at a high level of awareness.' However, it is unclear how sensing a feeling is different from feeling a feeling and how one can feel an emotion and not sense it. The distinction therefore adds little to our understanding. It only leads to even greater conceptual confusion.

Frijda (1986; 2007) has argued that the core of most emotions are formed by states of action readiness: the readiness to achieve a goal, to obtain an object, to protect oneself, to oppose another, to fight or to flee etc. However, people do not typically feel any emotion when someone requests them to close the window, they just get up and close the window, they don't feel any emotion either when they pack their bags to leave the train as it approaches the station and they may not feel any emotion when they get ready to go to work. So emotion and action readiness are not equivalent terms. It is not altogether obvious either whether all emotions reflect a state of action readiness. Tears of sorrow may be interpreted as a cry for help and a sign of helplessness, but sorrow does not appear to reflect a state of action readiness in any way similar to fear or anger. Action readiness may thus be an important component of some emotions, but it does not make the emotion concept redundant, it is not possible to read 'action readiness' whenever we read 'emotion'.

Attempts to reformulate feelings and emotions in terms of other concepts or to reduce them to some other state or process don't get us very far. Indeed, the concept of emotion may not be reducible to another concept. Perhaps we'll gain a better understanding of what emotions are by saying what they are not. For one thing, emotions differ from actions in that one is generally passive in their reception (Bennett and Hacker 2003; 2005). You cannot decide to feel shame or regret, you cannot through practice improve your feelings of gratitude and you cannot ask or demand another person to feel despair, the way you might ask someone to open a window or fill in a form. Feelings overcome us. This fact is also reflected in the metaphors people use, at least in English, to describe emotions. We say that we are overwhelmed by grief, paralysed with fear, struck by jealousy and plagued by remorse.[58] Even though we may try to suppress and control our emotions, we cannot invoke them at will. We may get angry if we recall a certain emotional event, but we cannot get angry or feel guilt just out of the blue. We can act angrily and we can raise our voice in anger, but that doesn't mean that we *feel* anger. After all, nobody thinks that actors on stage or on screen really are angry, afraid, in love and so on.

Emotions are feelings, but feelings of a special kind. They differ from sensations, such as a toothache or a headache, tactile perceptions, such as feeling whether something is hot, wet, soft or sharp, appetites, such as hunger or thirst and the feeling associated with the desperate need to go to the toilet. They also differ from what might be called agitations and moods (Figure 5.1). Sensations can be either localized, such as a tingle in your arm or a pain in your ankle or unlocalized, such as when you feel hot or cold. Sensations are different from perceptions in that they cannot be right or wrong. If you feel a sudden sharp pain in your left foot you don't revise your sensation later, that it was your right ear and not your left foot. Unlike visual perception sensations are not susceptible to illusions. The collusion of nerve endings at a particular point in the body may make it difficult to localize some sensations. A constriction in a colon may give rise to a range of physical symptoms, pain here, and a constant tingling there, but a neurologist will be able to determine exactly where the problem lies on the basis of the patient's report. The person is not mistaken in feeling pain in his left arm and a tingling in his upper lip; it is just that the origin of the

[58] For an alternative view I refer to Sartre (1939). Sartre criticized the psychology of his time for regarding emotion as a disruptive state that manifests itself to consciousness. He conceived of emotions as conscious, purposeful acts through which we constitute our world and for which we must accept responsibility. Feeling an emotion is something we do, it is an intentional act because it involves the things we care about. See also Solomon (2006: 93-113).

pain lies elsewhere. The location of the cause of the pain and the location of the pain need not coincide.[59]

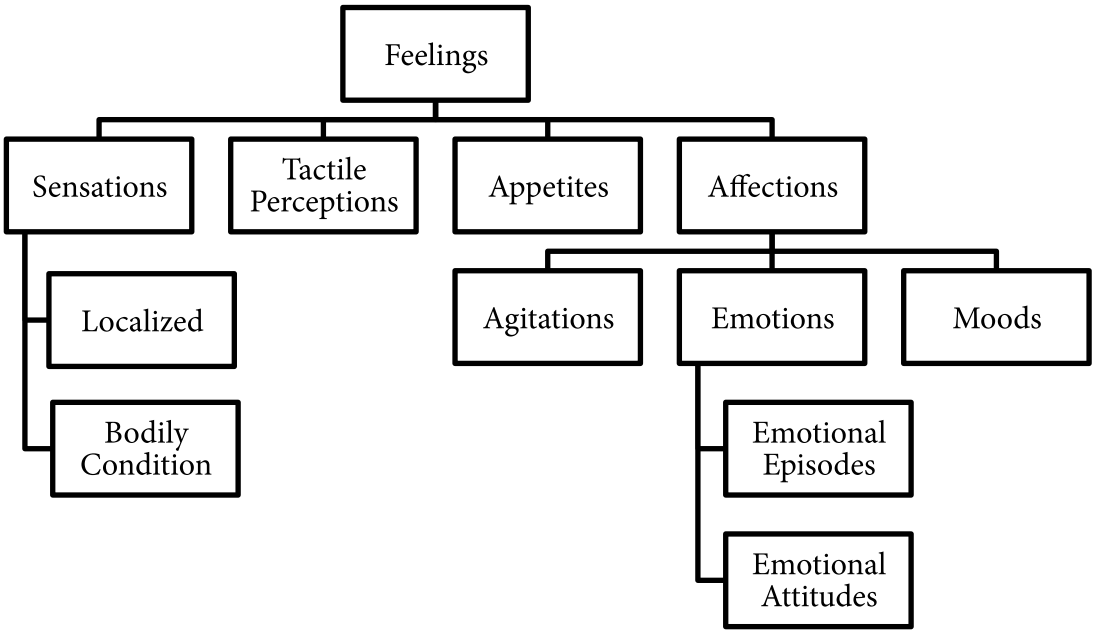

Figure 5.1 Feelings and emotions. Adapted from Bennett and Hacker (2005).

Appetites are a blend of sensation and desire. They are localized and lead to an urge to satisfy the corresponding desire. When you're hungry your stomach may begin to rumble, whereas thirst gives rise to a dry feeling in the mouth and throat, not in the knees. Appetites are recurrent, manifest themselves periodically and involve a generic object. While metaphorically speaking someone may hunger for sex, hunger is typically associated with food, thirst with drink and lust with sex. The feeling associated with the urge to relieve oneself belongs in the same category. The term appetite therefore does not cover all of these feelings; it's just that I don't have a better term. The feelings that come with the need to go to the toilet are localized and cannot be mistaken. You don't feel something and then wonder whether you are thirsty, have to pee or have to sit down and empty your bowels. These feelings point at a bodily need and cannot be invoked at will. If you have ever had to deliver urine at a hospital you will know that if you don't feel like peeing there is no way of inducing the *feeling*. It is only with great physical effort that you may be able to press out some urine.

Agitations are temporary disruptions usually caused by something unexpected. Typical agitations are the feelings of surprise, shock, thrill and excitement. They are modes of reaction rather than motives for action as Bennett and Hacker (2003; 2005) point out. A person may be paralysed with shock or startled by surprise, but that in itself does not

[59] This also applies to so-called phantom pains in which case a patient may feel pain in an amputated limb.

induce any action. Although you can continue to be surprised or shocked, the *feeling* only lasts for a short period and then ebbs away. As discussed in chapter 15, a sharp deviation from a foregoing sequence of events may occasion a startle response. Attention is then drawn towards the event's likely source, and a number of physiological reactions may ensue, such as an increase in heart rate and a rise in blood pressure. However, we need to distinguish between the shock or the surprise that accompanies, say a sudden loud noise, and the subsequent emotion.[60] A person may feel alarm upon analysing the possible causes of what sounded like breaking glass, he may get angry if the telephone rings when he asked not to be interrupted, but he may also be delighted when the telephone rings at the agreed upon time. We also need to distinguish between the general arousal associated with increased effort, for instance, when playing a computer game, as analysed in chapter 15 and the joy associated with scoring a point.

Unlike sensations emotions do not inform one of the state of the body part in question. They do not tell anything about the state of the world either, such as whether it is hot or cold outside or whether the air is humid or dry. Whereas appetites are localized, emotions are not. And whereas appetites have a generic object, emotions have a specific object. One doesn't just feel guilty or ashamed; one feels guilty and ashamed about spoiling wine onto one's friends' carpet. One isn't just angry, but angry *about* something and usually *with* someone, if only oneself.

Emotions can be further divided into emotional attitudes on the one hand and emotional episodes or perturbations on the other. The distinction is that between a disposition and an occurrent state and seeks to capture the difference between a person's fear of dogs in general and the same person's sense of alarm upon encountering the neighbour's dog when he walks out the door.

Emotional episodes are what typically come to mind when people think of emotions. When someone stands on our foot, bumps into our car or spills some food on our clothes, we typically respond with a burst of anger. We don't say, that was great, please do it again! Emotional episodes are shortlived and can, but need not, be manifested in various forms of expressive behaviour. Thus a person overcome with sadness may start crying, a person who bursts out in anger may speak out in a loud voice, use expletives and make forceful gestures and a person who despairs may sigh, stammer or shake her head. It should be noted though that not all emotions can be related to behavioural or physiological reactions. A person may feel proud upon being praised for his achievements, but it need not show in any way. He may subsequently express his gratitude in a short speech and underline his humility by comparing himself with greater achievements and share his own achievement with his team. None of these feelings need to be accompanied by any somatic reactions.

Emotional attitudes may originate in an emotional episode, for example a particularly nasty confrontation with a dog during one's childhood. Even though attitudes are dispositional rather than occurrent, they do have a temporal dimension. A person may

[60] It is therefore wrong to treat the startle response as a model of emotion as Robinson (2005) does.

harbour feelings of anger, shame, guilt, regret, pride and so on for years, but the intensity may fade with time. When I say that emotional attitudes are dispositional I do not mean that a person gets angry whenever a particular antecedent event occurs. When you're embroiled with a neighbour or a colleague, it colours your life, but in a different way than a mood. Emotional attitudes may motivate actions and may be felt in the absence of any physiological concomitants, even though they may surface when one thinks about it. The history of literature and cinema is full of examples of people seeking revenge long after the event that provoked their ire. In *Oldboy* (2003) a film by Korean director Park Chan-wook, a man is kidnapped and imprisoned in a hotel room for 15 years without knowing why or who his captor is. He is determined if he ever gets out to find the person who did this to him, and so, when he is unexpectedly released, he sets out on a path of revenge, only to discover that things are not as straightforward as he thought. In *The Joke* (1967) a novel by Milan Kundera set in 1950s and 1960s communist Czeckoslovakia, a man seeks revenge on a former friend who many years earlier instigated his expulsion from university and his confinement to working in the mines following an innocent remark, intended as a joke, on a postcard to a friend.

Emotional attitudes may show in people's behaviour and in their actions. A person who is deeply in love may make frequent phone calls to the subject of his or her attentions. He or she may have difficulty sleeping and concentrating and become indifferent to daily activities, which all of a sudden seem less important. The intensity of a person's love for, say dance, may show in the time and money he or she spends on attending dance performances and in the fact that he or she may travel all the way to Paris, London, Frankfurt or Wuppertal to see a dance performance, as I myself have done on many occasions. Emotional attitudes may also show in someone's decision to become a philanthropist, to join the board of directors of an organization or to become active in a social, political or ecological movement.

Moods are not just emotions that extend over a longer period of time. They are states or frames of mind and although they are typically long-lived, they can also be short-lived, such as when one experiences mood swings. A person may feel depressed for months, but cheerful during a dinner with friends or for the duration of a dance performance. Unlike emotions, moods are not directed at a specific object, although an object or event can bring about a change in mood. Whereas emotions can, at least to a certain extent, be controlled, moods appear to just come and go as they please. Cheerful music can cheer you up, but it can also make you even more depressed and after seeing a gloomy movie such as *Naked* (1993) by Mike Leigh, a depressed person may realize that his own situation is not that bad after all, while another person who had been looking forward to a good night out at the movies, may get all depressed. Moods cast a shadow over the world or put it in a different light. Accordingly, they affect people's behaviour in multiple ways. A person whose mood has changed from depressed to cheerful may be inclined to make plans, go out and so on. A person's mood may also affect his tendency to feel certain emotions. A depressed person may be more irritable and may fail to find pleasure in events that he knows should be enjoyable. Observing other people having a good time may only deepen his depression.

Emotions have both objects and causes, but these are two different things. The sound of the air-raid alarm causes people to be afraid and to seek shelter. But they fear for their lives, that of their beloved ones and their possessions, they don't fear the sound of the alarm as such. The cause of one's fear is therefore distinct from the object of one's fear. A mother who fears infection with the influenza virus for herself and her child may take various precautions such as washing her hands before consuming food and avoiding public spaces with large gatherings of people, but she need not live in a permanent state of fear.

Unlike agitations and sensations emotions have a cognitive component. You can only feel regret or guilt about something that has happened and hope for something that has not yet happened. To fear the consequences of an event a person must know that the event may turn out bad. It is because of their cognitive dimension that emotions can be intelligible, reasonable and justified or not. We may find someone's emotional response intelligible under the circumstances, but the intensity of his outburst out of proportion. We may also consider it unwise to give in to one's emotions. If we notice that someone is sad, angry or weary we may ask for a reason and seek to comfort the person.

Emotions, unlike moods and agitations, are influenced by cultural values and personal, political and religious convictions. And so, even though, emotions are in principle intelligible we do not always understand other people's emotions or their absence for that matter. We may be puzzled why the CEO of a Japanese corporation cries when he informs his employees of the losses that led to the company's demise and we may struggle to understand the difference between nostalgia, melancholy and *saudade*. Killing an animal on stage as part of a performance, as the Japanese Butoh dancer Tatsumi Hijikata did in *Kinjiki* (Forbidden Colors, 1959) in which he strangled a chicken between his legs, and in *Nikutai no Hanran* (Rebellion of the Flesh, 1986), which featured the ritual killing of a rooster and the terrorizing of various other animals, is sure to offend part of the audience, although today's seasoned theatre goers in Amsterdam and Berlin may experience a sinking feeling: not again. In some Islamic countries dance itself may be a source of moral indignation, if it involves the public display of the body, not to mention uncovered parts of the female body and unmarried individuals of the opposite sex touching each other.

It is easy to get lost in a philosophical linguistic conundrum when considering the objects of an emotion and not every emotion needs to have an object, for example it is hard to define the object of shyness. Something may cause a feeling of unease, but it may not be possible to point at the object of one's unease. The distinction between the cause and the object of an emotion is particularly relevant in the presence of multiple objects, when the risk of misattributing the cause of an emotion increases. Dance performances are typically accompanied by music. While it may not be possible to separate the dance from the music in that one could play different music while keeping the choreography the same, a spectator may respond emotionally to the music and attribute this to the performance as a whole. In this case it might be more correct to praise the choreographer for his choice of music than his choreographic abilities. Since for most people attending a dance performance is a night out, they tend to be in a good mood for the evening, which may also contribute to their emotional response, just as the cup of coffee they had before the show and the glass of wine they drank during the first interval (☞ §13.3).

Our exposition so far shows that a conceptual analysis already offers some insights into dance and emotion and that there is much to be gained by being precise in our choice of concepts. The analysis underlines that emotion is a complex phenomenon. No single emotion, such as fear, anger or pleasure, can serve as a model for emotion in general. I should add that the boundaries between moods, agitations, emotional episodes and emotional attitudes are not sharp. Is sorrow an emotion or a mood? Is disgust an emotion or an agitation? However, it is important to distinguish between an agitation such as surprise and the emotions that may accompany a pleasant or unpleasant surprise. As we shall see, neurophysiological theories of emotion fail to differentiate between emotional episodes and emotional attitudes, focusing exclusively on a select number of emotional episodes, and therefore generally ignore emotions such as love, melancholy, misery, nostalgia and guilt.

The distinction is important because we may infer a person's emotional attitude from our understanding of a situation in the absence of any overt emotional expression. We may then interpret the subsequent actions, however inexplicable they may seem, as ensuing from this attitude. In a movie a person's actions may seem unintelligible at first, but once we understand that he is seeking revenge, we may interpret his actions in that light and realize that he is devising a particularly cunning scheme to act out his revenge. If a person visiting with friends accidentally breaks a vase we know that he must be feeling sorry, not as simulation theorists would have it, because we immediately simulate the entire sequence of events, since we may never have broken a vase ourselves, but because we know that, in this sort of situation, people tend to feel guilty and ashamed. I should add that we might conceive of contexts in which we would *not* interpret the person's feelings as guilt and shame, for example when we have reason to believe the vase's breaking was not an accident, but a deliberate act or when feelings of guilt are neutralized and become the source of humour, as they are in a comedy.

17.2 DANCE AND EMOTION

Dance, mood and emotion are connected in multiple ways. A dancer may get frustrated if she repeatedly fails to get a particular choreographed movement sequence right and she may burst into tears when castigated by a ruthless ballet teacher. Dancers may develop mood disorders from having to submit themselves on a daily basis to a strict regime of training and constant criticism. Dancing itself may be a source of pleasure and performing to a sold-out audience at New York's Brooklyn Academy of Music or the Festival d'Avignon may fill a dancer with pride. If a performance does not go well a dancer may be ashamed and wish to hide in a corner of the dressing room and go home as quickly as possible to take a long shower and wash away her discomfiture. She may feel guilty towards the choreographer and the other cast members for messing up and as a consequence she may suffer from increased stage fright for the next performance. Dancers may also be jealous of other dancers or worry about their weight, an ankle injury or their mascara and all choreographers and dancers, no matter how famous or successful, are nervous before a premiere. Most of this is largely incidental though and not specific to dance. Athletes are also nervous before an important tournament and floor traders on a derivatives exchange may be as excited when trading starts as dancers are when they get to go on stage. What interest us here are those aspects of emotion that are specific to dance as an art form.

I don't think anyone would disagree that some dance can *express* emotion. After winning an important game a player may jump around with joy and two tango dancers may act out their love in a dance. Passers-by may notice the passion in their dancing, they may applaud the couple and encourage them to enter a competition, but none of this matters to the lovers, who just want to be close to each other and enjoy the simple pleasure of jointly coordinating their bodies. A choreography too can be an expression of the choreographers emotions. In 1984 Jiří Kylián created *Heart's Labyrinth* following the suicide of one of the dancers at Netherlands Dance Theatre, of which he was artistic director, an event that shook the entire company. William Forsythe created *And Through Them Filters Futile* (1993), the second part of *As a Garden in this Setting* (1992), at a time when his wife was terminally ill with cancer. A few months after her death Forsythe created *Quintett* (1993), a hauntingly beautiful and intensely moving ballet, that never fails to touch me, even after seeing it what must be more than twenty times. In cases such as this the artistic process cannot be separated from the process of coping with the death of a beloved person, it *is* a way of coping. Another person might go for long walks along the beach, drown his sorrow in alcohol, stay inside for months and lock himself off of the outside world.

The idea that art expresses emotion can be traced back all the way to ancient Greek and Indian philosophy. It is also part of the common sense view of art. As before problems emerge if we want to define what is actually meant by expression when we say that art expresses emotion. Scruton (1974: 214) has made a distinction between something being an expression of something and it being expressive. 'A gesture,' according to Scruton, 'is a natural expression of some feeling if it is a symptom of that feeling, and a symptom need not be expressive' (idem). Scruton then goes on to claim that 'in art there is no expression without expressiveness' (idem). What distinguishes expression as a symptom from expressiveness, is that it makes no sense of a symptom to say that it is successful. A person may squirm with pain and tremble with cold, but it makes no sense to ask whether his squirming and trembling were successful and could be improved in any way. While this may be true, one could very well judge whether an actor is successful in giving the impression of being cold or being in pain. Consequently, what would be symptoms in Scruton's terminology can be become expressive gestures in dance.

In the most minimal terms expression might be defined as 'a matter of something outward giving evidence of something inward' (Levinson 2006: 91). Levinson takes this to mean that 'expression is essentially the manifesting or externalizing of mind or psychology' since only psychological properties 'can be intelligibly expressed, whoever or whatever is doing the expressing' (idem). If we were to accept this definition, then how can something like music be said to be expressive? Levinson claims that, 'we can give content to "sad human appearance" by glossing it as "the appearance or kind of appearance sad humans typically display".' The only way to anchor 'sad musical appearance', according to Levinson, 'is in terms of our disposition to hear such music as sad' (idem: 99). Levinson claims that, when we hear music as expressive of an emotion, we hear it *as if* someone expressing the emotion expressed it (through music). To illustrate his proposal he invites us to 'imagine the music you are hearing to be the literal expressing of a state of mind' and to then ask ourselves what state of mind that appears to be (idem: 107). But do sad people really display a typical expression? And when it is said that 'the dance establishes images of grief and desolation' as Clement Crisp wrote of *Lost Action*, is it really the case that we imagine it *as if* it were the expression of a grieving person?

Perhaps confining the term expression to mental states alone is unnecessarily restrictive. We might say of a wine that it expresses its terroir and that it does so with finesse and elegance through concentrated aromas of blackberry, currants, and a complex, layered palate that suggests cherries and deep low notes of mineral.[61] We also say of genes that they are expressed by being transcribed into RNA, which is then translated into protein. However, it only makes sense of people to say that they express an emotion. And so it is only when one speaks of the expression of emotion that one has to assume someone doing the expressing.

When we say of a particular dance phrase that it is delicate, we don't mean that it should be handled with care, because it may easily break. The use of delicate in this case is metaphorical, not literal. As Zangwill (2007) has argued, when we say of music that it is sad or that it expresses sadness, it should not be taken literally either, but metaphorically. In dance the situation is slightly more complicated. Dance involves persons who can be meaningfully said to express an emotion, but when we say that the dance has a nervous quality, we don't mean that the dancers look nervous in the sense that they don't seem up to the task. On the other hand, when a movement is described as hesitant it can only be so because a dancer performs it hesitantly.

To summarize, the question of what the expression of emotion means is not easily answered and it is best to remain aware of the problematic nature of the term and of the *possible* definitions.

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[61] 'Expressiveness is the quality a wine possesses when its aromas and flavors are well-defined and clearly projected' (MacNeil 2001: 5).

The primary question that will concern us here is how expressions of emotion are recognized. It may be useful in this respect to distinguish between the representation and the expression of emotion, even though we can read expression whenever it says representation. An artist may express his or her emotions in a work, but in so doing have different characters represent different emotions. To bring out a conflict one may wish one person to express frustration and another to express joy. One person is looking forward to going out, another doesn't feel like it at all and does whatever he can to sabotage the other's plans. Emotions thus expressed can be recognized in individual gestures and the piece as a whole. For instance, one may see a form of caring and tenderness in one dancer supporting and carrying another dancer. If an actor raises his voice and uses a series of expletives, we may understand that he is angry. But of course we can only understand that this is so because we have learnt to associate certain forms of behaviour with different emotions.

The audience may recognize both an emotional episode, for example when a dancer suddenly starts shaking and trembling, and what I referred to as an emotional attitude, for example, when a dancer denies all contact with other dancers, avoids them or pushes them away when they come near.

Things become problematic if we move beyond individual dancers. A duet and a ballet as a whole can appear joyful or sad, that is, one can recognize the joy in a group scene, even though it cannot be reduced to the movements of an individual dancer. It makes a big difference whether two dancers embrace or whether one dancer makes an embracing movement. Because of the absence of another person the second scene may express solitude and longing instead of joy.

A much-debated question is whether dance or art *should* express emotion and whether it is part of the definition or essence of dance and art at large, as the expression theory of art has it. The expression theory of art is perhaps best summarized in a rather opaque statement by Leo Tolstoy in his essay *What is Art?* As he wrote:

> 'To evoke in oneself a feeling one has once experienced, and having invoked it in oneself, then, by means of movements, lines, colours, sounds or forms expressed in words, so to transmit that feeling that others may experience the same feeling – this is the activity of art. Art is a human activity, consisting in this, that one man consciously, by means of certain external signs, hands on to others the feelings he has lived through, and that other people are infected by these feelings, and also experience them' (Tolstoy 1996: 51).

The expression theory has had many advocates among dancers, choreographers and dance theorists. The pioneers of German *Ausdruckstanz*, Mary Wigman, Rudolf Laban and Kurt Jooss, and the founders of modern dance in the United States, Ted Shawn, Doris Humphrey, José Limon and Martha Graham, all regarded the expression of emotion as the essence of dance. Mary Wigman wrote that, 'there is something alive in every individual which makes him capable of giving outward manifestation (through the medium of bodily movement) to his feelings, or rather, to that which inwardly stirs him' (Wigman 1933/1996: 364). Two centuries earlier the French choreographer and dance theorist Jean-Georges Noverre (1727-1810) had railed against the ballet of his time in his *Lettres sur La Danse et sur Les Ballets* (1760), because, in his view, dance was meaningless unless it had some dramatic and expressive content. As he wrote in his first letter:

> 'This art has remained in its infancy only because its effects have been limited, like those of fireworks designed simply to gratify the eyes; although this art shares with the best plays the advantage of inspiring, moving and captivating the spectator by the charm of its interest and illusion. No one has suspected its power of speaking to the heart. If our ballets be feeble, monotonous and dull, if they be devoid of ideas, meaning, expression and character, it is less, I repeat, the fault of the art than that of the artist' (Noverre 1983: 11).[62]

There are, however, a few problems with the expression theory of art. To state the obvious, a choreographer does not have to feel an emotion, say grief, to create a dance, which expresses it, and the dancers don't have to be (actual) comrades for the dance to create the impression that they are. In Tolstoy's view a work of art is a vehicle for the transmission of the artist's inner feelings. This implies that the feelings could also be embedded in another work, without altering their content. But it is difficult to see how, let's say, a novel, a choreography and a work of architecture, might embody the same feelings. We might say that in the case of a ballet such as Jiří Kylián's *Heart's Labyrinth* (1984), the work of art is an expression of emotion in the sense that it is *evidence* of the artist's struggle to come to terms with his feelings of sorrow, disbelief and the total incomprehension that fills one when one is confronted with the suicide of a person one knows well. It is easy to make such a claim because in this case one may have read some interviews and know the emotion that informed the ballet, but what about the other ballets Kylián created? What are they evidence of? Ultimately, there is no need to assume that the artist expresses himself in or through his work. All that matters is that he or she creates an *expressive* object, event or performance.

Part of the problem with the expression theory of art arises from the assumption that there is an emotion, which is subsequently expressed or given form in the work of art. This notion is analogous to the idea that in language one first forms a thought or a meaning, which is then expressed in one's speech. But this is wrong. Meaning emerges as one speaks or writes and the meaning of the words that emanate from one's mouth or fingers never overlap for a full 100 percent with what one wishes to say. The philosopher R.G.

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[62] In his ninth letter Noverre criticized the Paris Opera Ballet for its use of masks, which, in his opinion, stood in the way of the dancer using facial expressions to express an emotion and breathe life into a character (☞ §3.1).

Collingwood argued along these lines that the artist does not try to embody an already existing emotion in the work he or she is creating. As he wrote: ‘the expression of emotion is not made to fit an emotion already existing, but is an activity without which the experience of emotion cannot exist’ (Collingwood 1938: 244). In the work of art an emotion and its expression have become indistinguishable.

Collingwood makes another important observation when he distinguishes between description and expression.

> ‘If you want to express the terror which something causes, you must not give it an epithet like “dreadful”. For that describes the emotion instead of expressing it, and your language becomes frigid, that is inexpressive, at once. (..) Some people have thought that a poet who wishes to express a great variety of subtly differentiated emotions might be hampered by the lack of a vocabulary rich in words referring to the distinctions between them; and that psychology, by working out such a vocabulary, might render a valuable service to poetry. This is the opposite of the truth. The poet needs no such words at all. (..) The reason why description, so far from helping expression, actually damages it, is that description generalizes. To describe a thing is to call it a thing of such and such kind: to bring it under a conception, to classify it. Expression, on the contrary, individualizes. The anger which I feel here and now, with a certain person, for a certain cause, is no doubt an instance of anger, and in describing it as anger one is telling truth about it; but it is much more than mere anger: it is a peculiar anger, not quite like any anger that I ever felt before, and probably not quite like any anger I shall ever feel again. (..) The poet, therefore, (..) gets as far away as possible from merely labelling his emotions as instances of this or that general kind, and takes enormous pains to individualize them by expressing them in terms which reveal their difference from any other emotion of the same sort’ (Collingwood 1938: 112-13).

As I will argue a choreographer does not need a vocabulary of expressive movements either in order to make an expressive ballet (☞ §20.5).

The Russian actor and theatre director Konstantin Stanislavski is well-known for developing a systematic approach to acting, often referred to as Method Acting, whereby actors draw upon their own emotions and memories in their portrayal of a character. If a character is required to cry at a particular moment in a scene, the actor should recall an intense emotional event from his or her own life so as to invoke real tears. The idea is that if an actor draws upon his or her own emotional memories, the emotions can be more authentically portrayed than if he or she were to copy some emblematic expressions of emotion, because the source of the emotion is genuine. As Aristotle already observed in his *Poetics* (XVII/55a): ‘one should also, as far as possible, work plots out using gestures. Given the same natural talent, those who are actually experiencing the emotions are the most convincing; someone who is distressed or angry acts out distress and irritation most authentically' (Aristotle 1996: 27-28).

Pina Bausch famously said that she was not so much interested in the dancers' movements as in what moves them. During the rehearsals for a new production she used to hand the dancers all kinds of questions, words or tasks: 'resist temptation', 'how does one make angels out of devils?', 'self-destruction', 'like a king', 'separating the wheat from the chaff', 'sign', 'pigeon', 'something utopian', 'fear of a small animal', 'console an object', 'beg proudly', 'spicy', 'cheap joy', 'punish charmingly' and so on.[63] These tasks were intended to help the dancers find in themselves a reason to move one way or another. The resulting movements and interactions then became the source material for the piece. Since people respond differently to different situations it may not be possible for the audience to tell either the emotion, the situation that caused it or the object of the emotion (one person may freeze upon seeing a scorpion marching through one's bedroom while another may start screaming).

An artist's emotional attitude, rather than some occurrently felt emotions, might also serve as *inspiration* for a work of art. For example, a choreographer may create a choreography out of anger over the political situation in the Middle East. The distinction between emotion as inspiration and the expression of emotion is important. It may seem that if an emotion serves as inspiration for a particular piece, it is thereby expressive of that emotion. But a choreographer who is angered by the political situation in the Middle East may respond by creating a peaceful ballet in which balance, mutual support and synchrony dominate, rather than violence and conflict. It would make little sense to then refer to the dance as an expression of anger.

Dance, like any other work of art, or indeed any situation or event, may also *elicit* an emotion in a spectator. The American dance critic John Martin considered this to be the essence of dance. As he wrote in his book *Introduction to the Dance* (1939) '[art's] minimum function is the transference of an emotional experience of some kind and degree to the spectator. If it does less than this, it is not a work of art, no matter how many facts it may state, events it may report or rules of procedure it may obey' (Martin 1939: 59). But as Martin added:

> 'obviously it is not the dancer's, or any other artist's, purpose simply to arouse us to feel emotion in a general sense, to stir us to no end. It is his purpose, rather, to arouse us to feel a certain emotion about a particular object or situation. (..) Therefore the dancer must do more than just work himself up into an excited emotional state and hop about in response to the whim of the moment. He must organize his material so that it will induce those specific reactions in us that will communicate his purpose' (Martin 1939: 54).

[63] A selection of words, questions and tasks from *Palermo, Palermo* (1989).

The debate in aesthetics centres on the kinds of emotions art may arouse, but this debate in turn arises from a misunderstanding of emotion and the psychology of emotion. For example, Zangwill (2007) denies that people experience sadness when they listen to music that they describe as 'sad', but acknowledges that music can bring about feelings of pleasure and displeasure. He claims that, when we say of a piece of music that it is exhilarating, 'the music is not exhilarating because we are exhilarated; rather, we are typically exhilarated because we hear exhilaration *in* the music. The exhilaration we *feel* derives from the exhilaration we *hear*' (Zangwill 2007: 396). But as I explained in chapter 15, music, dance and watching a game can be literally arousing, because one needs to constantly catch up with the ongoing flow of stimuli. However, as I argued above, arousal is a sensation and should be distinguished from emotion.

We may make a further distinction between *recognizing* an emotion, *understanding* that a person feels a certain emotion and *feeling* an emotion oneself. One may *recognize* the anguish in Picasso's *Guernica*, without actually *feeling* it oneself and one may *understand* that someone *must* be feeling an emotion even though she is hiding all signs of it. Essentially, these are the three themes we need to investigate.

We may also distinguish between the emotions occasioned by the dance, and those that have the dance as its object. A spectator may be happy to attend a performance, recognize images of struggle and despair in the dance and as a result feel a melancholy twinge about the futility of life. The happiness derives from the act of attending the performance, while the feelings of melancholy are caused by the performance. Because of its capacity to evoke an emotional response in the spectator the piece can then be said to be 'expressive', whereas pieces, which fail to elicit an emotion can be said to 'lack expressive power'. Alternatively, in the latter case it might be argued that the spectator has failed to appreciate the work's expressive qualities.

I should emphasize that it is very well possible to feel unintended emotions when attending to a work or art. Exaggerated displays of drama can be ridiculous and too much merriness can be annoying, if one isn't in the mood. A poor performance of a brilliant choreography may also make one sad or angry and fill one with remorse about spending considerable time and money on seeing the production. Finally, the fatwa against Salman Rushdie and more recently the murder of Dutch filmmaker Theo van Gogh, the death threats against the Danish cartoonist Kurt Westergaard and the many knife attacks aimed at paintings have highlighted art's capacity to offend people and the lengths to which some people are willing to go in their search for revenge. The capacity of art to elicit emotions should not be underestimated, nor should the power of those emotions themselves.

17.3 CONCLUSION

The focus in the present chapter has been on a critical analysis of some prevailing concepts of emotion. Emotion is a complex phenomenon and attempts to reduce it to another concept inevitably lead to the omission of other important aspects. Emotions should be distinguished from bodily sensations such as pain and agitations such as the feeling of shock or surprise. We should also distinguish between emotional episodes and emotional attitudes and between the cause and the object of an emotion. Receiving a gift may cause one to feel joy, but the object of one's feeling of gratitude is the giver, not the gift. Uncertainty about the object of one's emotions may lead one to draw the wrong conclusion. When watching a dance performance one may be carried away by the music and attribute one's feelings to the performance as a whole. The next production by the same choreographer may then come as a disappointment if the music is not to one's taste or if the choreography is radically different. People who were blown away by a performance of Pina Bausch's *Sacre du Printemps* by the Paris Opera Ballet may be thoroughly disappointed when they attend a performance of *Kontakthof*. Upon seeing a performance of *Falling Angels* by Jiří Kylián they may realize that what they enjoy are dynamic group scenes set to a pulsing score.

Much has been written about the role of emotion in the arts. Art can express emotion and it can elicit emotion. One can recognize the displays of emotion in a work of art and one can understand that a character in a novel, a movie or a play feels a certain emotion. In the next chapters I will analyse how expressions of emotion are recognized and how emotions emerge in the first place.

KEY POINTS

☞ 'Emotions are feelings of a special kind. Like moods and agitations, emotions are a subclass of affections. They can be distinguished into emotional episodes and emotional attitudes.'

☞ 'We may infer a person's emotional attitude from our understanding of the situation he or she finds him or herself in. We may then interpret the person's subsequent actions as ensuing from this attitude.'

☞ 'Emotion is a complex phenomenon. No single emotion, such as fear, anger or pleasure, can serve as a model for emotion in general.'

☞ 'The question of what the expression of emotion means is not easily answered and it is best to remain aware of the problematic nature of the term and of the *possible* definitions.'

☞ 'A choreographer does not have to feel an emotion, say grief, to create a dance, which expresses it.'

☞ ‘There is no need to assume that the artist expresses himself in or through his work. All that matters is that he or she creates an *expressive* object, event or performance.’

☞ ‘An artist’s emotional attitude, rather than some occurrently felt emotions, might serve as *inspiration* for a work of art.’

☞ ‘One can distinguish between *recognizing* an emotion, *understanding* that a person feels a certain emotion and *feeling* an emotion oneself. One can make a further distinction between the emotions occasioned by the dance, and those that have the dance as its object.’

18

PSYCHOLOGICAL THEORIES OF EMOTION

If you were to analyse an audience's emotions during and after a movie or a dance or theatre performance you might find various regularities in the kinds of emotions people feel as well as in their timing and intensity. This is perhaps most obvious when, in the middle of a movie, a beloved character passes away. At exactly this moment some people will be sobbing while others will feel a lump in their throat. There may, however, also be some people in the audience who are unmoved. They may consider the storyline too farfetched or perhaps they have seen the movie before. If you were to examine the people who were unmoved you may thus find some regularities in their behaviour as well.

Psychological theories of emotion seek to describe the regularities in people's emotional behaviour and to explain those regularities in terms of their presumed underlying processes. Some theories seek to account for the rich variety of what counts as emotion, while other theories try to provide an explanation in minimal terms. This chapter briefly reviews the three main psychological theories of emotion: the basic emotion model, the appraisal theory of emotion and the core affect theory. As we shall see each of these theories has something to add to our understanding of dance.

18.1 INVARIANT RELATIONSHIPS

Frijda (1988; 2007) has argued that, just as physics establishes the laws of nature[64], it is possible to formulate laws of emotion. Instead of laws it might be more appropriate to speak of invariant relationships (☞ §1.3) in the sense of Woordward (2003), although admittedly *The Invariant Relationships of Emotion* doesn't make for a catchy book title.

As Frijda observes '[emotions] emerge, develop, and wax and wane according to rules in [a] strictly determined fashion' (Frijda 2007: 2). Upon reading a negative review, whether of your own work or of a performance you feel passionate about, you may get all angry, you may feel like writing a letter to the editor or posting a vehement response on your blog, but after a few hours your anger may subside and a week later you may have forgotten all about it. When you were in your final year at high school you may have been jealous of a classmate because of his or her popularity with the opposite sex, but now, years later, you no longer care. Even in these two simple examples there is a pattern: emotions

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[64] Which according to Cartwright (1983) lie.

vanish after a certain amount of time has passed and they arise in response to events that are important to an individual's concerns, which is what sets them apart from agitations such as the startle response.

Situations or events are not pleasant or unpleasant of themselves. What matters is their meaning to an individual. A loss or gain in weight may be good news to some people and bad news to others, but most people may not even notice. If you don't care about your weight you are unlikely to worry about the number of calories in a piece of chocolate cake and go for the cream on top. We feel an emotion because we care about something, because we have an interest in it and because it matters to us. When I was a student at university I cared most about money of which I had little and less about time of which I had more. And so I didn't mind travelling an extra hour if it would qualify me for a discount. When I got a job in finance the situation reversed. Now I cared most about time, of which I had little, and less about money, of which I had more. And so, one of the things that would upset me most was losing precious time because I wanted to spend the little spare time I had left on the things I enjoyed most, such as seeing and making dance, reading, travelling, and silly me, the research that you are now reading. Since most people care about time and money, the amount of each they spend on something may therefore be a better indicator of their preferences than the ratings beloved by psychologists and marketing researchers.

To feel an emotion or to respond emotionally a person should believe that the occasioning object or event is real. The feelings experienced by people who believe in God or who believe that the ghosts of their ancestors may avenge themselves if they are not buried properly, are real, even though their beliefs lack an empirical basis. In the arts the term suspension of disbelief is used to refer to the willingness of the audience to overlook the fact that what they see on-stage or on-screen is fictional (☞ §19.7). But as Walton (1978) has argued, people don't call the police when they witness an on-stage or on-screen murder and they're not jealous of Elizabeth Swann in *Pirates of the Caribbean*, because she gets to date Will Turner (or vice versa), or of Keira Knightley because she gets to kiss Orlando Bloom (or vice versa). Viewers must therefore remain aware of the fact that what they witness is fictional. They must realize that they cannot intervene and can do nothing about the situation because the entire sequence of events has already been determined.[65] People's emotions are no less real for that, but only up to the point where they are willing to invest their emotions. We could therefore speak of film, dance, theatre and the other arts, as extending an invitation to feel, which viewers can either accept or reject (Smith 2003). It should be noted that in the early days of cinema some viewers may well have been scared by a scene with an approaching train, because they were unfamiliar with cinematic illusions.

As Frijda (2007) points out, emotions are elicited not so much by the presence of favourable or unfavourable conditions, but by actual or expected changes in those conditions. When I returned from a journey through India I was happy to be able to sleep

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[65] In games, which are also fictional, the end is open and the player can alter the course of events.

in my own bed again, take a shower every morning and have uninterrupted electricity, but it took me less than a few days to forget my blessings. Emotions also appear to have the peculiar property that removing an unpleasant condition does not yield a neutral state, but can, in fact, be a form of relief and pleasure. Emotions are susceptible to habituation, which is why people continue seeking new thrills. And yet, some things one never gets used to and I'm not talking about going to the dentist. In a documentary from 2006 Pina Bausch, then aged 66, confessed that she still felt the same anxiety before the premiere of a new piece and that she often wondered why she was doing all this. Many performing artists would agree. But perhaps if you would no longer feel that kind of nervousness, it is a sign you should already have stopped. Negative reviews too, may continue to hurt, especially when the critic couldn't be bothered to even make an attempt to understand what you are trying to do or when it is obvious that he or she didn't actually look or listen and is unaware of the prejudices that guide his or her judgement (☞ §5.9). Arlene Croce, long time dance critic for *The New Yorker* magazine, once wrote in a review of Pina Bausch that 'the Bausch troupe contains quite a few members who don't look like dancers and are none too prepossessing physically' (Croce 2000: 499). So what? I wonder.

The nature and intensity of an emotion appears to depend on the frame of reference within which the event is evaluated. If your bonus is lower than you expected you may be disillusioned, even though it is still a bonus, if it is lower than that of one of your colleagues, who as everybody knows, had just been lucky to acquire the Shepard account and didn't work as hard as you did on the Fisher account, you may even feel betrayed. If the government announces it will levy a special purpose tax on banker bonuses you may feel robbed, but perhaps also slightly pleased, because it means your colleagues won't get to keep much of their higher bonuses.

In general emotions fade with time, sometimes after only a few minutes or even seconds, but some emotional events may retain their power to elicit an emotion. Even after years have passed people may still get angry when they think back to an event that they feel was unjust, even though, in the meantime, their lives may have turned out quite favourably. The loss of a beloved person may cause a wound that never heals.

People get angry and sad even if they know it doesn't really matter. They respond emotionally when they miss a train although the next one may arrive in less than 10 minutes and they get upset if they think they have chosen the wrong queue at the supermarket. Emotions therefore appear to override reason. Knowing that whatever you feel is of passing importance does little to alter your feelings, for better and for worse. This is the reason why, throughout history, the emotions have been considered 'irrational'. This is not to say that emotions aren't amenable to reflection, it all depends. When you are about to get angry with someone and realize whom it is, your anger may subside or you may refrain from venting it. And even though people may wish to do someone harm, they usually stick to verbal displays of anger. Emotions are not as automatic as they may seem either. When you're daydreaming of the weekend trip to Rome that you've got planned for next week you may not care much about missing your train. Standing in line at a hypermarket during your first visit to Los Angeles you may take your time to scan the surroundings. As I noted above, emotions depend on the situation and on one's present concerns.

As Frijda (2007) observes, whenever a situation can be viewed in alternative ways, a tendency exists to view it in a way that either minimizes negative emotional load or maximizes positive emotional gain. That minimal dance performance you went to the other week was a complete utter bore, almost two hours, no interval and not a single memorable movement sequence! But it was interesting, in a way, and you are glad to have seen it because you had never seen a piece by this choreographer before and at least now you can say you have. And besides, you can't like everything, can you? It is true that sometimes your lucky hand in selecting which performances to see abandons you, but you enjoy taking aesthetic risks, as you like to tell your friends and colleagues. The fact that you didn't leave early, as some other people in the audience did, also demonstrates your commitment to the arts. You felt quite happy sitting there until the very end in the shared complicity with the other diehard spectators. So actually you should be proud of yourself!

We experience emotions when we experience an event, but also when we think about the future. After seeing a performance, which they really enjoyed, people may rejoice at the prospect of seeing another performance by the same choreographer and they may even feel like seeing another dance performance, regardless of who choreographed it. The emotions we experience when deliberating the future may inform us how to make a decision. However, such advance emotions only accurately predict actual emotions when the content and context of the 'pre-view' are similar to that of the 'view', which is rarely the case (Gilbert and Wilson 2009). People may base their decisions on memories of events that made a big emotional impression, but these events need not be representative. They may focus on a few defining characteristics and not on the whole event and they may overestimate an event's emotional impact. People also expect to feel terrible if, for some unforeseen reason, the holiday or the performance they had been looking forward to were cancelled, but they do not take into account the fact that they may use their time differently.

I can imagine that you think you don't need Frijda or me to tell you that, 'emotions arise in response to events that are important to an individual's concerns' (Frijda 2007: 7). And you're right: most of the above observations are pretty obvious. They seem obvious precisely because they are implicit in our behaviour. It is worth remembering though that there is no a priori reason for the asymmetry between pleasure and displeasure and for the observation that emotions lose their poignancy with time. Once you've learnt how to read, count, swim or ride a bicycle you never forget or unlearn. Emotional memory is different.

In so far as dance, theatre, cinema and literature portray human behaviour, the characters should exhibit the same patterns and regularities as actual human beings. This is why any behaviour that deviates from actual behaviour may seem inexplicable and irrational and why we may at first suspect a reason for a character's out of line behaviour. If a day after her husband's death a woman has already stopped mourning, we wonder whether she really loved him and whether she may have had a hand in his death. Even though it is not always warranted, because different causes can have the same effect, we infer possible causes from people's display of emotions or the lack thereof. If a person accidentally knocks over a framed photograph and breaks into tears while looking at the shattered glass, we assume that either the object itself or the person in the photograph was dear to her.

If characters defy our implicit understanding of how people normally behave emotionally, we either fit their behaviour into a general scheme – heroes in action movies prevail no matter what they have to endure and no matter how illogical the script – or else dismiss the actor, the script or the director as 'bad'. This is also true of the narrative structure in dance. As Arlene Croce wrote of the latter-day work of Martha Graham: 'all that happens on-stage is that the heroine suddenly finds the strength to clobber her antagonist. Where this strength comes from is not explained. The transfiguration of Joan of Arc in *Seraphic Dialogue* is a plot event rather than a dance event, and so is the "rebirth" of Clytemnestra' (Croce 2000: 39). But how can one tell a 'plot event' from a 'dance event'? This is something we will need to investigate, assuming that we accept the distinction Croce is making here, which I do, even though I disagree with much else she writes.

What I have alluded to so far are just some empirical regularities or invariant relationships that hold under various interventions. To the extent that we implicitly project them onto the world, they explain how we understand other people's actions, whether in real-life or in fiction. Pathological behaviour and randomness can be disturbing because they defy our common sense, that is, the various implicit principles according to which we interpret other people's behaviour. Describing the patterns in people's emotional behaviour is only the beginning. Ideally we would also like to explain where these patterns originate.

18.2 BASIC EMOTIONS

The dominant research paradigm in the psychology of emotion over the past few decades has been the so-called basic emotions model. According to Izard (2009) the failure to distinguish between basic and non-basic emotions may be the biggest source of misunderstandings and misconceptions in the science of emotion. The central claim of basic emotion theories is that there are a number of distinct discrete emotions that differ from each other in various important ways. Basic emotions are, or are supposed to be, what one might call in the jargon of analytical philosophy 'natural kinds', categories or groupings of features that do not depend on human observers.[66] Thus, for instance, anger, fear and joy can be distinguished in terms of their antecedent events, associated facial

[66] Chemistry provides the paradigm examples of natural kinds. As expected the concept itself is the subject of intense debate.

expression, physiology and behavioural response. In addition it is claimed that basic emotions are not learnt by way of some form of associative learning, but are represented in specific neural circuits, which regulate the physiological, behavioural and facial expressions associated with each particular emotion. If an event triggers the fear or anger circuit the ensuing sequence of responses is more or less determined. Consequently, measuring these responses will tell us something about the underlying emotion and emotion circuit.

There is, however, little agreement among those theorists who ascribe to this view, which emotions are basic and why. For example, Ekman et al. (1982) consider anger, disgust, fear, joy, sadness and surprise to be *the* six basic emotions, whereas Ekman (1999) also includes contempt, embarrassment, contentment, excitement, guilt, pride, relief, satisfaction, sensory pleasure, and shame, while omitting surprise. Panksepp (1998) considers seeking/expectancy, fear/anxiety, rage/anger, panic/separation, care/nurturance, play/joy and lust/sexuality to be basic emotion systems, while Izard (2009) identifies joy, interest, sadness, anger, disgust, fear, shame, guilt, contempt and love as *the* basic emotions. Other authors list yet different sets of emotions as *the* basic emotions (Ortony and Turner 1990).

There is a long history of dividing the emotions into a limited number of primary or fundamental emotions on the one hand and composite emotions on the other. In his *Summa Theologica* Thomas Aquinas (1225-1274) distinguished eleven passions, six in the concupiscible faculty: love, hatred, desire, aversion, joy and sadness and five in the irascible faculty: hope, despair, fear, daring and anger.[67] Descartes (1596-1650) held that there are only six primitive passions: wonder, love, hatred, desire, joy and sadness.[68] The *Natyashastra*, the ancient Indian treatise on the performing arts, distinguishes eight principal *rasas*, emotions or mental states, that a performance can elicit in the audience: love or sexual passion (*rati*), anger (*krodha*), fear or terror (*bhaya*), sorrow or pity (*soka*), amusement and laughter (*hasa*), wonder, awe and amazement (*vismaya*), disgust (*jugupsa*) and determination, heroism or perseverance (*utsaha*). Some later commentators mention a ninth emotion or mental state: serenity or calm (*sama*).

The historical continuity in conceiving of the emotions in terms of basic and non-basic emotions and the diversity in emotions that are considered basic, regardless of the underlying conception of emotion, should make us wary of claims that a particular set of emotions is basic, fundamental or primary. Why after all should we believe Ekman (1999) that his earlier categorization was mistaken, but that he has now finally arrived at the definitive list of basic emotions?

The arguments for the existence of basic emotions can roughly be divided into two categories: psychological and neurobiological. On a psychological account, one reason for assuming that some emotions are basic, is that they cannot be reduced to another emotion.

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[67] *Summa Theologica* 1a2ae Question 23, Article 4.

[68] The *Passions of the Soul*, article 69. Descartes added (article 68) that he only spoke of the principal passions, not of the particular passions, whose number he considered to be infinite.

For example Frijda (1986) considers anger a basic emotion because the corresponding action tendency, to remove an obstacle, is not reducible to other action tendencies. Ekman et al. (1972) consider those emotions basic for which there appears to be a distinct facial expression. Various cross-cultural studies support the view that facial expressions of happiness, anger, disgust, fear, sadness and surprise are universally recognized (☞ §20.2). One may wonder though why Ekman and his colleagues didn't include shame and embarrassment in their initial list of basic emotions, since both are accompanied by a distinct physiological response: blushing.

It has also been claimed that each basic emotion is associated with a distinctive pattern of autonomic nervous system activity. In a seminal experiment Ekman et al. (1983) measured various physiological reactions such as heart rate, skin resistance and finger temperature while participants recalled an emotional episode that elicited a particular emotion. They found that different emotions corresponded with specific physiological response patterns. For example, in one experimental condition anger was associated with increased heart rate and increased skin temperature, and fear with increased heart rate and decreased skin temperature.

There has been considerable debate as to the validity of these arguments (e.g. Ortony and Turner 1990). Against psychological arguments it might be argued that distress is an essential component of anger and therefore more fundamental. One could also argue that anger is just a response to a feeling of frustration and that therefore frustration is more basic. As I will argue in more detail below (☞ §20.2), in recent years the evidence that some basic emotions are associated with a distinct facial expression has come under attack. For example, it is unclear whether the expression associated with anger expresses anger, frustration or distress. Since most empirical studies focus on the *recognition* of facial expressions, it is also unclear how this can count as evidence for the automatic *production* of a facial expression when a particular emotion is experienced. Even if we assume that facial expressions are indeed universal, which is a matter of contention, it does not thereby follow that the emotions they express are basic.

More than 25 years after Ekman et al. (1983) reported on the physiological correlates of emotion, and countless experiments later, there is still no consensus as to which response pattern accords with which emotion (Larsen et al. 2008). For each study that claims to have found a distinct response pattern for a particular emotion, it is possible to find another paper, which provides evidence to the contrary. With the advent of functional neuroimaging as a research paradigm numerous studies have sought to establish the neural concomitants of each of the supposedly basic emotions. While the neurophysiological evidence does implicate certain brain regions in emotion in general (☞ §19), the alleged basic emotions do not correspond with a neural signature in the form of a distinct pattern of neural activity. In the light of these considerations various authors have argued that the *scientific* concept of basic emotions is perhaps best abandoned (e.g. Ortony and Turner 1990; Barrett 2006).

There is, however, another sense in which certain emotions can be said to be basic. Instead of trying to establish the behavioural, physiological and neurobiological characteristics of a particular emotion one could focus on what Ekman (1999) refers to as the 'fundamental life tasks' that it addresses. These fundamental life tasks can be described with reference to the elementary features of the events and situations that one may encounter: threats, hazards, loss, novelty, competition, success, failure, uncertainty, inequality, obstacles and so on. The various characteristics of a particular emotion can then be regarded as the capacities that address these events and situations. So in this view it is not so much the emotions that are basic or fundamental, but their antecedents.

In so far as these situations and events are recurrent on an evolutionary time scale, natural selection may have led to the emergence of various specialized neural circuits and psychological mechanisms that together generate an automatic response, which increases the organism's capacity to deal adaptively with the characteristics of each situation (Tooby and Cosmides 1990; 2008; Nesse 1990). Accordingly, an emotion cannot be reduced to any one feature, such as its physiology, behavioural repertoire or characteristic facial expression. Emotion involves all of these together, although they need not manifest themselves concurrently in each situation.

When trying to account for emotion in evolutionary terms we should take care not to reason backwards from any given emotion and search for its possible evolutionary origins. Evolution builds on what is already there. As the environment in which different species lived became more complex, so did their emotions.[69] And so, ideally, we should start with the simplest organism and the challenges it faced and then gradually move up towards more complex organisms. In practice evolutionary psychologists skip a few billion years and start from a reconstruction of the situations encountered by our immediate hominid ancestors and then outline the features of a hypothetical emotion that could produce the necessary behavioural and physiological outcome.

To analyse the evolutionary roots of an emotion we would first have to identify the features of the environment that would have called for an adaptive solution, such as hunger and thirst, the sudden loss of physical support and finding a mate, as well as the cues that signal its presence or imminence. Next we would have to imagine the possible actions and any changes to the organism as a whole that would have been adaptive. We would then have to identify all the mechanisms that would have to be in place to enable these changes and actions.

Tooby and Cosmides (2008) claim that it is possible to create a theory of each individual emotion along these lines. As they write: 'each functionally distinct emotion state – fear of predators, guilt, sexual jealousy, rage, grief, and so on – will correspond to an

[69] Evolutionary psychologists like to give the example of an organism escaping from a predator, but of course the predator has evolved the mechanisms necessary to increase the likelihood that it will catch prey. Animal migrations notwithstanding, neither predator nor prey arrived out of the blue. It is not as if emotionless animals found themselves being stalked by predators and evolved panic as an appropriate response.

integrated mode of operation that functions as a solution designed to take advantage of the particular structure of the recurrent situation or triggering condition to which that emotion corresponds' (Tooby and Cosmides 2008: 122). However, they do not specify which individual emotions can thus be described. It could be argued that what is commonly referred to as fear in fact covers a wide range of distinct forms of fear and that each of these corresponds with a distinct affect program. Agoraphobia may derive from fear associated with environments in which the vulnerability to attack is high, fear of strangers may derive from the likelihood that strangers are dangerous, fear of blood may be associated with wounds, hypochondria with fear of disease and so on (Nesse 1990). But is it necessary to assume a specific evolved response pattern for each contingency? Wouldn't it be more flexible if evolution evolved a limited set of principal components such as degree of arousal, pleasure and displeasure and approach and withdrawal tendencies, which might combine into distinct emotions? And is it necessary to construct a hypothetical evolutionary origin for each emotion? Evolution results in adaptations, evolutionary by-products and random noise. With hindsight a functional mechanism may appear to be the product of an adaptive process, but it could just as well be a by-product of some other mechanism or even random noise. Guilt and gratitude may have emerged as emotions that regulate the cooperation and intersubjective balance in social groups. But guilt only makes sense when one's actions are discovered; otherwise it is a waste of one's cognitive and emotional resources. Why should natural selection favour guilt rather than advanced mechanisms of lying and cheating?

It may not be possible to provide an evolutionary account for each and every emotion. Feelings of hope, which involve the uncertainty about a positive outcome, and despair, which involve certainty about a negative outcome, require a notion of time. Self-conscious emotions such as embarrassment, shame, shyness and pride, depend on a notion of the self. But the concept of the self is a social and cultural construction and so one would need to assume a lot more to account for these so-called social emotions. We can still describe each of these emotions in terms of their antecedents and the problem they address. It's just that evolutionary psychology may no longer be the right analytical toolbox.

And so, while it is plausible to assume that the capacities of the human mind evolved through natural selection to solve the adaptive problems regularly faced by our evolutionary ancestors, it is undecidable on theoretical grounds whether evolution has equipped us with a set of basic emotions or some fundamental components that, when combined and juxtaposed with different eliciting situations, give rise to the full panoply of emotions. I should emphasize that an evolutionary account of the emotions does not imply that people are pre-programmed to respond in a specific way in the face of a particular situation, since humans evolved a host of other capacities, such as awareness and consciousness to deal with the complexity of the environment.

It is a matter of debate whether the available empirical evidence supports the existence of basic emotions as natural kinds. But even if one were to dismiss the concept of basic emotions, that doesn't mean there are no basic emotion *categories*. We understand the world in terms of emotion concepts such as anger, fear, sorrow, regret and so on. In so far as an emotion can be marked off from other emotion categories it can be considered a basic emotion. Rage and fury are synonyms and both can be regarded as heightened forms of anger, but they can be distinguished from shame and regret.

We infer other people's emotions from our understanding of the situation they find themselves in and from our understanding of the kind of emotions people typically feel in such situations. We learn about such couplings of antecedent events and emotions through our own experience, but also from watching films and documentaries and reading novels. In so far as the eliciting situations share some structural similarities we may understand why animals flee at the approach of a predator and why the protagonists in Greek tragedies, Hollywood dramas, Japanese noh theatre and Indian myths act the way they do. It is not necessary to experience an event oneself in order to understand the feelings it may produce in the persons affected by it. Novel situations can be mapped onto more familiar situations. One may understand that a person who accidentally killed her own dog while parking her brand new SUV with which she had not yet sufficiently familiarized herself, will be overcome with both sorrow and guilt, while humbly accepting the furious accusations of her outraged husband and inconsolable seven and nine year old children. If you read about a woman who, as a child, falsely accused her sister's boyfriend of a vicious crime, which led to his arrest and prompted her sister to break all ties with her family, you understand that she must be feeling guilt and remorse, especially when you learn that both he and her sister subsequently died without ever seeing each other again.[70] You understand the woman's feelings not because guilt and remorse are basic emotions in the sense that they have a clearly defined psychological or neurobiological signature, but because the general features of the antecedent events are basic.

The culture and language that one grows up in provide one with the emotion concepts with which one categorizes the world. The emotion categories within a given language in turn depend on the emotion antecedents that frequently occur in a given culture. It follows that one's understanding of emotion is also constrained by one's culture. Contemporary observers may find it difficult to understand the religious rapture depicted in nineteenth and sixteenth century paintings. European, Asian and African observers may have a hard time trying to understand the feelings of the parents of two lovers from different Indian castes, who, under the alleged influence of Westernized commercial media, claimed to have fallen in love (whatever that may be), and who were subsequently murdered with their parents' consent, because they disgraced the honour of their family, caste and village. How can parents assent to the killing of their own child? How can one not feel sorrow upon the death of one's child?

The foregoing discussion allows us to make a further step forward in our analysis of dance and emotion. Situations and antecedent events allow us to understand the emotional

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[70] McEwan, I. (2001). *Atonement*. London: Penguin.

landscape of the dance. The work for which Pina Bausch has become famous consists of a collage of scenes in which one can recognize a standard repertoire of situations and themes such as rejection, loneliness, the inability to make contact with others, misunderstanding, humiliation and the hopes and perils of intimacy. Gender roles are typically fetishized. Men wear suits or pants and a shirt, while the women have long hair and wear dresses and high heel shoes. There's a lot of screaming, running, pushing and pulling. In various pieces the stage is dominated by a large obstacle: a big rock in *Vollmond* (2006), a mountain in *Rough Cut* (2005), a pile of flowers in *Der Fensterputzer* (1997) and a stranded ship in *Das Stück mit dem Schiff* (1993). In other pieces the floor is littered with tables and chairs, as in *Café Müller* (1978), debris, as in *Palermo, Palermo* (1989), soil, as in *Das Frühlingsopfer* (1975) and *Auf dem Gebirge hat man Geschrei gehört* (1984), grass as in *1980* (1980) or water, as in *Vollmond* (2006), making the stage a treacherous place. These stage obstacles serve as literal obstacles for the dancers, but also as metaphorical obstacles and as such they elicit different action tendencies, which in turn may be interpreted in emotion terms.

The situations in which the dancers find themselves are often metaphorical and hyperbolical. In one scene in *Nelken* a man is forced to undress and imitate a dog. In another scene one of the dancers cuts onions, which are subsequently thrown into another dancer's face. In a scene in *Komm tanz mit mir* (1977) a man puts one coat after another onto a woman and piles numerous hats onto her head. It is an act of protection and as such an act of love, but it is too much, it suffocates. At a certain point in *1980* (1980) a dancer questions the ensemble about their most intimate fears. As the dancers recede towards the back of the stage, they have to shout their answers louder and louder, thus exhibiting what they would most like to hide.

Since the *situations* are recognizable, if not familiar, we understand the emotions they entail. We understand that the man forced to imitate a dog in *Nelken* is humiliated. We understand that the woman is literally weighed down by the burden of the man's well-intended care and attention.

The fact that these situations are instantly recognizable may be one reason for the worldwide appeal of the work of Pina Bausch. This is not to say that her work is somehow universal, as is often said of dance in general. Such a claim is problematic, if not wrong, precisely because moving outside of any context, or within the context of a dance performance, is not universal. Only to the extent that a *situation* occurs in different cultures, does it constitute the antecedents of a shared emotional response. The present analysis also explains the criticism that can be and has been raised of Bausch's work. The same themes recur again and again and their treatment can be emblematic.

It is interesting to observe that dance critics concur in their observation, or analysis if you wish, of Bausch's work but differ in their judgement. Clement Crisp, dance critic for the *Financial Times*, admits to owning a mistrust of Tanztheater and its 'merry appurtenances of pretension: the secret physical language, the chatter, the angst and the cheery assumption that we need to understand about these private anxieties, these ill-behaved and self-obsessed dead-beats' (Crisp 2008). Arlene Croce wrote that:

> 'in Bausch theatre, men brutalize women and women humiliate men; the savage round goes on and on endlessly. The content of these bruising encounters is always minimal. Bausch doesn't build psychodramas in which people come to understand something about themselves and their pain. She keeps referring us to the *act* of brutalisation or humiliation – to the pornography of pain. (..) Since there's nothing between us and her – no mediating dramatic rationale, no technique to transfigure and validate raw emotion – we think that she's somehow authentic, that her suffering, at least, must be real' (Croce 2000: 497).

Now contrast this with what the German dance critic Norbert Servos writes in his monograph on Pina Bausch:

> 'Pina Bausch's works take our everyday societal, physical experience as their starting point, using sequences of objectifying images and movements to translate them and distance us from them. (..) The point of departure is the performers' genuine, subjective experience, which is also invoked in the audience. Simple, passive reception of the pieces is therefore impossible. Because it both works and deals with undivided energies, this "theatre of experience" mobilises the emotions, which give rise to form. It doesn't play-act, doesn't pretend "as if"; it *is*. As the audience is moved by this emotional authenticity, which confuses and delights their minds and senses, they are forced to take a stand to clarify their own positions' (Servos 2008: 21).

Of course, we will need to analyse Servos' claims of how Bausch's work elicits an emotion in the audience. We will also need to analyse how different critics can differ so radically in their judgement, while giving the same reason to sustain it. But to the extent that what they write isn't hyperbole, both Crisp and Croce must have *recognized* the events on-stage as representing Angst, bruising encounters and so on. It is just that they appraised it differently.

18.3 THE APPRAISAL THEORY OF EMOTION

Given the wide variety of emotions it may be impossible to design a single theory that accounts for each and every emotion and all empirical regularities, yet this is what the appraisal theory of emotion claims to achieve. Appraisal theories of emotion assume that emotions are elicited by evaluations (appraisals) of events and situations. For example, imagine that you are stuck in traffic. Things like this happen from time to time and there is little you can do about it. You may therefore resign yourself to the situation. Now consider what happens when you notice that the owner of the truck that is blocking the street is having a chat with another person. They are laughing and appear to be in no hurry to clear the road and get going. You may get angry and blow your horn repeatedly. You may open your car window and shout some expletives in the direction of the driver. In the first instance the event is appraised as standing in the way of achieving a goal – getting to your destination in time – but the coping potential is appraised as low and so you feel resignation. In the second instance another person is appraised as blameworthy for the event and the coping potential is appraised as high. By asserting yourself you may get the driver to acknowledge you, get back into his truck and move on and so you get angry. The same event may thus elicit different emotions depending on how the event and the context in which it occurs are appraised. You may also regret not having left home earlier or blame yourself for not having done so. And if the truck driver is a big guy in a leather jacket you may refrain from blowing your horn and just bite your lip for fear of incurring damages to your car, while feeling a rising anger at yourself for your cowardice.

Appraisal theory seeks to explain why different people experience different emotions in response to the same event. Why is it that some people swoon over the work of Pina Bausch while others dismiss it as tedious and unendurable?[71] And why were you deeply moved the last time you saw *Café Müller*, even though it left you cold when you first saw it, now more than twelve years ago? Theories which assume that emotions are elicited by events themselves, without an intervening evaluation process, have great difficulty accounting for these everyday observations.

Appraisal theory also seeks to explain why different situations and events may produce the *same* affective response. People feel joy, anger, regret and excitement in many situations. Is there anything these situations have in common? Finally, appraisal theories seek to explain how emotions are elicited and why some emotions are appropriate in some situations and not in others. It makes no sense to blow your horn when you are stuck in the middle of a traffic jam and can see hundreds of cars standing still in front of you.

According to appraisal theorists, or at least one prominent advocate, 'there is, at present, no viable alternative to an appraisal (in the broad sense of the word) explanation for the general prediction of the elicitation and differentiation of emotions' (Scherer 2001: 389-90). So how does appraisal theory address these issues?

The principal assumption of appraisal theory is that different emotions are produced by different evaluations. It is further assumed that different individuals who appraise the same situation in significantly different ways will feel different emotions; that an individual

[71] '*Café Müller* features everything I find most tedious about the genre. A café which is a child-Bausch's memory of her father's establishment. Three men, three women, revenants banging into chairs, memories, tables, walls, each other, grappling in dreariest repetition with their neuroses. Unendurable. Cheers from the thronging faithful' (Crisp 2008). 'Tanztheater seems to me half a lie: there is nary a sequence of communicative dance in this dreary enterprise, and the theatre is formulaic. Self-expression and self-indulgence are taken to a reductio ad absurdum of thoughts about life (..) and served raw' (Crisp 2005).

who appraises the same situation in significantly different ways at different times will feel different emotions and that all situations to which the same appraisal is assigned will evoke the same emotion (Rosemand and Smith 2001). Another central tenet of appraisal theory is that emotions are generated when appraisals are made. This explains why remembered and imagined situations can elicit emotions and why remembering an event can induce a different emotion than what was felt at the time. There is, however, a limit to what can be felt when sensations or emotions are remembered. You only know how it feels to be in pain when you actually feel pain. You may remember that, when your wisdom tooth was extracted, the pain in your jaw was unbearable and extended through your entire head, making it impossible for you to function normally, but you are no longer able to experience how it felt. The same is true of emotions. You may get angry when you recall an event that infuriated you, but you may wonder why on earth you freaked out when that police officer pulled you over that day when you were driving along the 178 near Ridgecrest, California. You may remember walking on clouds when you were in love, but you may find it hard, if not impossible, to invoke the feeling at will.

Appraisal processes can be both conscious and unconscious and multiple appraisals can be made simultaneously, giving rise to conflicting emotions. You may be happy to have found a job, because it will earn you an income, but sad because you have to give up some of your freedom. You may be sad that the holiday is over, but look forward to being able to take a normal shower and sleep in your own bed again, instead of on those old hotel mattresses. Because emotions depend on contextual appraisal processes they are often appropriate in a given situation. Few people actually blow their horns when they are stuck in a traffic jam because they realize it is pointless. Appraisal theory also explains why emotions may differ in their intensity and duration. The intensity and duration of grief will depend on the value of the object, its meaning to the person, whether it was replaceable or not and so on. Suppose that you broke a vase, which happens a lot in expositions like this. The vase itself may be worthless and you may be able to buy a similar or even a more beautiful one for little money. But if it was a present of a dear friend you may feel sad and if it was the only object in your possession that still connected you to a friend who died in a traffic accident, you may be heartbroken.

Appraisal theorists have described a number of appraisal dimensions such as novelty, concern congruence or incongruence, outcome probability, coping ability, which may be further distinguished into control, power and adjustment potential, agency, that is, whether it is the self, another person or the situation that is the principal causal agent. Based on these dimensions one might then outline the appraisal structure of say, shame, which involves appraising an event as: (1) relevant; (2) brought about by the self; (3) urgent; (4) involving bad outcomes; (5) committed through negligence; (6) incompatible with one's personal standards (Scherer 2001). A person sitting front row during a performance might be ashamed about having forgotten to switch off his mobile phone. He may feel the eyes of the entire audience and the performers upon him as his phone rings and know that they have every right to despise him at that very moment. He may also feel embarrassed about his ringtone, which all of a sudden sounded pretty stupid and made him look like a twelve year old. The same person may feel embarrassed when a little later, less than two meter in front of him, the performers start to undress until they are totally nude. When a moment later the performers look straight into the audience our spectator who had just wandered into the theatre expecting to see some dance, may avert his eyes and study the stage floor in front of him. The appraisal structure of embarrassment is different from shame and so are its antecedents, experience, physiological concomitants and accompanying expressive behaviour (Keltner and Buswell 1997). Embarrassment typically involves a violation of a social convention, which may threaten a person's self-image in the interaction with others, to which the person responds with submissive and affiliative behaviour. In our example the spectator felt awkward because he didn't know how to behave. Normally, people would be embarrassed to expose themselves the way the dancers do, but the dancers' provocation and transgression of a social norm may have caused the spectator to feel embarrassed.

Some elementary emotions, which Ellsworth and Scherer (2003) refer to as 'appraisals of intrinsic pleasantness or unpleasantness', cannot be divided into component parts. Most people think of puppies, kittens and other, though not all, newborn animals as cute. Some odours are disgusting and pornographic images tend to produce a bodily response in male observers, regardless of the context and no matter how inappropriate the situation. However, as Frijda (2007) has argued, intrinsically pleasant or unpleasant stimuli may produce positive or negative affects, without eliciting an emotion. A person may notice a bodily response upon seeing a sexually explicit 'stimulus' but not feel any desire or motivation to act upon it.

Appraisals may consolidate in the form of affect schemas or emotion scripts such that, when a similar situation is encountered or a particular event re-occurs, a specific appraisal pattern is activated. A good example of this is criticism. Most people almost instantly begin to defend themselves when they are criticized instead of evaluating the other's comments and conceding that he or she may have a point. Another example would be the expectation disappointment cycle. People feel disappointed when something fails to match their expectations. After watching a performance, which they thought was absolutely stunning people may have high expectations of the next performance by the same choreographer. Because their expectations are high, it may well disappoint, regardless of its intrinsic merits.

The appraisal theory of emotion allows us to explain a great number of observations, too many, perhaps, for a nagging feeling that we have merely rephrased and repackaged our original question remains. We don't need appraisal theory to tell us that people who don't care about dance feel indifferent towards it. And the claim that people feel different emotions, because they make a different appraisal is hardly an advance. Appraisal theory thus seems to be little more than an elaborate restatement of common sense.

Things are not that bad though, since our present account also allows us to make some specific predictions. If we interpret interest as an emotion along the dimensions of novelty and complexity on the one hand and coping potential on the other (☞ §10.2) we may predict that people with considerable experience in dance may appreciate a choreography of great internal complexity, while a casual observer may be baffled and when asked what he or she thought of it say that he or she 'knows very little about dance' (to which I always reply that you don't have to *know* anything, just look).

Appraisal theory also explains why the emotions *elicited* by dance are constrained to a few categories, because one or more appraisal dimensions are missing. A dance performance is unlikely to cause people to feel guilt, pride, despair or shame. It is possible to construct some specific cases in which an individual may feel anger, guilt, envy and so on. A person may feel guilty about attending a dance performance, because she had to cancel a date with a friend to do so, but she would have felt just as guilty had she gone to the cinema or stayed home. A person may feel a rising anger during a particular performance because he thinks it isn't proper dance, that is, because it is incongruent with his idea of dance, because he blames the theatre for producing it and the government for funding it and because he considers his potential to cope with the event as high, for example, because he considers writing a letter to a newspaper or posting a fuming review on his blog. Another person may resign himself to having wasted an evening and be glad that he didn't buy a first category ticket, which would have cost 70 euro. Another person may be jealous of the dancers' incredible, well-trained bodies, but this feeling doesn't have this particular dance performance as its object. He or she would feel the same during any dance performance or athletics event. To create a dance performance, which *elicits*, rather than represents, envy, shame, guilt, contempt, hope, pride, relief, regret, pity, remorse or greed in the majority of spectators, would be quite an artistic challenge. Whether one would want to do so is, of course, a different question. It follows that, from the perspective of the potential emotions that can be elicited, dance and art at large, is far more uniform than is usually thought.

18.4 CORE AFFECT

In recent years a number of authors have developed an alternative to both the basic emotion approach and the appraisal theory of emotion by anchoring emotion in what is referred to as Core Affect (e.g. Russell 2003; Barrett 2006). Core affect is defined as the 'neurophysiological state consciously accessible as the simplest raw (nonreflective) feelings evident in moods and emotions' (Russell 2003). It is a continuous assessment of one's current state, which, in its pure form, manifests itself as a free-floating, non-intentional, undefined feeling, although it can also be directed at an object or event as one interacts with the world. The performing arts may actually provide one of the best examples of what is meant by core affect. Imagine that you have just attended a performance and are on your way home. It's half past eleven, actually it's 23 past, but never mind, and you sit inside a near empty train. It will be another hour before you'll arrive at your destination. You've got a book with you and there's a newspaper lying on the seat in front of you, but you don't feel like reading and so you just stare out of the window into the darkness. The performance is still fresh on your mind. You are in an emotional after-state, so to say, but what exactly is it that you feel?

Russell (2003; 2005) describes core affect as an integral blend of two components, pleasure and activation, which can be visualized in the form of a two-dimensional plane with displeasure-pleasure along the horizontal axis and deactivation-activation along the vertical axis. At any given moment the conscious experience of core affect can then be represented as a single point somewhere on this plane. It is possible to attach some common names to different regions on this plane, but only as an illustration, since the concept of core affect is intended as pre-conceptual and pre-reflective. A combination of pleasure and activation might define a feeling of excitement or elation, while pleasure and a mild form of deactivation can be described as serenity or contentment and deactivation combined with a mild sense of displeasure as lethargy.

One is always in a state of core affect, one feels good or bad, tired or excited or nothing in particular. External events can bring about changes in core affect, either directly or indirectly, by way of an appraisal process. Drugs too can alter core affect, as can changes in one's hormonal state and the endogenous release of neuromodulators such as dopamine. As Russell (2003) notes, a key to understanding core affect is that people have no direct access to the causal chains that influence alterations in core affect and may misattribute and misinterpret the cause of a change in feeling. Why is it that you feel happy-sad (there's no other way to describe it)? Is it the performance? The wine? The music? Or the encounter during the second interval with a friend you hadn't seen for almost a year, but who, unfortunately, didn't have time to go for a post-performance drink?

A change in core affect can lead to a search for its cause. Whatever cause is found then becomes the object of one's feeling. After a change in core affect has been attributed to a particular object or event, it can acquire what Russell (2003; 2005) terms an affective quality: the capacity to change core affect. Whereas core affect is defined as 'I feel X', affective qualities are perceived as a property of an external object (☞ §30.1). After drinking a glass of wine that tasted particularly good, wine may be coded as pleasant. This process continues indefinitely, for after drinking another glass of wine, which was not as pleasant, the original attribution may be refined, it is cabernet sauvignon that is pleasant, not riesling, but when you buy a bottle at your local supermarket you realize that it's not as simple as that either and so you almost give up on that whole wine thing until you discover a wine merchant which sells some truly outstanding wines.

To account for the full range of emotions core affect theorists introduce a number of additional concepts that act as building blocks and which together account for emotion as we know it. A typical emotional episode starts with the perception of an *antecedent event* in terms of its *affective quality*. As the antecedent event registers, *core affect* changes. The change in core affect is attributed to the antecedent event, 'great solo!', which becomes the *object*, and which is then identified, classified, interpreted and *appraised* along various dimensions. The antecedent event then becomes the object of an *action* (applause, yelling). In the meantime various *physiological and behavioural changes* may occur, a change in heart rate or a rise in body temperature. All of the previous processes become the object of *meta-cognitive judgements* and the entire process can be categorized according to everyday emotion concepts 'I guess this is what they call buyer's remorse' in an *emotional meta-experience*. Finally, a deliberate attempt can be made at *regulating* one's emotion ('don't blush', 'look the other way').

Apart from the question whether there is any empirical evidence that this is how emotion is structured, one may wonder whether the whole concept of core affect is more than just an easy organizational principle. Why assume two core dimensions and not five or eleven? Dimensional approaches to emotion also implicitly assume the existence of some kind of affect thermometer, which measures changes in one of the proposed dimensions. The question is whether there is such a thing as a pleasure scale. It may be that one can distinguish between fear and terror and between anger and fury, but the core affect approach proposes more than this. It suggests a form of pleasure calculus along the lines of Jeremy Bentham, who laid the foundations of the doctrine called utilitarianism in ethics. The central idea is that pleasure is positive and pain negative and that both can be quantified in discrete units and accumulated to give an overall value. This way short-term gains could be weighed against long-term losses. Bentham devised an ingenious algorithm, which took into account various dimensions of pleasure and pain, such as its intensity, duration, certainty or uncertainty, proximity, fecundity and purity, to calculate the balance of pleasure and displeasure. The question is whether we can quantitatively compare different *kinds* of pleasure, such as the pleasure afforded by a dance performance and a good glass of cabernet sauvignon, as Bentham's student John Stuart Mill already pointed out. The same criticism also applies to core affect theories of emotion.

According to the core affect theory of emotion all events contribute to where on the affect plane one ends up. This may explain overall shifts in mood and emotion, but it does not account for the fact that I can be moved by a performance and simultaneously feel uncomfortable because of the cramped seats. It may be that when I become conscious of the feeling in my legs and feet my feelings in response to the show are temporarily suppressed, but I can be sequentially conscious of different feelings. At a phenomenological time scale of several minutes, rather than the microseconds it takes to shift attention, I can then be simultaneously delighted and annoyed. To account for this a core affect theorist might propose multiple planes in juxtaposition to different objects, but that would undermine the entire core affect concept and make it into a multidimensional scheme. The core affect approach does not explain how we understand other people's emotions either. If someone were to tell you that he dropped his new camera, you assume that he must be sad, you don't picture a plane and then put a point somewhere in the third quadrant.

18.5 CONCLUSION

The present chapter has briefly reviewed the three main psychological theories of emotion. Each of these theories contributes to our understanding of dance and emotion. Within a proper evolutionary and cultural framework the basic emotion approach explains why we can understand other people's emotions in a particular situation. Because emotion concepts are culturally defined a Portuguese listener may recognize the *saudade* in a fado song, while an English person may only hear melancholy and sadness. The appraisal theory of emotion explains, among other things, why understanding that a situation is emotionally charged and recognizing the emotions it elicits in the actors, has little to do with our own feelings, which depend on our own appraisal dimensions. The core affect theory explains why we may feel something without being able to classify it. It also offers a dynamic, constructionist account of how emotions are attributed, categorized and regulated.

Eventually these different aspects would have to be brought together within a coherent framework and linked to underlying brain processes. To this end Lewis (2005) has adopted a dynamical systems perspective in which an external event, such as two dancers appearing on stage, interacting and then disappearing, or an internal event, such as the memories it may elicit, can be said to cause a perturbation in the system's current state. Through various processes of positive and negative feedback the system may then tend towards a new equilibrium. In the case of emotion, at a global scale positive feedback may derive from attention to specific features, such as a person's posture and direction of movement, if the initial triggering event was the detection of an aggressive face. In this particular example increased vigilance may diminish one's fear, a form of negative feedback, but it may also intensify one's uncertainty. In neurobiological terms it is possible to delineate the various loops involving both excitatory, inhibitory and modulatory processes that may serve as the channels for the positive and negative feedback processes underlying emotion. The framework proposed by Lewis (2005) is purely descriptive though and does not yet allow for mathematical modelling and quantitative predictions.

Zangwill (2007: 395) has argued on conceptual grounds that, 'what people feel when they listen to music [watch dance] are *not* the emotions that correspond to emotion descriptions of music [dance].' The present analysis shows that psychological considerations give rise to the same conclusion and without the need for any philosophical juggling exercises. Emotions depend on an appraisal process. In the absence of the appropriate appraisal dimensions by definition the emotion associated with these dimensions will fail to arise. Some combinations of appraisal dimensions are unlikely as are some combinations of core affect. Upon achieving a goal a person cannot decide to feel anger, fear or remorse, because, all things equal, achievement of a goal does not elicit these emotions. Parents may feel proud when watching their child perform, but in general the emotions elicited by a dance performance depend on a limited number of possible appraisal dimensions.

As Frijda (2007: 112) emphasizes, we do not experience appraisals, we experience situations and events as appraised. But how do appraisals produce the feelings that are characteristic of emotions and the physiological changes that accompany some, though not all, emotions? After all, one can appraise something without feeling anything. And what do the principal dimensions of pleasure and activation proposed by the core affect theory of emotion consist in? If we want to get a full grasp of emotion we have to dig deeper into the neuroscience of emotion.

KEY POINTS

☞ 'Emotions are subject to various invariant relationships.'

☞ 'We interpret fictional characters according to the same invariant relationships as actual human beings. We may therefore suspect a reason for a character's deviant behaviour.'

☞ 'It is a matter of debate whether the available empirical evidence supports the existence of basic emotions as natural kinds.'

☞ 'It is undecidable on theoretical grounds whether evolution has equipped us with a set of basic emotions or some fundamental components that, when combined and juxtaposed with different eliciting situations, give rise to the full panoply of emotions.'

☞ 'We infer other people's emotions from our understanding of the situation they find themselves in and from our understanding of the kind of emotions people typically feel in such situations.'

☞ 'Our understanding of situations and antecedent events allows us to understand the emotional landscape of a dance performance.'

☞ 'Affective states can be vague and indeterminate.'

☞ 'The appraisal theory of emotion assumes that different emotions are produced by different evaluations; that different individuals who appraise the same situation in significantly different ways will feel different emotions; that an individual who appraises the same situation in significantly different ways at different times will feel different emotions and that all situations to which the same appraisal is assigned will evoke the same emotion.'

☞ 'According to the appraisal theory of emotion the kind of emotions *elicited* by dance is constrained to a few categories, because one or more appraisal dimensions are missing.'

☞ 'From the perspective of the potential emotions that can be elicited, dance and art at large, is far more uniform than is usually thought.'

19

NEUROPHYSIOLOGICAL THEORIES OF EMOTION

The study of the neural substrates of emotion and mood is the subject of what has become known as affective neuroscience. Emotions have a neural substrate, which follows from the observation that damage to certain brain regions may lead to emotional impairments, while leaving cognitive abilities intact and from the physiological changes that accompany some emotions, such as crying, an increase in heart rate, sweating, trembling, throwing up and so on, all of which must be controlled by some part of the brain. It also follows from the observation of the effects of alcohol, drugs and psychopharmacological substances on people's mood and emotions. After drinking a glass of wine people may lose some of their emotional inhibitions, they may also be more inclined to consider things funny, while too much alcohol may cause people to more easily lose their temper. The capacity to experience emotions therefore depends on the integrity and proper functioning of the brain.

The discipline of affective neuroscience seeks to answer such questions as: Which neural circuits underlie emotion? Are all emotions subserved by the same circuit or do different brain regions underlie different emotions? How do emotion, attention, cognition and motor behaviour interact? Various neurobiological theories have been proposed to explain all, some or some aspects of emotion or some particular emotions and various brain structures have been identified as relevant for the processing of emotion. The present chapter is loosely organized around some important concepts, theories and brain regions and also provides some historical background to the development of the neuroscience of emotion.

19.1 THE AUTONOMIC NERVOUS SYSTEM AND THE HYPOTHALAMUS

Instantaneous emotions or emotion episodes, whether feelings of anger, joy, shame, grief, despair, shyness or pride, are usually accompanied by physiological changes such as a rapid heart rate, a rise in body temperature, a 'rush to the head', sweating, dryness of the mouth, blushing and so on. These changes are mediated by the autonomic nervous system, which regulates the cardiovascular, respiratory, gastrointestinal, electrodermal and endocrine organs. The regulatory functions of the autonomic nervous system can be organized into three processes: *maintenance* of an optimal baseline state; *activation* of those systems necessary to respond to changes in the body (e.g. a blow to the head) and the environment (a rapidly approaching car) and *deactivation* of those systems when the situation has changed (Levenson 2003). Emergency situations demand the concerted activation and inhibition of a wide range of processes. If the car in front of you suddenly slams on its brakes you have to assess the situation in a split second and act accordingly. Afterwards your heart may continue racing for a while and it may take another half hour or so before you realize that you were hungry and need something to eat.

Anatomically the autonomic nervous system descends from the midbrain all along the spinal cord down to the first and second lumbar vertebrae from where the reproductive and urinary systems are innervated. The autonomic nervous system is commonly divided into two subsystems: the sympathetic and parasympathetic nervous system. They typically operate in opposition to each other, for example, enlargement of the pupil is regulated by the sympathetic nervous system and constriction of the pupil by the parasympathetic nervous system, although their functions are complementary rather than antagonistic. When you jump out of bed you may experience an increase in heart rate, a slight dizziness and a sinking feeling in your stomach. During this moment the sympathetic and parasympathetic nervous system seek to re-establish a balance whereby blood pressure is adjusted to the upright body.

The autonomic nervous system is modulated by projections from the hypothalamus, which itself integrates signals from numerous cortical and subcortical areas. The hypothalamus is located below the thalamus and above the brain stem. Like the basal ganglia and the amygdala it consists of multiple nuclei, each of which is involved in different functions, including the regulation of body temperature, heart rate and blood pressure, thirst and hunger, sweating and shivering, dilation of the pupil and the sleep and wake cycle. Fever, for example, is the result of a higher 'thermostat' setting in the hypothalamus and so is the feeling as if your whole body is glowing when you watch an exciting movie or an exhilarating dance performance. The various functions controlled by the hypothalamus are also associated with emotion. A state of arousal typically involves a higher body temperature, while sexual arousal and fear are both accompanied by dilation of the pupil. In the 1930s and 40s it was found that electrical stimulation of different parts of the hypothalamus in laboratory animals produces somatic responses characteristic of emotional perturbations such as alterations in blood pressure and heart rate and raising of body hair.

In addition to neural projections to different parts of the brain stem, the hypothalamus exerts its regulatory control through the secretion of various neurotransmitters and through its effects on the endocrine system, a system of glands that release various hormones that are instrumental in the regulation of metabolism, growth, tissue function and mood. The endocrine system includes the pineal gland, the pituitary gland, the thyroid gland, the adrenal gland and the pancreas as well as the ovary and the testes. It is through neuroendocrine hormones secreted by the hypothalamus and the pituitary gland, which itself is innervated by the hypothalamus, that the adrenal glands, located on top of the kidneys, are modulated. The adrenal glands, in turn, secrete adrenaline, which boosts the supply of glucose and oxygen to the brain and the muscles by increasing the heart rate and widening the blood vessels. It also temporarily suppresses digestive processes. It follows that what is often referred to as an adrenaline rush is both cause and effect. If you ever emerge from a cinema or a theatre feeling all excited, your face red and your body sweating, even though you didn't run up the stairs to get to the exit, this is why. And if you suddenly feel you have to go to the toilet when you walk through the foyer, it is because during the performance the feeling was temporarily and automatically suppressed.[72]

Even though they did not evolve for this purpose, the physiological responses associated with emotion can also be interpreted as signs. For example, the pupils may widen when one experiences fear or sexual arousal or when one exercises mental effort in tasks with high working memory load. Dilation of the pupils has also been associated with facial attractiveness (e.g. Tombs and Silverman 2004). In experiments measuring this effect participants are unaware of the effect of the pupil size on their judgement. It is tempting to interpret this finding as a sign of reciprocal sexual interest. However, it may also just be that large pupils increase the contrast between the pupil and the white of the eye and therefore make the face seem more attractive.

The physiological concomitants of emotions have also found their way into the metaphors we use to describe emotions. People are said to be foaming with rage and to be drooling over something they desire, although these metaphors may derive from the observation of emotions in various animal species. In dance the audience is typically too far away from the performers to notice any somatic changes, which is why choreographers will not try to manipulate them. It may not be an accident that in music videos in which the dancers are made to look lustful their hair and body are all wet: sweaty bodies = carnal pleasure.[73]

The autonomic nervous system and the hypothalamus account for many of the overt aspects of emotion. But it is not yet the full story. It is in a way, the final chapter. The hypothalamus and the autonomic nervous system are at the end of the line, they modulate the somatic response characteristics of some emotions, but they depend on signals from other brain regions. In a different sense they are also at the beginning of the line, since the brainstem and the hypothalamus send afferent projections to the prefrontal cortex.

19.2 THE JAMES-LANGE THEORY AND THE SOMATIC MARKER HYPOTHESIS

In a paper published in 1885 and in his subsequent book *The Principles of Psychology* William James proposed a highly influential theory of emotions. James claimed that, contrary to our common conception, emotions are preceded by physiological changes.

[72] A change in body position may also play a role.
[73] Christina Aguilera: *Dirrty*, George Michael: *Fast Love* and Ricky Martin: *Livin' La Vida Loca* to name but a few.

According to James emotions consist in the perception of the somatic changes that occur in response to emotional events. We do not learn of an unfortunate event, feel sad and begin to cry, we start crying upon learning of the event and realize that we are sad. Or in James' own words:

> 'Our natural way of thinking about these coarser emotions is that the mental perception of some fact excites the mental affection called the emotion, and that this latter state of mind gives rise to the bodily expression. My theory, on the contrary, is that the bodily changes follow directly the perception of the exciting fact, and that our feeling of the same changes as they occur is the emotion. Common sense says, we lose our fortune, are sorry and weep; we meet a bear, are frightened and run; we are insulted by a rival, are angry and strike. The hypothesis here to be defended says that this order of sequence is incorrect, that the one mental state is not immediately induced by the other, that the bodily manifestations must first be interposed between, and that the more rational statement is that we feel sorry because we cry, angry because we strike, afraid because we tremble, and not that we cry, strike, or tremble, because we are sorr, angry, or fearful, as the case may be. Without the bodily states following on the perception, the latter would be purely cognitive in form, pale, colorless, destitute of emotional warmth. We might then see the bear, and judge it best to run, receive the insult and deem it right to strike, but we should not actually feel afraid or angry' (James 1890: 449-50).

James distinguished three stages in the production of an emotion. First the occurrence of an event causes certain somatic changes, such as a change in one's heart rate or sweating. Next these changes are picked up by sense receptors and relayed to the brain, which then interprets these signals and produces the relevant emotion.[74] A similar theory was independently put forward by the Danish psychologist Carl Georg Lange, which is why it is commonly referred to as the James-Lange theory of emotion. If the theory sounds counter-intuitive, think of the popular wisdom according to which just by smiling or laughing you will feel better. It doesn't matter what you laugh about, laughter will set into motion a chain of events, which will become self-reinforcing.

James also foresaw the consequences of his theory for aesthetics. For as he writes a few pages later:

> 'we must [immediately] insist that aesthetic emotion, *pure and simple*, the pleasure given us by certain lines and masses, and combinations of colours and sounds, is an

[74] There has been some debate over what James meant and may have meant, however, the present text is not a deconstruction of William James. Ellsworth (1994) offers a revisionist reading of James. Reisenzein et al. (1995) argue that this interpretation is not supported by his writings and that the 'traditional' view presented here is in line with James' theory of emotion.

absolutely sensational experience, an optical or auricular feeling that is primary, and not due to the repercussion backwards of other sensations elsewhere consecutively aroused. To this simple primary and immediate pleasure in certain pure sensations and harmonious combinations of them, there may, it is true, be *added* secondary pleasures; and in the practical enjoyment of works of art by the masses of mankind these secondary pleasures play a great part' (James 1890: 468).

The James-Lange theory of emotion has had a mixed history of reception. Already in the 1920s it was established that sympathectomy, a surgical procedure whereby parts of the sympathetic nerve system are severed, does not prevent people from feeling emotions, although it does block neural signals originating in the brain from innervating different glands or organs. Incidentally, the procedure is still performed as treatment for excessive sweating or blushing. The James-Lange theory has been discredited by various subsequent findings[75], but his ideas continue to find supporters among literary theorists and philosophers. For instance, Robinson (2005: 28) claims that 'in his main points about emotion, James, as so often, is right on target' and that 'as William James suggests, it is physiological change that puts the "emotionality" into emotion. James seems to be right about this on both conceptual and empirical grounds. Conceptually, there is nothing we can identify as an emotional response unless there is marked physiological activity of some sort or other. Indeed an emotional response is, at least in part, a set of physiological responses' (idem: 36). In support of her claim Robinson cites the research of Paul Ekman into facial expressions of emotion and the work of LeDoux (1996) and Damasio (1994) reviewed below.

As argued above emotions do not equal physiological changes although some emotional episodes or perturbations are characteristically associated with various somatic changes. Emotional episodes also involve changes in attention, perception, memory and learning. It follows that emotion cannot be reduced to any one aspect. But isn't it the case that, as William James (1890) wrote, 'if we fancy some strong emotion, and then try to abstract from our consciousness of it all the feelings of its bodily symptoms, we find we have nothing left behind'? An armchair philosopher might be content with this formulation, but people who live in a totalitarian regime know better. Living in fear does not mean constantly drowning in sweat, being all pale and having an elevated heart rate.

[75] One recent neuropsychological study reported a double dissociation between feeling an emotion and the autonomic responses that normally accompany that emotion in response to music. It was found that patients with damage to the ventromedial prefrontal cortex reported normal judgements of their subjective feelings in response to music, but showed weaker skin-conductance responses than normal subjects, while patients with damage to the right somatosensory cortex showed normal skin-conductance responses, but were impaired in their self-rated feelings in response to music (Johnsen et al. 2009). These findings therefore disprove the central claim of the James-Lange theory of emotion.

The fear is no less real for that. It may express itself in sleeping disorders and exaggerated vigilance, but most of all it affects people's entire way of life.[76]

In recent years the James-Lange theory of emotion has been revived by Antonio Damasio (1994) in his 'somatic marker hypothesis'. As noted above, Damasio distinguishes between emotions and feelings. An emotion according to Damasio is 'a patterned collection of chemical and neural responses that is produced by the brain when it detects the presence of an emotionally competent stimulus' whereas feelings are 'the mental representation of the physiological changes that characterize emotions' in juxtaposition to the mental images that caused them (Damasio 2001). Thus, an emotion is a bodily response and feeling an emotion is a cognitive response, which connects an emotion to its cause. Somatic markers, in the view of Damasio, are physiological reactions, or mental representations thereof, that are associated with decisions and other emotionally significant events. They function as either incentives or alarm signals in situations of ambiguity and uncertainty when decision-making can be a challenge. The somatic marker hypothesis can be viewed as an attempt to provide a neurophysiological account of what is commonly referred to as a 'gut feeling'. As Pina Bausch once said in an interview, when asked how she knows when and how things fit together, 'you feel it when it is right, and you feel when it is not right too' (Servos 2008: 236). Somatic markers can emerge directly from the body, in what Damasio refers to as the 'body loop', or as internal representations in an 'as-if loop'. They are assumed to be integrated with decision options in the ventromedial prefrontal cortex.[77]

In support of his proposal Damasio refers to the case of patients with damage to the ventromedial prefrontal cortex. These patients are typically impaired at decision-making tasks, even though their attention, working memory and cognitive abilities are unimpaired. One such patient, Phineas Gage, has become well known in the neuroscience literature, partly through Damasio's description, and has even entered popular culture. Gage was a construction site worker who in 1848 was wounded during a freaky accident whereby an iron rod passed through his skull, entering below his left eyebrow and exiting through the top of his skull. Gage survived, but while his cognitive abilities appeared to have remained intact, he had become 'a different person.' Prior to the accident he had been an amiable person, whom people praised as 'a shrewd and smart businessman, very energetic and persistent in executing all his plans of action.' But he was now 'fitful, irreverent, indulging at times in the grossest profanity which was not previously his custom, manifesting but

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[76] This type of fear has found a brilliant expression in the work of the Romanian-born German novelist and poet Herta Müller who was awarded the 2009 Nobel Prize in Literature by the Swedish Academy.

[77] The ventromedial prefrontal cortex in Damasio's account includes the medial and lateral orbitofrontal cortex (☞ §19.5) and overlaps with the medial sections of Brodmann's areas 10, 11, 12 and the lower sections of areas 24, 25, and 32. Other investigators use a different and/or more specific nomenclatura. In describing the work of Damasio and colleagues I will use the term ventromedial prefrontal cortex as used by the authors.

little deference for his fellows, impatient of restraint or advice when it conflicts with his desires, at times pertinaciously obstinate, yet capricious and vacillitating, devising many plans of future operation, which are no sooner arranged than they are abandoned' (Damasio 1994: 8). He lost his job and went on to lead a wandering life drifting from one odd job to another and from one place to the next.

Based on photographs of Gage's skull, which had been preserved in the Warren Medical Museum, and using a model of the iron rod, it was possible to reconstruct the likely trajectory of the rod as it went through his skull and the extent of the brain damage it caused (Damasio et al. 1994). The damage turned out to be confined to the ventral and inner surfaces of the prefrontal cortex in both hemispheres. However, as MacMillan (2008) points out, we will only ever have an estimate of the extent of brain damage Gage suffered and we know too little about him, both before and after the accident, to draw firm conclusions about his behaviour.

Most studies investigating the somatic marker hypothesis are based on a single experimental paradigm known as the Iowa gambling task. In this task a person is presented with four decks of cards, A, B, C and D, from which s/he has to draw 100 cards. Each time a card is drawn the participant earns a monetary reward. However, some cards result in a penalty and the participant loses money. The goal of the task is to earn as much money as possible. Of course, the set of cards has been carefully doctored. The cards in piles A and B are associated with a reward of \$100, those in piles C and D with a reward of \$50. Five out of ten cards in deck A result in a penalty, varying from \$150 to \$350. Only one out of ten cards in deck B is associated with a penalty, but it's a penalty of \$1250. In deck C five out of ten cards incur a penalty ranging from \$25 to \$75. In deck D one in ten cards results in a \$250 penalty. Decks A and B give high rewards, but also high penalties, resulting in a net loss of \$250 for every 10 draws. Decks C and D have lower rewards, but also lower penalties, leading to a net gain of \$250 for every 10 draws. The participants don't know this. They have to figure out which cards to draw as they proceed.

It has been reported that patients with damage to the ventromedial prefrontal cortex perform poorly at the Iowa gambling task compared with a control group, because they continue selecting cards from the risky, losing decks (A and B), whereas people in the control group shifted to cards from the safer, winning decks (Bechara et al. 1994). In a follow-up study it was found that upon drawing a winning or losing card participants showed a greater skin conductance response, a measure of autonomic nervous system activity. After a period of time people in the control group also showed an *anticipatory* skin conductance response when drawing a card from one of the risky decks (Bechara et al. 1996). Perhaps crucially, in another experimental study it was reported that after a number of trials normal participants had a hunch, which decks were good and which were bad, before they were consciously aware of what might be guiding their choice (Bechara et al. 1997). The authors interpreted these findings as evidence for the somatic marker hypothesis, as it seems as if the brain picks up on the physiological response when people make a decision.

There are a number of problems with this interpretation though (Dunn et al. 2006; Maia and McClelland 2004). First of all, it is not clear why the anticipatory skin conductance response should increase ahead of a draw from a bad deck. If absence of a somatic marker causes impairments at the Iowa gambling task in patients with damage to the ventral medial prefrontal cortex one would expect these somatic markers to be associated with good decks. It has also been found that not all control participants do well on the Iowa gambling task, while showing normal anticipatory skin conductance responses (Bechara and Damasio 2002). Importantly, an alternative explanation of the poor performance of patients with damage to the ventral medial prefrontal cortex is that they are unable to reverse or 'unlearn' a previously acquired rule. In the original task the tenth card in deck B incurs a loss of $1250, while all previous nine cards win $100. When the initial cards are shuffled so as to prevent the acquisition of a rule and thereby a preference for one of the decks, performance of patients with damage to the ventral medial prefrontal cortex was similar to that of healthy control participants (Fellows and Farah 2005). It has also been reported that, contrary to the somatic marker hypothesis, patients with damage to the autonomic nervous system, a peripheral denervation of autonomic neurons to be precise, actually performed *better* than a control group on the Iowa gambling task (Heims et al. 2004). In these patients regions associated with direct peripheral feedback from the body and areas in the anterior cingulate and insula cortex were damaged, so in terms of Damasio's somatic marker hypothesis both the 'body loop' and the 'as-if loop' were compromised. One would thus have expected some form of impairment. It has also been found that normal participants are capable of giving an accurate verbal report of their knowledge at different stages of the task and that the original questions, which suggested participants only had a pre-conceptual hunch, were too open-ended to bring out this knowledge (Maia and McClelland 2004). This suggests that participants base their decision on a conscious choice, making it unnecessary to assume the existence of somatic markers. Taken together these findings call into question the main evidence on which the entire theoretical edifice of the somatic marker hypothesis is constructed. A more sympathetic interpretation suggests that additional evidence is needed to support it (Dunn et al. 2006).

Like James before him Damasio focuses exclusively on emotional episodes, ignoring the equally important category of emotional attitudes. People afraid of flying will avoid travelling by plane and go to great lengths to travel by car or train instead. Their fear of flying does not manifest itself in a permanent state of fear on par with the fear one experiences in a threatening situation. Damasio also fails to distinguish between the cause and the object of an emotion. The emphasis on somatic changes as the physiological concomitants of feelings ignores the fact that many emotions, such as gratitude, pride, guilt and regret need not be accompanied by any bodily changes. Furthermore, physical exercise may cause changes in heart rate, blood pressure and so on without producing any emotional feelings. Somatic perturbations are therefore neither necessary nor sufficient conditions for feeling an emotion.

Damasio's *Descartes' Error* (1994) is one of the bestselling popular neuroscience books and his ideas have found a wide audience. Philosophers and literary theorists seeking to anchor their work in 'scientific' research often refer to it.[78] However, in so far as it claims to give a full account of emotion, the somatic marker hypothesis falls short on conceptual grounds, while the empirical evidence on which it builds has been found wanting.

19.3 THE LIMBIC SYSTEM

In 1937 the American neuroanatomist James Papez proposed that emotions are mediated by a network of interconnected brain regions, now referred to as the Papez circuit. The paper in which he outlined his ideas marked a great conceptual advance over previous proposals. Papez conceived of the thalamus as a central relay station, which splits sensory input into a stream of thought and a stream of feeling. The thought stream channels sensory input to the sensory cortices, where they are turned into thoughts, perceptions and memories and from there on to the cingulate cortex. The stream of feeling connects the thalamus directly with the hypothalamus. Papez further proposed that the cingulate cortex projects to the hypothalamus by way of the hippocampus, while the hypothalamus projects to the cingulate cortex by way of the anterior thalamus, creating a circular network. The convergence of output from the hypothalamus and the sensory cortex in the cingulate cortex would then give rise to a 'feeling', while the convergence of output from the cingulate cortex and the thalamus in the hypothalamus would create a somatic response.

At about the same time the German-American psychologist Heinrich Klüver, working in collaboration with the American neurosurgeon Paul Bucy, found that bilateral removal of the temporal lobes in monkeys produced a range of behavioural disorders, including a lack of emotional responsiveness, increased exploratory behaviour and an increased tendency to explore items with the mouth. The monkeys also developed an appetite for improper foods, such as rocks, and sought to have sexual intercourse with anything and anyone. The disorder, which today carries the name Klüver-Bucy syndrome, suggested that the integrity of the temporal lobes is critical for emotional behaviour.

About a decade later Paul MacLean proposed a theory of the brain structures involved in emotion in which he sought to integrate the work of James and Papez while incorporating recent findings like those of Klüver and Bucy. He extended the circuit proposed by Papez to include the amygdala and some other regions and named the entire complex the visceral brain. Like James before him MacLean assumed that emotional experience arises from the synthesis of visceral sensations from within the body and the

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[78] E.g. Nussbaum (2003: 114-18). Zizek (2006: 222-231) takes Damasio (1994) as exemplary in his critique of cognitive neuroscience. Malabou (2004) bases her account on the work of Damasio (1994; 2003), LeDoux (2002) and selected texts by Changeux and Jeannerod.

cognitive perception of the world outside. He conjectured that this synthesis takes place in the visceral brain, in particular the hippocampus. In 1952 MacLean coined the term 'limbic system' to replace 'visceral brain' as the name for the brain's emotional centre.

MacLean's limbic system concept is still used as shorthand for the neural network subserving emotion. For example, throughout their paper on the neuroscience of art Ramachandran and Hirstein (1999) refer to 'limbic activation' as the explanation of why some patterns or works of art are considered pleasurable. The authors of a neuroimaging study, which attempted to directly establish the neural concomitants of the pleasure associated with listening to music, reported that, 'listening to music strongly modulates activity in a network of mesolimbic structures involved in reward processing' (Menon and Levitin 2005).

However, the limbic system concept has been challenged both on empirical and theoretical grounds. There are no generally accepted criteria for defining its anatomical boundaries or its component parts. MacLean gave a central role to the hippocampus in his outline of the limbic system, but the current consensus is that it is associated with memory and not so much with emotion. Subsequent studies have also implicated other brain regions not originally included in the limbic system in emotional processes, casting further doubt on its centrality for emotion.

Why then do many neuroscientists and psychologists still refer to the limbic system? One reason may be that some brain regions included in the limbic system have been implicated in emotional functions. And if one study implicates the hypothalamus in some emotional process and another the amygdala in some other process, it is tempting to add up the results from both studies as evidence for the existence of the limbic system. Or as LeDoux (1996) observes, 'evidence that one limbic area is involved in some emotional process has often been generalized to validate the idea that the limbic system as a whole is involved in emotion. And, by the same token, the demonstration that a limbic region is involved in one emotional process is often generalized to all emotional processes' (LeDoux 1996: 102). Consequently, referring the feelings elicited by dance or art in general to activation of the limbic system not only has little, if any, explanatory value, the concept as such is so vague as to be essentially meaningless.

19.4 THE AMYGDALA

There is converging evidence from neuroimaging studies, neuropsychological studies and research with laboratory animals that the amygdala, a structure in the medial temporal lobe of the brain, plays a key role in the processing of emotion. It had already been known from the work of Heinrich Klüver and Paul Bucy that bilateral removal of the temporal lobes in monkeys produces a range of behavioural disorders. A subsequent study, some twenty years later, showed that bilateral removal of the amygdala is 'sufficient' to produce the same changes in behaviour (Weiskrantz 1956). Various neuropsychological studies have reported that patients with damage to the amygdala have difficulty recognizing emotional facial expressions, especially expressions of fear (e.g. Adolphs et al. 1994) and vocal expressions of anger and fear (Scott et al. 1997), while neuroimaging studies with normal subjects have implicated the amygdala in the recognition of emotional facial expressions (Adolphs 2008) and bodily expressions of fear (Grèzes et al. 2007). All of this suggests that the integrity of the amygdala is a necessary condition for the recognition of fear and the production of a fear response.

However, subsequent studies have cast doubt on various earlier findings. One study showed that if a patient with complete bilateral amygdala lesions was explicitly instructed to look at the eyes, recognition of fearful faces became entirely normal (Adolphs et al. 2005). Whereas normal people spontaneously focus their gaze on the eyes when looking at a picture of a face, this patient just looks at the nose and mouth and fails to pick up on the information in the eyes. As a matter of fact, she fails to look at the eyes regardless of the expression, but since the regions around the eyes are the most important feature for identifying fear – joy for example can be inferred from a smile – she is impaired at recognizing fear. The same patient has been subjected to a battery of tasks whereby she had to watch displays of (dynamic) full body movements and (static) full body postures expressing fear (Atkinson et al. 2007). To the researchers' surprise her performance was completely normal. They replicated the experiment with a second patient with bilateral damage to the amygdala with identical results. This is all the more surprising as it has been reported that viewing bodily expressions of fear results in increased activity in the amygdala (Grèzes et al. 2007). These findings therefore underline once more that the notion of 'increased activity' itself does not say anything about the underlying functional processes or the area's contribution to a behavioural task.

Much of what is known about the amygdala derives from fear conditioning experiments with rats. In fear conditioning an initially neutral stimulus (the Conditioned Stimulus) can acquire the capacity to produce various physiological effects after being repeatedly paired with an aversive event (the Unconditioned Stimulus). If the Conditioned Stimulus is a tone and the Unconditioned Stimulus an electrical shock, after a few trials upon hearing the tone a rat will show alterations in heart rate, blood pressure and hormone release as well as behavioural responses such as freezing or a startle reflex. In a series of experiments LeDoux (1996; 2000) has detailed the neural pathways implicated in this process. His research has highlighted the amygdala as a key component of the system involved in fear conditioning.

The amygdala, like the basal ganglia, consists of various nuclei, which in turn can be divided into several subregions, although most studies, especially human neuroimaging studies, refer to the amygdala as if it were a unitary structure, and not to any of its component parts. The areas relevant to fear conditioning are the central, lateral, basal and accessory basal nuclei. The lateral nucleus receives input directly from the auditory cortex and from auditory processing areas in the thalamus. The lateral nucleus is connected with the central nucleus which projects to brain regions associated with the control of physiological processes, the hypothalamus, the peraqueductal grey and the bed nucleus of the stria terminalis. It has been established that damage to the hypothalamus affects blood pressure, but not freezing, that damage to the peraqueductal grey interferes with freezing, but not blood pressure and that damage to the bed nucleus of the stria terminalis disrupts the release of stress hormones, but has no effect on either blood pressure or freezing (LeDoux 2000).

Based on these and other findings LeDoux has advanced the hypothesis that signals originating in the sense organs, the eyes, ears, nose, mouth and skin, are relayed simultaneously from the thalamus to the amygdala and to the cortex. The direct, subcortical route to the amygdala would allow for a fast response before the stimulus has been fully processed. The example LeDoux used to illustrate this hypothesis has been reproduced in numerous publications and has become part of the popular imagination. A hiker walks through the woods and finds a thin, curved object on his way. Is it a stick or a snake? The image that falls on the retina is transformed into neural pulses, which are relayed to the thalamus, which after some intermediate processing sends its output signals to the visual cortex, while at the same time projecting a crude, partially processed signal to the amygdala. The amygdala then initiates a response on the basis of this quick and dirty signal. At the same time the visual cortex processes the signal and feeds the outcome to the amygdala. As LeDoux writes: 'the time saved by the amygdala in acting on the thalamic information, rather than waiting for the cortical input, may be the difference between life and death. It is better to have treated a stick as a snake than not to have responded to a possible snake' (LeDoux 1996: 166). He adds that, 'most of what we know about these pathways has actually been learned by studies of the auditory as opposed to the visual system, but the same organizational principles seem to apply' (idem).

As yet no study has reported direct anatomical evidence for such a rapid visual subcortical route. One study, which measured the latency of visually responsive neurons recorded from microelectrodes in the amygdala of human subjects, did not find evidence for a fast subcortical route either (Mormann et al. 2008). It is also worth pointing out that we are really talking about microseconds. As noted before (☞ §13.1) one of the remarkable findings about the visual system is the speed at which objects are recognized (Thorpe 1996). Even though perceptual processing takes time, at a phenomenological level perception is instantaneous. If you turn your head upside down and from left to right you do not experience an interruption, you continue seeing. It is only in some extraordinary circumstances that neural processing latencies become apparent, such as when objects move very fast. The claim that a subcortical route may ensure a rapid response is therefore essentially meaningless, since cortical signals may innervate the amygdala, the hypothalamus and the brainstem with a latency that is only fractionally greater than the presumed direct subcortical route.

The paradigm for LeDoux's theory of emotion also reveals a cultural bias. It may seem as if everybody is afraid of snakes and spiders, but that is not so. Whereas some people may freeze when they find a snake on their path others may think 'lunch!' Some years ago, during a short trip to Vietnam I visited Le Mat Snake Village, near Hanoi, which is famous for its snake restaurants. The driver of my taxi took me on a tour of some back alleys until we arrived at what looked like just another house from the outside, but where, sure enough, stalled on various shelves and cupboards were large jars and bottles filled with rice wine, into which snakes, scorpions and who knows what other animals had been infused. In the courtyard there were various cages with different snake species. The proprietor of one establishment was so kind as to take out a cobra from its box for me to take some photos. I didn't stay for dinner though.

LeDoux (1996) has extended his findings to a general view of emotion processing in the brain. But important as it may be, fear is not representative of emotion and so it is wrong to conclude on the basis of these findings alone that the amygdala is associated with emotion in general. It is also the emotion we experience the least, although our hominid ancestors may have experienced it more often. So what does the amygdala do when there is nothing to fear? Is it inactive? If we assume that the human body including the brain is based on a principle of energy and neural efficiency this would be highly unlikely.

A growing body of literature provides additional evidence for the role of the amygdala in emotion. One intriguing study found that whereas normal subjects tend to attribute emotions and intentions to animated clips of moving geometric shapes (☞ §6), a patient with bilateral amygdala damage – her again – described the film entirely in objective terms (Heberlein and Adolphs 2004). This suggests that damage to the amygdala also results in a selective impairment in the capacity for interpreting animacy and intentionality.

Activation in the amygdala (and the orbitofrontal cortex) has also been found to be positively correlated with increasing uncertainty in tasks involving ambiguity (Hsu et al. 2005). Another study, with both mice and human subjects, found that sequences of unpredictable tones resulted in greater amygdala activation, compared with predictable tones, even though the tones were not associated with any rewarding or punishing outcomes (Herry et al. 2007). This suggests that even abstract unpredictable events elicit increased amygdala activity. If, in the latter study, the unpredictable tones were played in the background while the subjects engaged in a task known to create a state of anxiety, both mice and human subjects responded in a way consistent with greater anxiety. These findings support the idea that, depending on the context and the input it receives, the amygdala can either modulate vigilance or trigger a change in emotional state (Whalen 1998).

The latter finding is, of course, of great interest to our present study, as it suggests a neurophysiological substrate for the observation that sound colours the interpretation of visual scenes. Putting on some unpredictable music with some eerie noises may be enough to increase the audience's state of vigilance and produce a shift in their emotional state, an effect that is frequently exploited in horror movies and thrillers. I should add that numerous other neuroimaging studies have reported a positive correlation between amygdala activity and object properties such as the 'impact' of a news photograph (Ewbank et al. 2009) and novelty (Weierich et al. 2010), which suggests that it may be difficult to find stimuli that do *not* increase amygdala activity.

19.5 THE ORBITOFRONTAL CORTEX

Numerous studies have implicated the orbitofrontal cortex in various aspects of emotional behaviour (Rolls 1999; Rolls and Grabenhorst 2008), decision-making (Wallis 2007), hedonic experience (Kringelbach 2005) and adaptive behaviour (Schoenbaum et al. 2009). Increased activity in the orbitofrontal cortex has been found to be associated with the chills elicited by intensely pleasurable music (Blood and Zatorre 2001) and the sight and flavour of chocolate (Rolls and McCabe 2007), while damage to the orbitofrontal cortex may cause various kinds of emotional impairments and changes in the subjective experience of emotion.

The orbitofrontal cortex is a region of the brain directly behind the forehead located above the orbits of the eyes. It is reciprocally connected with other regions of the prefrontal cortex and with various subcortical structures that have been associated with affective processing, such as the amygdala (☞ §19.4), the hypothalamus (☞ §19.1), the nucleus accumbens and the ventral striatum. It receives input from a wide range of brain regions, including the olfactory, auditory, taste, visual and somatosensory cortex, the inferior temporal cortex, the parietal cortex, the superior temporal cortex and the anterior cingulate cortex, each of which projects to a specific region of the orbitofrontal cortex. The orbitofrontal cortex has only few connections with motor regions, especially when compared with other prefrontal regions. Within the orbitofrontal cortex itself there are many intrinsic connections between its various subregions. These different subregions are likely to play distinct roles depending on the input they receive.

The anatomical organization of the orbitofrontal cortex therefore suggests that it integrates sensory and reward information (Rolls and Grabenhorst 2008). Additionally, its rich direct and indirect connections with the amygdala, the hypothalamus, the brainstem and the spinal cord suggest that it has an influential role in regulating the autonomic aspects of emotional expression. For example, projections from the orbitofrontal cortex to the intercalated masses of the amygdala inhibit the central nucleus of the amygdala thereby disinhibiting its projections to the hypothalamus, the brainstem and the spinal cord. The orbitofrontal cortex also projects directly to the hypothalamus, while another pathway from the orbitofrontal cortex to the central nucleus of the amygdala inhibits hypothalamic processing (Barbas 2007). These anatomical observations are corroborated by neuropsychological findings and neurophysiological and neuroimaging studies.

In laboratory animals damage to the orbitofrontal cortex results in impairments at tasks that involve learning the reward value of a stimulus. More in particular, after learning an association between a stimulus cue and a reward, the poor animals fail to reverse their behaviour if the cue-outcome association is switched, so that they receive a taste of the nasty quinine instead of the sweet sucrose solution they had learnt to expect. The same behavioural deficit has also been found in human patients with damage to the orbitofrontal cortex, but not in patients with damage to the dorsolateral prefrontal cortex (Fellows and Farah 2003). This suggests that the orbitofrontal cortex is crucial for adaptive behaviour. Additionally, there are numerous reports of emotional impairments in patients with damage to the orbitofrontal cortex. Some patients have difficulty detecting facial and vocal expressions (Hornak et al. 1996), while in various studies patients reported changes in the intensity and frequency of their emotions (Hornak et al. 2003).

Neurophysiological studies in primates using single cell recordings have found that neurons in the orbitofrontal cortex respond selectively to primary tastes – sweet, salt, sour and bitter – as well as the taste of water. Other neurons respond selectively to the viscosity and texture of food items. The responsivity of these neurons is modulated by hunger and satiation, more in particular, there is typically a decrease in responsivity when the monkey is fed to satiety. Neurons in the primary taste area by contrast do not show such a reduction in responsivity. Rolls (1999) interprets this finding as evidence that neurons in the orbitofrontal cortex represent the reward value of the taste and not taste itself.

Functional neuroimaging studies in humans support these findings, revealing regions of the orbitofrontal cortex activated by sweet tastes, saline tastes, pleasant touches and olfactory stimuli. Feeding subjects to satiety, something researchers not only do with rats and monkeys, but also with humans, has been found to decrease the activity in regions activated by the odour of that food (Francis et al. 1999). It has also been reported that activation in the medial orbitofrontal cortex correlates with the subjective pleasantness rating of warm and cold stimuli applied to the hand, whereas activity in the somatosensory cortex did not correlate with pleasantness (Rolls 2008). Another neuroimaging study showed that the sight of chocolate produced greater activity in the medial orbitofrontal cortex and ventral striatum in chocolate cravers, of whom I am one, than in non-cravers (Rolls and McCabe 2007). The authors also reported a greater correlation between activity in the medial orbitofrontal cortex and the pleasantness ratings of the chocolate in chocolate cravers than in non-cravers.

Based on his research into the characteristics of the orbitofrontal cortex Rolls (1999) has outlined a theory of emotion, which regards emotion as states elicited by rewards and punishers. In his view the orbitofrontal cortex represents the reward or affective value of primary reinforcers, that is, reinforcers that do not require learning, such as tastes, smells and facial expressions. Through repeated exposure other stimuli are associated with these primary reinforcers to produce a representation of the expected reward value of different sensory stimuli.

In defining a reward as anything for which an animal will work and a punisher as anything that it will work to avoid, Rolls takes an essentially behaviouralist approach to emotion.[79] A bonus, a trophy, a medal, a good review, a hug, a kiss, a good meal are all rewards for which people will work. Defeat, unemployment, fire, theft and the involuntary termination of a relationship are punishers, which people seek to avoid. According to Rolls appraisals (☞ §18.3) involve an assessment of whether something is rewarding or punishing, but 'the description in terms of reward or punishment (..) seems much more precisely and operationally specified' (Rolls 1999: 61). Accordingly, he represents emotion by way of a two-dimensional diagram with positive reinforcement (reward) as one axis and negative reinforcement (punishers) as the other axis. The presentation or omission of a positive or negative reinforcer or their combination could then be represented by a point somewhere on this plane.

Although this theory may provide the neural underpinnings of the core affect approach to emotion (☞ §18.4), it is difficult to fit the great variety of emotions into such a two-dimensional diagram and to account for the specific intentional structure of emotions. People don't just feel gratitude, they feel gratitude towards a specific person for a specific reason, they don't just feel guilty, they feel guilty about a specific action and may continue doing so for a long time, much longer than the reduced responsivity of single neurons in the orbitofrontal cortex would sustain. They would basically have to die off if a person were to feel guilty for the rest of his life. And, as mentioned before, my love for, say, dance, theatre and art, does not only express itself in the intensity of my feelings, but also in the fact that I am prepared to travel to another country only to see a performance or an exhibition. As Bennett and Hacker (2003; 2005) point out, Rolls does not distinguish between emotions, sensations and appetites either. But appetites and a pleasant touch are quite different from emotions. Appetites are periodical, emotions are not. After an animal has digested its food the neurons in the orbitofrontal cortex will respond as before, until it has reached satiety again. This is not how emotions work. Finally, appetites and sensations of touch such as a caress lack the cognitive dimension of emotions. A person might imagine feeling lost and lonely when travelling alone in a country where people don't speak English, without actually ever having experienced such a situation. It is hard to see how this might fit into the theory of emotion outlined by Rolls (1999).

19.6 CONCLUSION

Experimental findings from cognitive and affective neuroscience continue to show that the brain is more complex than originally thought. Attempts to reduce emotion to a single network or to capture the brain regions implicated in emotion in a single framework have

[79] A problem with this view, as we shall see below, is that a positive affective response can also occur in the absence of a behavioral reinforcement and vice versa, for instance if the reinforcement consists in the removal of an obstacle or a source of displeasure.

all proved wrong and oversimplified. It is unlikely that future findings will reveal that there is a simple emotion circuit after all. I should emphasize once more that the goal of the present chapter is not to develop a novel theory of emotion, but to try and synthesize current research in order to gain a better understanding of dance and choreography. The function of the amygdala and the orbitofrontal cortex as such is not my primary concern. So how do the present findings mark an advance over and above psychological theories of emotion?

Emotion is not a single process, but a multiplicity of processes instantiated in a distributed network of neural circuits. This may not sound like a particularly radical conclusion, but it does have various implications for how we think about emotion. Each of these processes has its own thresholds and its own dynamics and each can be independently activated by numerous stimuli. These processes operate in parallel, respond to different cues and produce different autonomic, behavioural and subjective changes. Each process influences other processes and is itself modulated by processes originating in different parts of the brain. As we have seen, feedback from the peripheral nervous system, the endocrine system and the orbitofrontal cortex can all modulate subcortical brain regions involved in emotion processing, such as the amygdala and the hypothalamus.

It follows that, within a spatiotemporal assemblage of stimuli, a single stimulus can bias the processing of other stimuli: unpredictable sounds and an image of a snake or a spider can trigger an amygdala response, which in turn can modulate visual processing, the autonomic nervous system and attention. The stimuli in this assemblage do not need to be correlated as they usually are in natural environments. An artist can create an artificial assemblage comprised of unrelated features and include some cues that are known to have an emotional effect. Put simply, displaying enlarged images of spiders, sharks, and snakes or playing eerie music during a dance performance will have an emotional effect on the audience and bias the processing of the dancing and possibly people's interpretation.

Smith (2003) has argued that classical Hollywood cinema employs a variety of redundant emotion cues, which he calls emotion markers, 'configurations of highly visible textual cues for the primary purpose of eliciting brief moments of emotion' (Smith 2003: 44), which increase the likelihood that different spectators will be nudged towards the desired emotional orientation. He illustrates his proposal with an analysis of the opening scene of Steven Spielberg's *Raiders of the Lost Ark*, and a number of other films.

Essentially *Raiders of the Lost Ark* is a quest and the audience follows the hero as he conquers one obstacle after another in his attempt to reach the goal and obtain the object.[80] That all of this is highly unlikely doesn't matter. In the opening scene we follow Indiana Jones as he makes his way through the jungle, evading various booby traps, in order to find an ancient golden statue. One of his guides tries to shoot him from behind, but Jones fences off the attack, establishing himself as a hero and introducing his unlikely weapon, a

[80] In all Indiana Jones movies the object usually eludes him again after he has found it, which would make for an interesting Lacanian reading, but that's another book.

whip. At one point a flock of birds suddenly flies up, at another moment a bunch of tarantulas fall on Jones' back, which he casually wipes off. As Smith argues, the primary function of the flapping birds and the tarantulas is to elicit an emotion in the viewer: they have little or no narrative function. All of this may not be very subtle, but it works, even when you are aware that you are being manipulated. I decided to watch the whole scene again to make sure that the present account is factually correct and found myself once more getting carried away.

Films use a wide range of perceptual cues to elicit an emotion: facial expressions, movement, dialogue, vocal expression, costumes, music, sound, set design, lighting, colouring, depth of field, camera angle, camera movement, editing and so on, which may be one reason why films are so successful as emotion machines. In dance the number of elements is more limited and there are less prefab cues, such as the spiders in *Raiders of the Lost Ark* and the insects or the dinner scene in *Indiana Jones and the Temple of Doom*. Still, the principles are essentially the same.

The concept of emotion covers a wide range of physiological changes, behavioural responses and cognitive processes. The subjective experience of emotion is just one aspect of emotion and itself the result of numerous neural processes. These processes are active before we become consciously aware of an emotion and they continue to be active after our awareness has shifted to another object. The autonomic nervous system activity and endocrine activity are not mere physiological concomitants of emotion and emotion is not the cause of some subjective feelings, physiological changes and outer behavioural manifestations. All of these processes are integral to emotion.

One of this book's central themes is that the brain is always learning. This is what neural networks do. In chapter 13 and 14 I argued that past and ongoing events create a state of anticipation. But they do more than that. The typical Hollywood thriller is full of cues. We all know that evil lurks behind the corner, in cellars and in attics. This is why we feel suspense when, for no apparent reason, there is an electricity outage and one of the protagonists takes a candle to go and look inside the dark corridor, where, of course, a drought blows out the candle. Growing up in a culture that employs the same cues in children's books, movies and television series, we have come to understand this kind of emotional symbolism. But we also learn during a movie and while reading a novel. We get to know the characters, their feelings and their surroundings and so we can predict how a character will respond in a certain situation.

Conventional Hollywood movies neatly match a number of existing emotion templates. They push all the right buttons and can therefore be said to *satisfy* our emotions. There are also novels, movies, plays and dance performances in which the characters enact what to us are novel response patterns for which we have no templates. To Western viewers the work of the Thai director Apichatpong Weerasethakul may seem incomprehensible, because the dialogues and actions do not match our own templates. These movies and performances therefore expand our emotional horizon. They provide us with new templates and emotion schemes and show that the world is more complex and the range of human behaviour more varied than we thought.

19.7 COROLLARY 1: THE PARADOX OF FICTION

Much philosophical ink has been spilled on what is known as the paradox of fiction. Following Frijda (2007) I asserted that to feel an emotion a person should believe that the occasioning object or event is real. But why then do people respond emotionally to situations and events they know to be fictional, as in cinema, literature and theatre? As Michael Jackson says in the music video for *Thriller* after his girlfriend has walked out of the cinema, where they had been watching a horror movie: ‘It’s only a movie.’ ‘You were scared, weren’t you?’ he asks. Upon which she replies: ‘I wasn’t that scared.’ Even if we ourselves may not have been scared by the preceding film excerpt, we understand why the girl was scared and why part of the audience reacted as it did. It is not as if she is talking complete gibberish. Indeed, it is the smiling and popcorn eating Michael Jackson whose behaviour is slightly out of the ordinary.

In a seminal paper Radford (1975) reignited the debate claiming that our emotional response to fiction is ‘irrational, incoherent, and inconsistent.’ His argument rests on the premise that (1) in order to respond emotionally we should believe the people to exist and the situation to be real; (2) in the case of fiction such beliefs are unwarranted; and (3) fictional characters and events do in fact move us. The first premise makes sense, for if we have reason to believe that someone is lying we will not be moved by whatever he or she tells us. We may even get angry if a person tells a sad story and then informs us afterwards that he was only joking. But nobody gets angry upon learning that *Requiem for a Dream* (2000) is not a documentary but a work of fiction. It might be argued that, when watching a movie or reading a novel we are so consumed by the narrative that we forget that it is all fiction. However, spectators remain passive throughout a movie and do not try to warn the character of any impending danger. They don’t flee the theatre when they realize that Eli in *Let the Right One In* (2008) is a vampire and might have it in for them as well. So in that sense they do remain aware of its status as fiction. It is also undeniable that people are moved, they laugh, they cry, they cringe and look away during particularly nasty scenes. Radford (1975: 78) therefore concludes that ‘our being moved in certain ways by works of art, though very “natural” to us and in that way only too intelligible, involves us in inconsistency and so incoherence.’ But does it? And is there really a paradox? The solutions that have been proposed to the paradox of fiction can roughly be divided into ‘pretense theory’ and ‘thought theory’.

According to Walton (1978; 1990) readers of fiction and cinema audiences do not actually feel scared, sad, angry, pity and so on, but only ‘make-believedly’ so and what they experience are not real emotions, but ‘quasi-emotions’, which are identical to actual emotions in terms of their physiological and psychological aspects, but lack the action tendencies usually associated with emotion. Readers and spectators of fiction engage in a game of make-believe in much the same way that children do when they make sand pies. Parents may play along by saying that the pie looks tasty, though without taking a bite from it.

This supposed solution to the paradox of fiction also accounts for another famous paradox in the arts, the paradox of suspense. Briefly, it revolves around the observation that people feel suspense even when they know how a film will end, for example, because they have seen it before. But if people engage in a game of make-believe when they watch a movie, they can do so on repeated viewings.

A problem for the pretence theory, as pointed out by Carroll (1990), is that it assumes that people can choose to feel a 'quasi-emotion', but this assumption appears to be unfounded. Michael Jackson may have been smiling as he watched the horror movie, but most viewers cringe when, in the famous sushi bar scene from *Oldboy*, Oh Dae-su eats the still living and crawling octopus. Conversely, one cannot choose to feel sadness if the movie isn't moving. In my view *Babel* (2006) by director Alejandro González Iñárritu, which was clearly intended as a dramatic film, was so over the top that I often found myself laughing. It also seems a bit odd that we would need Walton (1978; 1990) to inform us that we are really engaging in a game of make-believe when we engage with a work of fiction and that our emotions are quasi-emotions. If the hypothesis were true one would assume people to be aware of this. And isn't it the case that we fear for the characters, rather than ourselves? The pretence theory would also have trouble accounting for the experience of virtual reality. Players in an immersive virtual reality environment take cover when they are chased by a vampire, even though they are perfectly aware that what they see isn't real and that vampires don't exist.

An alternative solution to the paradox of fiction proposes that what causes one to cringe when one sees Oh Dae-su bite off the head of the octopus is the *thought* of doing so one-self. Authors who adhere to this view deny that in order to feel an emotion one should believe a situation or event to be true (e.g. Carroll 1990: 79-88). The thought of having one's tooth extracted can give one the creeps and the memory of a holiday can fill one with joy, so there is no paradox in feeling an emotion when entertaining a thought. While this theory may account for emotional responses to possible objects and events, it becomes problematic in case of imaginary creatures and entirely fictional situations. Why after all should the thought of vampires, werewolves and so on fill one with fear? It might be argued that what one is afraid of is not so much being chased by a zombie or getting lost in outer space, but being chased and getting lost. However, it seems as if thought theory has only shifted the problem.

The paradox of fiction dissolves once we take the neuroaesthetic point of view. As we have seen in chapter 3 the brain regions responsive to faces are activated both by photos and drawings of faces (☞ §3.1). The system is robust to distortions of size, shape, colour and configuration. It doesn't matter if a face, or a representation of a face, is two-dimensional, partly occluded by a veil, detached from a body or the size of a standard IMAX screen, which is 22 metres (72 ft) wide and 16.1 metres (53 ft) high. We still recognize it as a face. Our perception is not adjusted by our correct belief that faces are three-dimensional, that they cannot be that big and that they require a body to sustain its functioning. The perceptual system operates independently of what, for lack of a better word, one might term higher cognitive functions. It 'does what it does' and then relays its output to other brain regions. The same is true of the amygdala, the hypothalamus, the anterior cingulate cortex and so on. Each of these regions processes the input it receives from other regions and then projects its output to whatever regions it is connected with. The question whether what is processed is real or fiction, true or false does not enter into this stage of processing. The behavioural aspects of emotion are suppressed, because the knowledge that what we are watching or reading is fiction is simultaneously co-activated or repeatedly re-activated.

A central assumption in the paradox of fiction and the various solutions that have been proposed, is that emotions involve beliefs. Walton (1978: 6-7) holds that 'it seems a principle of common sense, one which ought not to be abandoned if there is any reasonable alternative, that fear must be accompanied by, or must involve, a belief that one is in danger.' But believing is something a person does. Beliefs do not enter into this process until after the stimulus has been processed. It would be a category mistake to claim that beliefs modulate brain processes. Instead one would have to ask what processes sustain the maintenance of beliefs. One's feelings, beliefs, associations and interpretation are the result of the co-activation of multiple neural processes.

19.8 COROLLARY 2: CAN DANCE BE DISGUSTING?[81]

Have you ever seen a building that made you laugh? And when did you last attend a dance performance that was so disgusting it made you feel physically sick? And what about music? Have you ever heard a cello suite or a piano sonata that was either totally hilarious or utterly disgusting? While I could easily think of some fragrances that make me feel like throwing up, the smell of vomit or ammonia spring to mind, and while I could just as easily name several movie scenes that made me want to look away in disgust, I cannot think of any revolting music, buildings or dance performances. I would be equally hard pressed to name a funny building or a violin concerto that makes me burst with laughter.

I am aware that my own experience may not be representative in this respect. My exposure to architecture, music and dance is necessarily limited, both geographically and historically. My cultural disposition has been determined by my upbringing and as someone who likes to hang around at art exhibitions and theatres, I may have learnt to control my emotional responses, to always be on guard, to contemplate and appreciate, rather than to indulge in what I see and hear. I also know that some drugs may predispose

[81] An earlier version of this paragraph was published as Hagendoorn (2007).

the user to experience the world in a different way, so some people may say yes to all of the above, but for different reasons. In that case it is not the object or event, but the drugs that produce the emotion by directly interfering with the brain's neurochemistry.

I should also add that, in the context of the present paragraph, when I speak of dance I mean 'dancing' in the strict sense of abstract, not necessarily rhythmic, body movement. Some people may be disgusted by the scene in *The Crying Body* (2004), a dance production by the Belgian artist Jan Fabre, in which, at one point, the female dancers lift a leg and begin to pee.[82] However, I would refer to this particular scene, the act of peeing on stage, as theatre, not as dance or dancing. Of course, the boundary between dance and theatre is not clearly defined and I wouldn't object if anyone wants to call this particular scene or any other similar scenes dance. I could also stretch the definition of building or architecture to include cartoon buildings, such as *Howl's Moving Castle* (2004). But none of this will do much to change the overall tenet of what I'm trying to say. For it remains true that it is easier to think of a disgusting fragrance or a good joke, than of a funny building or a truly revolting string quartet. And whereas horror movies and comedies have developed into genres in themselves, there is no such thing as horror ballet or comedy music.

It could be that audiences aren't interested in either repulsive music or funny buildings and that composers, musicians, architects and choreographers engage in a form of market-oriented self-censorship. After all, who would want to live or work in a building that constantly puts you on the verge of laughter and who would play music that you would like to turn off the moment you have put it on? But then, why do people go to the cinema to watch a movie only to cover their eyes during the scenes they have come to see? To be sure some composers and musicians have experimented with humour in music. Frank Zappa even titled one of his (live) albums *Does Humor Belong In Music?* although the humour is more in the lyrics than in the music. It could be that someone somewhere is composing nauseating music, but that nobody is listening, because it is, well, nauseating. It could also be that it is still believed that dance and architecture should be beautiful and that music should be pleasant to listen to and not a source of humour or disgust. While this may once have been the case, it is hard to maintain in today's art world. But in a world in which anything goes, it is remarkable that for some reason not everything is made or not in the same proportion. But perhaps in contemplating these questions we have been looking into the wrong directions. Perhaps, for reasons internal to the nature of humour and disgust, it is difficult to conceive of either a funny building or disgusting dance or music.

To learn more about the nature of disgust we could do a survey of what people find disgusting. Such a survey may give us a list of items, actions and qualities that people tend to find disgusting: excrements, slimy things, creeping things, the smell of sweat, menstrual

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[82] Yes I know, here we go again, that's what I thought. Why not go to the toilet, before the show, why do it on-stage? And who's going to clean it all up afterwards? The dancers? The choreographer? The artists get to shock the audience – how radical! how original! – but after the show some underpaid cleaners have got to clean up the mess they made on stage.

blood, rotting flesh, rats, cockroaches, picking one's nose and then putting the finger into one's mouth, sewers, various forms of sexual intercourse, cigarette smokers, etc. (Miller, 1997).

Experimental psychology may further inform us that there appears to be a unique facial expression associated with disgust, one that people from cultures around the world instantly recognize (Ekman and Friesen 1971; 1986) (☞ §20.2). From developmental psychology we may learn that children have to be taught that excrements are dirty and only begin to experience disgust from a certain age, which suggests that disgust is first and foremost a cultural phenomenon.

A cross-cultural anthropological study may reveal some remarkable differences in the sorts of food that people tend to find disgusting. In some countries people eat grilled insects or put mayonnaise on top of their French fries, the mere thought of which is enough to disgust others, as in the famous opening scene from *Pulp Fiction* (1994). To complicate things further, some cheeses smell awful but taste good and some food may taste good until people are told what they have just eaten, in which case they may instantly feel like throwing up, either because a religious prohibition forbids them to eat it or simply because they cannot fathom eating pet animals. All of this suggests, again, that disgust is culturally acquired.

Neuroimaging studies may tell us about the neural correlates of disgust by having people smell some awful odorant or watch some disgust-inducing pictures while inside a brain scanner. These studies reveal that disgust is associated with increased activity in one particular region, the insula (Stark et. al. 2007; Wicker et. al. 2003). Neuropsychological studies of patients with brain damage further reveal that damage to this area may lead to a selective impairment of the experience of disgust, suggesting that disgust is contingent on the integrity of a specific brain region and therefore has its roots in nature after all (Calder et. al. 2000).

These empirical findings may at first seem hard to reconcile. We may have gained knowledge but little insight and appear to be further removed from our original question than before we delved into the science of disgust. But if we shuffle our findings a bit, it may turn out that there is a pattern after all. For one thing, while our initial and incomplete list of disgusting items, actions and attributes, is both varied and promiscuous, it becomes less so when we consider what does *not* occur on it: music for instance and inorganic substances. The domain of disgust also appears to be structured around a number of oppositions, plant vs. animal, human vs. animal, life vs. death or decay, us vs. them, me vs. you, dry vs. wet etc. (Miller 1997).

To make sense of these seemingly contradictory findings Rozin and Fallon (1987) distinguish between core disgust, which focuses on food and food contaminators, and elaborated disgust, which revolves around sexual practices, poor hygiene, violations of the body and moral violations. Core disgust is a visceral response, ejecting or avoiding food because it looks, tastes or smells bad or because its origins are contaminated, a response that may also be found in some other animal species. Elaborated disgust is a form of indignation in response to behaviour we judge wrong, inappropriate or offensive. Building on this distinction Rozin and his co-workers conjectured that, whereas anger may be theorized as a response to threats that can be challenged and fear as a response to threats that cannot be challenged, disgust can be seen as a bodily response to threats that can neither be challenged nor avoided and which involve drawing a protective line between the self and the perceived threat (Haidt et. al. 1997). There is, after all, no point in getting angry with a stinking, rotting piece of fruit or in running away from it as one would from a potential assailant. However, one would be wise not to eat it and to throw it away, so as to prevent it from contaminating other fruit.

What this theory suggests is that, once acquired through learning, that is, by way of culture, disgust becomes natural in a sense, sharing the same neural substrate across different stimuli dimensions. We may be equally disgusted by a foul smell as by someone's behaviour. One neuroimaging study showed that the insula, which, as we have seen, has been associated with disgust, was activated when people viewed images of social outcasts such as drug addicts and homeless people, which they described as disgusting (Harris and Fiske 2006).

The finding that the insula is associated with disgust and moral indignation may be an example of neural efficiency. As the neuroscientist Stanislas Dehaene has argued, cultural inventions such as arithmetic and reading are too novel for the brain to have evolved specific neural structures to perform these tasks (Dehaene and Cohen 2007). However, specialized structures are not necessary if these novel capacities can encroach on existing structures. But as Dehaene argues, those novel cultural adaptations thereby inherit the structural constraints of the existing neural circuitry. Elaborated disgust may therefore build on an evolutionary more ancient food distaste system as a result of which our stomach may also turn when we are morally indignant.

What I would like to suggest is that, because of the differential ways in which sound, scent and motion are processed in the brain, sounds and pure motion stimuli are less likely to stimulate the disgust system than scents. There may be many and direct connections between the brain regions processing olfactory and taste stimuli and the regions associated with disgust, but only few and indirect connections with regions processing auditory stimuli. Accordingly, we are unlikely to experience disgust when we walk through a building or listen to music, because of the way our brain is organized. Of course, this hypothesis is entirely speculative and would have to be tested empirically.

The present hypothesis may explain why we don't find many disgusting piano études, violin concertos, buildings and choreographies. The same line of reasoning can also be applied to humour. In chapter 15 I argued that some things are considered funny because they are absurd and out of place, whereas other things are funny because they share a common temporal structure, whereby in a first stage an incongruity is detected, which in a second stage is resolved (☞ §15.2). This may explain why narrative is more often a source of humour than architecture. In music, too, it appears that incongruous sounds can be funny. A whistle, a farting noise or an out of place instrument played at the right, that is the *wrong* moment, can be the source of comedy.

I do not claim that dance and music cannot be disgusting and that architecture cannot be humorous. I do not claim either that this is the final answer. Each of the above approaches to disgust provides us with a different insight. What the present analysis offers, is a tentative explanation as to why for some art forms the threshold for humour and disgust may be higher. These thresholds are not written in stone or carved into the brain. They shift over time, due in part to the transgressive practices of artists. Boundaries are withdrawn or extended, for instance, because of a moral prohibition.

In a hilarious television commercial for a mobile phone brand Swedish filmmaker collective Traktor envisioned a society in which dancing is illegal. When a man starts dancing in the street, a mother quickly covers the eyes of her screaming child and calls the police. What made this commercial funny, apart from the many visual pranks, was the absurd notion that dance can be disgusting. But it is absurd only to the extent that people understand the unlikelihood of dance arousing disgust.

KEY POINTS

☞ ‘Attempts to reduce emotion to a single neural circuit or to capture the brain regions implicated in emotion in a single framework have all proved wrong and oversimplified. It is unlikely that future findings will reveal that there is a simple emotion circuit after all.’

☞ ‘Emotion is not a single process, but a multiplicity of processes instantiated in a distributed network of neural circuits. Each of these processes has its own thresholds and its own dynamics and each can be independently activated by numerous stimuli. These processes operate in parallel, respond to different cues and produce different autonomic, behavioural and subjective changes. Each process influences other processes and is itself modulated by processes originating in different parts of the brain.’

☞ ‘Within a spatiotemporal assemblage of stimuli a single stimulus can bias the processing of other stimuli. The stimuli in this assemblage do not need to be correlated as they usually are in natural environments. An artist can create an artificial assemblage comprised of unrelated features and include some cues that are known to have an emotional effect.’

☞ 'In so far as it claims to give a full account of emotion, the somatic marker hypothesis falls short on conceptual grounds, while the empirical evidence on which it builds has been found wanting.'

☞ 'The concept of the limbic system is so vague as to be essentially meaningless. Referring the feelings elicited by dance or art in general to activation of the limbic system has little, if any, explanatory value.'

☞ 'The amygdala plays a key role in emotion although its precise function is still a matter of debate. Depending on the context and the input it receives the amygdala can either modulate vigilance or trigger a change in emotional state.'

☞ 'Emotions are triggered both by real and fictional events. This is because the question whether what is processed is either real or fictional does not enter into the early stages of perceptual and emotional processing.'

☞ 'Because of the different ways in which sound, odour and motion are processed in the brain, auditory and motion stimuli are less likely to stimulate the disgust system than scents. Accordingly, we are unlikely to experience disgust when we walk through a building, listen to music or watch dance.'

20

THE EXPRESSION OF EMOTION

Dance as an art form is more than just a display of virtuosity, endurance and agility. Of course, it can be just that and we may admire a dancer for her virtuosity, but admiration for the skills of a performer is not unique to dance; it plays a role in the appreciation of all forms of exceptional human performance. If dance were only about virtuosity, if it were only about watching some highly skilled people moving about in extraordinary ways, people might just as well attend a ballet class, they wouldn't have to pay 60 euro or more for a theatre ticket.[83]

What makes a ballet into a ballet is its composition, its expressive power and its meaning (☞ §27). In an interview the Russian choreographer Michel Fokine (1880-1942) once said of *The Dying Swan* (1907), the famous solo he created for Anna Pavlova, that 'it was a combination of masterful technique with expressiveness. It was like a proof that the dance could and should satisfy not only the eye, but through the medium of the eye should penetrate into the soul.'[84] The ballet proved to be a phenomenal success. Pavlova herself reputedly performed it more than 4,000 times throughout her life and it has since become one of the best-known ballets in dance history. Countless critics have written lyrically about the work's expressive power. The British dance historian and critic Cyril Beaumont (1891-1976) wrote that 'no one who has not seen this dance can imagine the impression it produces on the mind and heart of the spectator. The pitiful fluttering of the arms, the slow sinking of the body, the pathetic eyes, and that final pose when all is stilled, arouse an emotion so deep and so overwhelming that some moments elapse before the spectator can voice his appreciation by means of applause' (Beaumont 1945: 26). But what does the work's expressive power consist in? What is it that elicits such a deep and overwhelming emotion?

It seems natural to try and account for the expressive nature of dance by relating the movements it contains to the gestures people use when they express their feelings. And so in the present chapter I will analyse what experimental psychology and cognitive neuroscience can tell us about the expression of emotion.

[83] Harald Lander's *Études* (1948) is just that, a ballet in the form of a ballet class, beginning with some exercises at a barre, moving on to tendus, grands battements, fondus and ronds de jambe and ending with a series of mazurkas, tarantellas and broad leaps.
[84] As quoted in Balanchine and Mason (1968: 129).

20.1 A BRIEF HISTORY

The present study stands in a long tradition of rapprochements between art and science. In 1993 I had the good fortune of visiting an exhibition at the Grand Palais in Paris, *L'Âme au Corps. Arts et Sciences 1793-1993* (The Soul inside the Body) just days before it was closed for the public after a piece of the roof structure had let loose. I had the foresight to buy a special edition of *Beaux Arts* magazine, which served as a mini-catalogue to the exhibition. There was also a 500-page lusciously illustrated catalogue, which I browsed through in the museum bookshop, but which, as a cash-strapped student, I could not afford. The exhibition aimed to trace the representation of the body at the intersection of art and science from Rembrandt's *The Anatomy Lesson of Dr. Nicolaes Tulp* (1632) and the intricate anatomical drawings in Andreas Vesalius' *De humani corporis fabrica* (1543) to Etienne-Jules Marey's early experiments with chronophotography and the representation of melancholy, madness and inner turmoil in the work of artists such as William Blake, Edward Munch and Odilon Redon. One of the highlights of the exhibition was a rich selection of works by the French painter Charles Le Brun (1619-1690).

During his life Le Brun was one of France's most celebrated painters, largely because his bombastic style appealed to the taste of Louis XIV. He was, among other things, responsible for the decoration of the Châteaux de Versailles and for many years served as chancellor at the Royal Academy of Painting and Sculpture. Le Brun believed that art should be grounded in the latest scientific insights and he was one of the first artists to take a scientific interest in the workings of the human mind. In 1668 he delivered a famous lecture at the Académie Française in which he expounded his ideas on the expression of emotion. A transcript of his lecture, published several years after his death as *Conférence sur l'expression générale et particulière*, proved to be so popular that it received numerous reprints and was translated into Italian, German, Dutch and English. For more than a century it dominated the discourse on the expression of emotion (Montagu 1994).

In his lecture Le Brun drew heavily from Descartes' *Traité des Passions* (1649). Indeed, some passages are taken directly from Descartes.[85] Descartes had conceived of the passions in terms of a mechanistic model whereby sense impressions, sensations of the body or inner movements of the soul set into motion the 'animal spirits' contained in the cavities of the brain, which then innervate the heart and the muscles. According to Descartes 'it must be observed that the principal effect of all the human passions is that they move and dispose the soul to want the things for which they prepare the body. Thus the feeling of fear moves the soul to want to flee, that of courage to want to fight, and similarly with the others' (Descartes 1985: 343).[86] Descartes acknowledged that the brains of men are not all

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[85] See Montagu (1994: 156-62) and Ross (1984: 29).

[86] Descartes' notion of the passions is therefore remarkably similar to Frijda's notion of emotion as action readiness.

equally disposed, which is why one person may experience fear upon encountering a scary monster, while another may opt to defend himself.

Le Brun borrowed from Descartes his mechanistic conception of the passions, but whereas Descartes primarily discussed somatic expressions of emotion, such as blushing and weeping, Le Brun focused extensively on facial expressions, of which Descartes himself had expressed his reservations. As he wrote in article 113 of *The Passions of the Soul* of the 'actions of the face':

> 'It is hard to distinguish them; they differ so little that there are men who have almost the same look when they cry as others when they laugh. It is true that there are some that are quite recognizable, such as wrinkles in the forehead in anger, and certain movements of the nose and lips in indignation and mockery, but they do not seem to be natural so much as voluntary. And in general all the actions of both the face and the eyes can be changed by the soul, when, willing to conceal its passion, it forcefully imagines one in opposition to it; thus one can use them to dissimulate one's passions as well as to manifest them' (Descartes 1985: 368).

Le Brun reasoned that, if the brain is the seat of the soul, then the face shows the movements of the soul most clearly, because of its proximity to the brain. Consequently, if facial expressions are manifestations of the movements of the soul, to breathe life into a portrait and to give a painted figure a soul, what a painter needed to do was to give an accurate rendering of the expression belonging to a particular passion.

In his lecture Le Brun outlined a systematic theory according to which each passion, from anger and admiration to desire, fear, scorn, surprise, love and so on, corresponded with a specific facial expression. He also claimed to have established a correlation between the shape and features of human faces and those of various animals, which revealed a person's character and disposition. In his own work and that of his students there are no traces of these analogies though so it is not clear whether he truly believed in this aspect of his theories.

It is easy to ridicule Le Brun, especially his ideas about the correlation between human faces and animals, but his illustrations of the passions are not much different, at least in principle, from the photo sets used in contemporary emotion studies. And as Montagu (1994) comments, Le Brun's aims were noble. He sought to ground his work in the principles of nature and to free himself from mere mimetic representation, which would include all the whims of nature.

> 'To see [his] treatise only as a scientific study, or only as a pattern-book, is to misunderstand its aims and to misjudge its achievement. It is a monument to man's belief in his ability to comprehend the working of nature, and to the artist's confidence in his power, not to follow nature as an imitator, but to become a creator who, on the

limited field of his canvas, could bring into being a world at once in conformity with natural laws, and free from natural imperfections. By its means the artist could communicate his vision in images, securely founded on the laws of nature, and true to her principles' (Montagu 1994: 8).

Some two centuries after Le Brun delivered his lecture at the Académie Française the French neurologist Guillaume Benjamin Duchenne de Boulogne (1806-1875), who worked at the hospital of La Salpêtrière in Paris, published his book *Mécanisme de la physionomie humaine. ou Analyse électro-physiologique de l'expression des passions des arts plastiques* (1862). The book contains numerous photographic plates of the facial contortions that occur when electrical shocks are applied to the facial muscles, a technique developed by Duchenne de Boulogne to study the facial expression of emotion. Like Le Brun before him Duchenne de Boulogne believed that facial expressions provided a window to the soul. He even considered them a universal language created by God.

The book is divided into three sections: General considerations, a scientific section and an aesthetic section. In the aesthetic section Duchenne de Boulogne defends himself against criticism of the choice of his principal subject, 'an ordinary old man', arguing that, 'every human figure could become morally beautiful through the accurate rendering of the soul's emotions' (Duchenne 1876: 130-31).[87] However, as a concession to his critics he included a set of photographs of a different, female, model. Some of the photos in this second series were taken in a more elaborate theatrical setting and included four personifications of Lady Macbeth.

Duchenne's goals were not only scientific, but also aesthetic. He believed that through a better understanding of the mechanisms of facial expression he could establish the 'conditions of beauty'.[88] In the scientific section Duchenne gave a critique of different versions of the famous *Laocoön* group on the grounds that he had been unable to reproduce the tormented expression of Laocoön. Based on his findings he even provided an improved version, using a bit of Photoshop *avant la lettre*, 'of how the expression would have gained in beauty, and above all truth, had [it] been modelled (..) in accordance with the immutable rules of nature' (Duchenne 1876: 122).[89]

Charles Darwin had been fascinated by the work of Duchenne de Boulogne and he asked his permission to use several plates from *Mécanisme de la physionomie humaine* in

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[87] 'J'ai voulu seulement démontrer qu'en l'absence de beauté plastique, malgré les défauts de la forme, toute figure humaine peut devenir moralement belle par la peinture fidèle des émotions de l'âme' (Duchenne 1876: 130-31).

[88] 'Je saisirai alors cette occasion pour réunir autant que possible l'ensemble des conditions qui constituent le beau, au point de vue plastique' (Duchenne 1876: 8 and 133).

[89] 'On voit dans la figure 71, où j'ai essayé de rétablir les rapports naturels des lignes médianes du front et du méplat de ses parties latérales avec l'obliquité et la sinuosité du sourcil, combien l'expression aurait gagné en beauté, et surtout en vérité, si le front du *Laocoon* avait été modelé par le statuaire Agésandre conformément aux règles immuables établies par la nature' (Duchenne 1876: 122).

his book *The Expression of the Emotions in Man and Animals* (1872). In this book Darwin traced the expression of emotions in humans to analogous expressions in other species. He drew on sketches and photographs of animals and people, replies to questionnaires sent out to missionaries and colonial officers around the world, as well as his own observations made during his travels and visits to the London Zoo. In the introduction he wrote of Le Brun's *Conférence* that it is the best-known ancient work and that it 'contains some good remarks' (Darwin 2009: 13). However, he also included a brief quotation in which Le Brun described the expression of fright adding that, 'I have thought the foregoing sentences worth quoting, as specimens of the surprising nonsense which has been written on the subject' (idem: 16).

It is easy to see why expressions of emotion appealed to Darwin since they would provide further evidence for his thesis on evolution. Swans, when angered, erect their feathers, open their beak and make hissing noises. Dogs growl and uncover their teeth when they are on the defensive and they droop their ears and wag their tail when meeting their master. Humans, too, express their emotions in multiple ways. People raise their arms in despair, swing their fists with anger and shrug their shoulders with indifference. They smile, cry, blush, frown and raise their eyebrows. Some of these expressions are voluntary and determined by cultural conventions, others, such as blushing, are involuntary and cannot be inhibited.

There are obvious adaptive benefits to a capacity for recognizing expressions of emotion. It is better to flee from a potential aggressor than to approach and greet him. It is even better to be able to detect an assailant in advance and from a distance. It is equally beneficial to stay away from food that elicits disgust in a conspecific. On these grounds one could reason that, once available to an organism, expressions of emotion might persist.

The Expression of the Emotions in Man and Animals was an instant bestseller, selling more than 5,000 copies, but at the beginning of the twentieth century it had disappeared into oblivion. Its central notion that emotional expressions are universal and innate had become suspect with the rise of anthropology and behaviouralism. It wasn't until the 1960s that interest in Darwin's work on emotion was revived.

20.2 FACIAL EXPRESSIONS

In chapter 3 we saw that humans have evolved a specialized capacity for recognizing faces, which appears to be hardwired into the brain (☞ §3.1). People not only recognize faces as faces, they also recognize facial expressions. Depending on the context one can usually tell from looking at a person's face whether he or she is either cheerful or sad. It is quite obvious that the famous chimera, which sits on top of the Notre Dame in Paris, his tongue protruding from his mouth and his head resting on his hands, is sick from having to look at the same view day in, day out. This suggests that some emotions are associated with a typical facial expression and that in addition to face perception humans also possess a specialized capacity for recognizing facial expressions.

Over the past 40 years a considerable amount of research has been devoted to the study of facial expression. In a seminal study Ekman and his collaborators showed that some common human emotions – anger, fear, disgust, surprise, joy and sadness – appear to correspond with a unique, universal facial expression. As Ekman showed, members of the Fore tribe from Papua New Guinea, who had had little contact with other cultures, could nonetheless identify facial expressions of these emotions from photographs of people of different ethnicity. In various experiments, when asked how they would look in a particular situation, they produced the same facial expression as people from other cultures (Ekman et al. 1969). These findings have since been replicated in various empirical studies and as Russell and Fernandez-Dolls (1997: xi) observe, 'by the 1980s psychologists had largely accepted as a "fundamental axiom of behavioral science" the link between faces and emotions.'

However, as Russell (1994) has argued, many experimental findings may be an artefact of the methods used to study the recognition of emotion. For one thing, the photographs used in most studies are posed and decontextualized, as in a studio portrait, but the person posing for the camera may take into account that the expression has to be recognizable and may produce a caricature which is itself influenced by previously seen caricatures. The facial expressions used as stimuli are therefore unrepresentative of actual everyday expressions of emotion. As portraits or works of art the images typically used as experimental stimuli are a failure, because they show an expression at its apex. They seem frozen and unlifelike, a grimace more than an expression. It is hard to believe these people genuinely feel the emotions they portray. In fact it had already been observed by Charles Le Brun and his contemporaries that facial expression is a *movement* that starts from a person's baseline face, which may well be wrinkled or have an Angelina Jolie-like natural pout.

Most studies use a within-subject experimental design, whereby a subject has to sort through an entire set of facial expressions. This invites comparison between subsequent stimuli and may enhance the perceived contrast between various expressions. In one paper Ekman et al. (1991: 294) acknowledged that, 'in our early studies [Ekman 1972] we found unreliability in initial responses when subjects had to judge expressions. (..) We have found that subjects better understand what is expected of them after trying it a few times.' But this is odd, if the claim is that facial expressions of emotion are instantly recognizable. Most empirical studies also adopt a forced-choice format, whereby a subject has to decide which of a given set of labels best describes a facial expression. But this may create a pre-selection bias. When given a different set of labels to choose from, subjects might rate the same facial expression differently. Is it anger, frustration or distress? When participants are free to choose how to label a particular expression the results show great variability and include labels which are not emotions (Russell 1994). It should also be noted that the success rate in these experiments, while above chance, is never a full 100 percent. Effectively, we are once more chasing *p*-values in relatively small samples.

Additionally, there is evidence *against* the universal recognition of facial expressions of emotion. One study found that, compared with European observers, East Asian observers were less successful at distinguishing facial expressions of fear and disgust, which were consistently confused with surprise and anger respectively (Jack et al. 2009). This deficit, if that's what it is, was associated with a difference in eye fixations. Whereas European observers distributed their eye movements evenly across the face, East Asian observers fixated more on the eye region. This distinction has a parallel in the use of emoticons, the typographical characters used to convey emotions in text messages and e-mails. European and North-American emoticons are 'horizontal' with an emphasis on the mouth, whereas East Asian emoticons are 'vertical', with an emphasis on the eyes. The Asian sign for happy/joy is (^_^) while the sign for sad is (;_;) or (T_T). By contrast, the European signs are :-) and :-(. I should add that, while this study highlights the *cross-cultural diversity* in the recognition of facial expressions of emotion, it also demonstrates the *within-cultural congruence*.

Only few studies have investigated the second central claim of the expression theory of emotion, that emotions *cause* facial expressions. I can be short: there is no evidence that they do in any reliable way (Russell et al. 2003). Happiness or joy does not automatically produce the expression used in studies examining the recognition of emotion and neither do sadness, disgust, surprise, fear and anger. Expressions of emotion may therefore be primarily produced with communicative intent in the presence of others.

Even if an emotion *can* be expressed by way of a facial expression, it does not follow that a facial expression *was* produced by that emotion. There is no one-to-one correspondence between emotion and expression. People may cry when they are sad, but since people may also cry out of joy, it does not follow that someone who cries is sad or that, once he has stopped crying, he is no longer. If, when asked to express contempt, the majority of participants in an experimental study do so by smirking, it does not follow that people who feel contempt smirk and that therefore smirking expresses contempt, nor that people who don't smirk don't feel contempt. When we see tears well up in someone's eyes we may inquire whether something is the matter or look for further clues as to the person's state of mind, either in his behaviour or the environment. The ability to express and recognize emotions should therefore be seen as part of a larger communicative process.

I should emphasize that people across cultures *do* use information from facial cues to infer a person's emotional state, but reading a face, like any text, depends on context, as McDonald's discovered when it expanded into Asia. In Hong Kong people tend to be wary of anyone who displays what is perceived to be an excess of congeniality and employees who smile on the job are suspected of enjoying themselves at the consumer's and management's expense (Watson 2006). And so, instead of smiling counter staff 'project qualities that are admired in the local culture: competence, directness and unflappability.

In a North American setting the facial expressions that Hong Kong employees use to convey these qualities would likely be interpreted as a deliberate attempt to be rude or indifferent' (Watson 2006: 92). While this example demonstrates a cross-cultural difference in the interpretation of facial expressions, it also shows that people control their facial expressions in order to convey information, it's just that the context in which they do so is different.

In the late 1910s and early 1920s the Russian filmmaker Lev Kuleshov demonstrated that the same deadpan facial expression, when juxtaposed with a different image, gave rise to a different interpretation. Depending on whether the image of the actor's neutral, expressionless face was followed by an image of a plate of soup, a girl, or a coffin, viewers interpreted his face as showing an expression of either hunger, desire or grief.[90]

From a cognitive perspective face perception can be distinguished into three components: perception of the face as such (☞ §3.1); identification and categorization ('Bill Clinton', 'Asian man', 'elderly woman'); and recognition of expression and social signals ('smile', 'kisses', 'wink'). This distinction is supported by neuropsychological studies, which demonstrate that damage to different parts of the brain can produce selective impairments in the recognition of facial identity and facial expression (e.g. Tranel et al. 1988; Duchaine et al. 2003).

An important model of face perception proposes that facial identity and facial expression are processed in separate pathways (Bruce and Young 1986). It has also been proposed that this model can be related to two neural processing streams (Haxby et al. 2000). According to this model the inferior occipital gyrus processes structural features, which identify a face as a face. From thereon one pathway leads to the superior temporal sulcus, which processes changeable facial features such as eye gaze, facial expression and lip movement, while another pathway leads to the lateral fusiform gyrus, which processes invariant aspects of faces and is responsible for establishing facial identity.

There is, however, little empirical evidence to support such a dual pathway model (Calder and Young 2005). It would require a double dissociation between the recognition of facial identity and facial expression, but as yet there are no reports of patients with impaired recognition of facial expression, but intact recognition of facial identity and vice versa. There is no neuroimaging evidence that would support such a dual processing model either. To the contrary, various studies using different experimental paradigms have found a functional overlap between the recognition of facial expression and identity (e.g. Fox et al. 2009). Behavioural studies using various methodologies have similarly shown functional interactions between the recognition of facial identity and facial expression. Based on a review of the existing literature Vuilleumier and Pourtois (2007) therefore conclude that 'fMRI and ERP results demonstrate that emotion face perception is a complex process that cannot be related to a single neural event taking place in a single brain region, but rather

[90] This observation has at long last also found its way into cognitive neuroscience (e.g. Mobbs et al. 2006).

implicates an interactive network with distributed activity in time and space.' Their conclusion that 'emotional processing can strongly affect brain systems responsible for face recognition' may be premature though and may be an artefact of the experimental procedures used. This conclusion was given in by, among other things, neuroimaging studies, which report increased activity in the amygdala and face selective areas such as the fusiform face area when subjects watched faces expressing fear. However, one subsequent study reported that when movies instead of static photographs of facial expressions were used, there was no difference in amygdala activity between the responses to neutral faces and expressions of happiness, disgust and fear (van der Gaag et al. 2007).

The scientific study of the recognition and production of facial expressions of emotion and their neural concomitants is marred by methodological problems. People express their emotions through facial expressions. However, they do not do so at all times and except for a few exemplary cases there does not appear to be a one-to-one correspondence between an emotion and its expression. Cognitive neuroscientists and psychologists should have done well to heed Descartes' reservations about the facial expression of emotion in his *The Passions of the Soul*. Perhaps what is needed is not so much a new scientific paradigm as an old paradigm, which recognizes the many complexities in the ways in which people express emotion.

20.3 BODY EXPRESSIONS

Except for portraits and close-ups in cinema faces are hardly ever seen in isolation. They belong to a body. The body as a whole and a person's overall behaviour provides many more cues than the face alone. It is, for example, often easy to tell that someone is nervous. Just look around you next time you board a plane or sit in the waiting room at your local dentist. Some people may be restless: they shift in their chair, scratch their nose, and keep looking at their watch and at the people around them. Other people may be tense: they sit frozen in their chair; they hardly move and just study the patterns of the stains on the carpet in front of them. The fact that nervousness may express itself in two opposing manners shows that it may be difficult to isolate a single element or class of elements that might be added to a neutral position or movement so as to make it appear nervous in the same way as one might add sugar, honey, saccharin or sorbitol to food to produce a sensation of sweetness. As I argued above, one reason for this is that the sensation of taste and emotion are two categorically different feelings (☞ §17.1).

The ability to express an emotion with one's entire body is a key element of the performing arts. Various actors and directors have translated their experience in the form of a theory or a method. The French singer and actor François Delsarte (1811-1871) devised a system of expressive gesture in which movements of different body parts are assigned specific meanings and emotional qualities. His system was based on observations of how people behaved in everyday situations and public spaces. He never published his ideas, although he did plan a book. What we know of his teachings derives from lecture notes and the address he gave at the Sorbonne in 1865. Oddly, he never made any mention of dance or ballet. His primary interests were voice training and stage acting. His teachings had a tremendous influence on Ted Shawn and Ruth St. Denis, two of the pioneers of American modern dance, and, by way of their teachings, on the next generation of modern dancers. As Delsarte's ideas were transmitted from one person to another, his teachings were reduced to mere poses and it was in a direct response to the Delsarte method that Stanislavski developed his naturalistic approach to acting.

The German dance theorist Rudolf von Laban is best known for his development of a notation system for dance, but he also aspired to develop a systematic analysis of expressive movement. Whereas his *choreutics* was concerned with form and considered the principles of structuring a movement in space, his *eukinetics*, from the Greek words *eu* for good and *kinesis* for movement, dealt with the expressive qualities of movement. I should add that Laban is notoriously casual in his terminology, he frequently changed concepts, sometimes within the same text, and in his later work and his analysis of industrial labour he replaced the terms choreutics and eukinetics with Shape and Effort.

Laban distinguished four different fundamental dimensions of Effort: space, weight, time and flow, each of which could vary between two extremes: Space between flexible and direct; Weight between light and strong; Time between sustained and quick; Flow between bound or controlled and free. Thus, for instance, the shape of an embrace can be described as an enclosing movement. Its expressive quality can vary along the dimension of weight (loose or tight), time (long or quick), space (with the arms diffuse and groping or focused and fixed in one place) and flow (determined or uncertain). A person walking on tiptoe carefully places his feet so as not to disturb a sleeping person and slowly positions his foot on a staircase to test whether it is squeaking before shifting his entire weight to his foot. In this example we again recognize the dimensions of time, weight, space and flow. In actual performance every movement engages all four dimensions. As Laban observed, all movements evolve in space and time bringing the weight of the body into flow (Laban and Lawrence 1967: 58).

In Laban's analysis each of the four factors can be 'struggled against' or 'indulged in', to use his own words (idem: 57), and each can be given emphasis, separately or in combination with one or more other factors. Laban associated the resulting movement qualities with different moods or feelings. An emphasis on space is associated with the organization of movement, while an emphasis on weight is associated with intention and determination. A combined emphasis on space and weight would then give rise to stable movements.

Laban's attempt to bring some system to the description of expressive movement, while admirable, falters when one tries to match the concepts with actual movements. While it is easy to tell the difference between fast and slow, rigid and fluid, it is difficult, if not impossible, to systematically differentiate between movements with different combinations of two, three or four qualities.

Scientists have also taken an interest in body expressions. In the 1920s the Russian psychologist Nikolai Oseretsky developed an extensive research programme which aimed to record, measure, classify and analyse all significant forms of expressive movement, including posture, pose, facial expression, gesticulation, gait, handwriting and body movements. His primary objective was not to gain an understanding of expressive movement, but the design of a systematic test for the assessment of the development of motor skills in children. His work lives on in the form of the Bruininks-Oseretsky Test of Motor Proficiency and the Lincoln-Oseretsky Motor Development Scale.

In 1933 the American psychologists Gordon Allport and Philip Vernon published their book *Studies in Expressive Movement*. Allport and Vernon were primarily interested in personality traits and not so much in passing expressions of emotion. They define expressive movement as 'those aspects of movement, which are distinctive enough to differentiate one individual from another' (Allport and Vernon 1933: vii). As they point out, several difficulties arise in attempting to define and classify expressive movements, and those same difficulties continue to beset us to this day. One difficulty is that:

> 'no single act can be designated exclusively as "expressive", and none exclusively as "non-expressive". Every act seems to have its non-expressive as well as its expressive aspects. It has its adaptive or *zweckmässig* character, and also its individual or *ausdrücklich* character [original in italics and in German – IH]. In unlocking a door, for example, the task itself prescribes definite coördinated movements suited to the goal, but it allows also a certain play for individual style in executing the prescribed movements. There are peculiarities in the steadiness, pressure, precision, or patience with which the task is executed' (Allport and Vernon 1933: 21-22).

As Allport and Vernon observe, these peculiarities may be influenced by various external conditions such as strain and fatigue, age, the physical environment, health, the exigencies of the immediate goal and so on. They provide a 12-page tentative classification of expressive movement, in which they list descriptive terms commonly applied to patterns of expression, characteristic poses and different ways in which people can stand, sit, hold their hands, gesticulate and shake hands. Their phenomenological top-down approach therefore contrasts with Laban's bottom-up approach.

Modern research into expressive movement takes its cue from the basic emotion approach (☞ §18.2). Consequently, emotions such as frustration, despair or worry are ignored. In a typical experiment actors are filmed while they portray some basic emotions, primarily anger and fear, either in the form of a pose or in a short, 3 to 5 second, movement sequence. The researchers then edit the clips and select those which have the best recognition rate in a test audience or which they themselves consider appropriate.

These clips are then used in the actual experiment in which 12 to 20 participants are requested to view the clips and decide which of the two or six predefined emotion categories is being expressed. What these experiments therefore essentially test is the ability of the actors to portray a certain emotion with a few gestures and poses and not the ability of the participants to recognize them. There is not much difference between these experiments and one in which participants draw a square, a circle, a triangle and an oval, which another group of participants are then required to classify.

In one study participants were shown brief video clips of two dancers (one male and one female) who had tried to convey fear, anger, grief, joy, surprise, and disgust. The participants were requested to judge which emotion was being portrayed in both actual video footage and a point-light version. In the first condition 88% of the responses matched the emotion being portrayed, in the point-light condition 63% (Dittrich et al. 1996). A subsequent study in which ten actors portrayed anger, disgust, fear, happiness, and sadness at different levels of exaggeration, provided further support for the hypothesis that, on average, people can guess correctly which of these emotions is being portrayed from body movements alone (Atkinson et al. 2004).[91] Since the researchers judged the stimuli before they were presented to the participants it is unclear what these experiments actually tell us. To assess people's ability to recognize emotional expressions one would have to record an episode taken from a real life situation, determine the person's emotion at the time and then ask people to view the video to do the same. This is more or less the situation dance, theatre and cinema audiences find themselves in, except that the dancers and actors may also intentionally portray an emotion using various common, but culturally specific, signs.

In recent years a number of studies have begun to probe the brain regions that are activated when people view images of emotionally expressive bodies. In one neuroimaging study participants viewed short, 3-second videoclips of actors portraying one of five emotions (anger, disgust, fear, happiness and sadness) and were asked to rate the intensity of the emotion expressed in the movie on a 3-point scale, 1 for a little, 2 for quite, and 3 for very much (Peelen et al. 2007). The purpose of the study was to investigate the neural correlates of emotional body displays and so the participants did not have to guess which emotion was being displayed. It was found that activity in the amygdala was positively correlated with the activation in the extrastriate body area and the fusiform body area (☞ §3.2). The authors claim that this suggests that the greater activity in the body sensitive areas is due to modulatory projections from the amygdala, but of course the data do not warrant such a claim. One cannot conclude from the mere correlation between two variables X and Y that either X causes Y or Y causes X.

Current neuroimaging studies of the recognition of full body expressions are plagued by the same methodological problems as studies of facial expression. They use a within-subject design, which invites comparisons between stimuli, and a forced choice paradigm,

[91] The actors had their faces covered so as to restrict the task to the recognition of body movements.

which not only informs the participants that the images are intended to portray an emotion, but also which emotions: they are not given a choice between, say, anger, hatred, frustration and jealousy. Furthermore, current research on the recognition of bodily expressions of emotion focuses on expressions of happiness, anger and fear (e.g. Grèzes et al. 2007; Pichon et al. 2008; Van de Riet et al. 2009). But to reiterate once more, happiness, anger and fear are not representative of emotion and it does not follow from a neuroimaging study, which reveals increased activity in a particular network of brain regions when subjects view video footage of actors portraying anger or fear, that this network is therefore involved in the processing of emotionally expressive full body movements. It is not clear either how these results should be interpreted. An aggressive posture may be interpreted as a provocation by some, while others may back off. It is by no means the case that fear is the counter response to anger or aggression or that people are afraid when they see another person expressing fear. Some people may be quite happy to see a criminal being physically punished and may be encouraged by his expression of fear.

In daily life quite often it is not the explicit portrayal of an emotion that elicits an emotional response, but an event. If we see another person collapse we are surprised, because of the disruption of the anticipated motion path (☞ §5.7), we may feel compassion because we care about the well-being of others and we may be inclined to lend a hand to help the other person get up and collect his belongings. People do not typically collapse voluntarily, they do so because they slip or trip, are hit by a car or a bullet, or suffer a heart attack. In order to intentionally produce these feelings in an observer it is not enough for an actor to just sink to the floor. If a falling movement is to elicit a feeling of compassion of sorts, it should be such that the movement appears involuntary and the person helpless (☞ §6). On various occasions I have seen dancers fall during a performance. But the audience only reacts with an audible sigh if it looks as if it is not part of the performance.

In recognition of the fact that in everyday situations we often witness scenes in which people behave emotionally, one neuroimaging study used a simple contextual situation involving a male actor either threatening or teasing a female actor by grabbing at her handbag (Sinke et al. 2010). In one experimental condition participants in the study were instructed to classify the scene as threatening or teasing, in another condition they were requested to focus on three dots that were projected onto the actors' bodies and to judge whether the dots were of the same or different colours. It was found that irrespective of the task, and therefore irrespective of whether the participants attended to the scene or the dots, activity in the right amygdala was greater in threatening than in teasing situations. In the condition in which participants attended to the dots, the increased activity in the amygdala was correlated with increased activity in body selective regions (☞ §3.2), the fusiform gyrus, the extrastriate body area, MT/V5, and the superior temporal sulcus. Additionally, heightened activation in the left premotor cortex and the hypothalamus was found in the threatening situation, independent of the task. The increased activity in the amygdala and the hypothalamus may reflect increased vigilance and action preparation, although, of course, this is just an interpretation.

The above experiment has greater ethological validity than experiments which show a person taking on a threatening pose. It also mimics, albeit in an extremely simple form, a scene that could also be witnessed on stage, and so we might extrapolate the findings to dance and theatre. Importantly, in this experiment unattended scenes still provoked a neural response in brain regions associated with emotion processing. In the previous chapter I argued, following Smith (2003), that cinema, theatre and dance use emotionally salient cues that surreptitiously influence the viewer's emotional response. The present experiment suggests that a quarrel taking place somewhere on stage may alter activity in the amygdala, even if the scene is unattended to. As we have seen, this in turn may result in increased vigilance (☞ §19.4). I am aware that I am reading a lot into this experiment and more than is scientifically warranted. However, it is a hypothesis worth pursuing further.

20.4 EXPRESSIVE BEHAVIOUR

An emotion can manifest itself through physiological changes, such as blushing or an increase in one's heart rate, through facial and body expressions and through changes in one's behaviour. Together these changes can be described in the phenomenology of that emotion. When we are ashamed we become acutely aware of ourselves, of our bodies and of our flaws. Even the possibility that someone, anyone, might observe us may be enough to elicit a feeling of shame. Accordingly, people who feel ashamed may wish to hide and disappear, they may wish to sink into the ground or die on the spot. Similarly, when one feels miserable one may not feel like doing anything and whatever one engages in costs a tremendous mental effort. The entire world and everything in it seems dark and heavy. It follows that, in order to express a certain emotion, one can borrow gestures and manners of behaviour from the phenomenology of that emotion.

Dominique Mercy's solo in *Danzón* (1995), a piece by Pina Bausch, set to *Poveri Fiori*, an aria from the last act of *Adriana Lecouvreur* by Francesco Cilea, in a recording by Maria Callas, is one of the most powerful dance solos that I know. To me it speaks of despair, madness, solitude and finally resignation. It is only about three minutes long, but if I could choreograph three minutes of such emotional intensity I would be a proud and happy person indeed. But what does this solo's expressive power consist in? Is it the shape of the movements? The manner in which they are performed? Would it be as powerful without the accompanying music or if it were performed by a woman instead of a man?

Of course, all of these elements are integral to this particular solo. In *Vollmond* (2006) Dominique Mercy dances another powerful solo set to a song by the Balanescu Quartet. It also speaks of despair, madness and solitude, but it is a different solo. There are some broad similarities between both solos: he repeatedly clutches his head with both hands, he raises his arms in the air, he frequently looks around in every direction as if asking for help that doesn't come and at some point he falls flat on his back. In *Danzón* a number of seemingly senseless movements are repeated. At one point he does a push up and immediately afterwards he briefly lies down on his stomach, his arms stretched to his side. All of this suggests that he is so desperate that he doesn't know what to do. In the end he just grabs his shirt and walks away. While each movement could mean something different, by placing them together they come to express despair.

As I argued above (☞ §18.2), the situations we encounter in everyday life can be divided into a number of categories: threats, hazards, success, competition and so on. Depending on how they are appraised these situations call for specific forms of behaviour. As Frijda (1986) has argued, emotions correspond with a change in action readiness, which direct the organism towards a certain type of behaviour. Consequently, some situations are associated with particular forms of behaviour and particular emotions, while conversely some forms of behaviour typically occur in particular situations and are associated with particular emotions. It follows that, if we know the situation we may guess the corresponding emotion and behavioural repertoire and if we know the behavioural repertoire we may guess the corresponding situation and emotion. Our success at guessing the correct emotion depends on the information present in the situation or the behavioural repertoire and on the strength of the association between the three elements. To improve our success rate we would thus need to analyse the behaviour typically associated with an emotion, this is the province of the phenomenology of emotion, and the behaviour typically associated with a particular situation, which is the province of ethology.

The behavioural repertoire of most animal species can be divided into a number of elementary classes or families, which can be traced back to their evolutionary origins. There are types of behaviour and movements that revolve around courtship, flight, attack, defence, chase, searching and foraging, protecting and caring, resting and sleeping and so on. Each of these action categories comprises a loosely defined family of movements. The flight family consists of movements such as withdrawing, recoiling, running away, flinching and retreating. It branches off into the hiding family, which includes hiding or seeking to hide, but also making oneself small, covering oneself or part of the body and other defensive movements. We can further distinguish between searching (for food or for an absent object), chasing (a present and fleeing object) and protecting and caring for an object. Some of these behavioural categories are associated with a particular emotion or set of emotions, such as flight with fear and defence with anger, other categories are associated with more complex appraisal schemas.

It follows that, in order to express an emotion, one can borrow gestures and manners of behaviour from the movement families associated with the situations in which those emotions typically occur. Thus, a person moving around on an empty stage while imitating movements from the search family may create the illusion that something is missing. Doing so in an ever-greater frenzy may create the illusion that the missing object is important and that something may happen if it isn't found in time. These are the kind of scenes that constitute what Arlene Croce referred to as a dance event rather than a plot event (☞ §18.1). One's interpretation is determined primarily by the movements themselves, not by external factors.

In an interview Merce Cunningham once described one of his first solos, *Root of an Unfocus* (1944): 'I was still concerned with expression. It was about fear. The dance was in three parts. The first part gave the impression of someone realizing there's something unknown. The second part shows the dancer struggling with this but it's futile because there's nothing there. In the third part he is defeated by it. The ending was a series of falls and crawling off the stage' (Cunningham and Lesschaeve 1985: 79).

Cunningham's short description is remarkably consistent with the phenomenology of fear and anxiety. Fear occurs in the presence of a threat and elicits a pattern of evolved defence and avoidance mechanisms to deal with the threatening object or event. Whereas fear is directed at an object, anxiety is non-directional. It may emerge when fear cannot be dealt with or when the nature of the threat remains obscure. It involves a feeling of foreboding and may express itself in lethargy (there's nothing to be done about it) as well as hyperactivity (anything might help). In the interview Cunningham only mentions two movement classes explicitly, falling and crawling, but both are in accordance with his statement that the piece was about fear. Crawling derives from the flight family, but since people only crawl when they are unable to walk or run, it also has the connotation of being wounded or being held back. Falling and stumbling is associated with failure and the presence of obstacles that impede one's movement. The movements thus suggest a situation and a corresponding emotion.

We understand other people's actions, emotions and motives, to the extent that we understand the situation they find themselves in. Even in the absence of any visible signs we may understand that a person is sad, angry, happy or jealous. Indeed, knowing that a person is sad we may interpret her *lack* of expressive behaviour as an expression of sadness.

In everyday life the context, which enables us to interpret the expressive quality of a person's conduct and appearance, is given. In cinema and the performing arts the context has to be created. In dance the music, the stage design, the lighting, the costumes, the interactions between the dancers and the previous movements provide the context in which we interpret the individual movements of each dancer and a scene as a whole. For example, *Fabrications* (1987), to which I referred in the introduction to this chapter, is one of the few ballets by Merce Cunningham in which the women wear dresses and the men wear shirts and trousers. The work's emotional undertones might therefore derive more from the costumes than from any quality inherent in the movement itself, as also pointed out by Copeland (2004: 159). *Winterbranch* (1964), another piece by Merce Cunningham, consists of dancers falling to the floor, getting up and falling again. When it was first performed audiences generally interpreted it as frightful, but as Copeland (2004: 158-59) writes: 'when segments of *Winterbranch* (1964) were incorporated into subsequent events, the emotional tone of the work was no longer nightmarish or apocalyptic. Stripped of

Rauschenberg's disorienting lighting and LaMonte Young's aggressive, high decibel-level sound score, what the audience saw was (merely) the act of dancers falling. Without other factors to color the emotional texture, this basic movement motif came to resemble a series of vaudevillian pratfalls; hence, the spectators tended to laugh rather than recoil in horror.'

20.5 CONCLUSION

The basic emotion paradigm in combination with the use of photographs as experimental stimuli has had a devastating effect on the study of emotion and has contributed to the current impoverished understanding of the expression of emotion in cognitive neuroscience and experimental psychology. Admittedly, it is easy to get lost in the myriad ways in which movements, whether of the face or the body as a whole, can be expressive, but contemporary neuroscience has swapped attempts to arrive at a phenomenology of expressive movement for an overly simplified paradigm, which may lend itself to laboratory studies, but loses sight of our everyday emotional reality. In a dialogue or actual interaction between persons facial expressions quickly change in accordance with the persons' feelings and their communicative intent. By concentrating on the six allegedly basic emotions initially proposed by Ekman et al. (1972) – anger, fear, disgust, joy, surprise and sadness – other emotions, such as despair and frustration, and moods, such as nervousness and worry, are ignored.

It is not that people don't recognize expressions of anger, joy and sadness, but that both the means by which people might express emotions and the kind of emotions that can be expressed are far richer. You can tell that a colleague is frustrated if he repeatedly hammers the enter button on his keyboard and you may sense that he is desperate if he suddenly recedes in his chair. Of course, your colleague may merely have wanted to stretch his muscles or perhaps he was playing a computer game and receded in his chair because he just broke his own top score. But if you know what he is working on, if you know he had an important phone call to make, then you may inquire whether the system crashed again or get up from behind your own desktop and offer him a drink. Receding in a chair and hammering on a keyboard as such do not express any specific emotion. Even banging one's fist on a table need not be a sign of anger. It can also be a sign of resolution or intended to make a sudden loud noise so as to startle a sleepy looking colleague.

While it may not be possible to classify facial and bodily expressions of emotion, that doesn't mean that anything goes and that all interpretations are equally valid and equally likely. If someone bangs his fist on the table it triggers a limited number of possible associations. When tasting wine people usually spit out the wine after assessing its quality.[92] In other circumstances spitting out food indicates that there is something wrong with the food or the person eating it, while spitting at someone or in front of someone's feet is

[92] In case you're interested, wine tasting involves four basic steps: colour, smell, taste and savour. When judging wine one typically looks for integration, expressiveness and complexity.

generally considered an insult in most cultures. It follows that spitting can, but need not, express disgust. It can also express contempt or be part of a food tasting ritual. However, spitting is unlikely to express despair, awe, pride, pity, gratitude, regret, love, guilt, hope or curiosity.

We had been hoping to learn whether it is possible to identify the mechanisms that enable us to recognize facial and body expressions of emotion and whether the properties of those mechanisms constrain and bias our capacities in systematic ways. There are some reports that the recognition of facial expressions of emotion is impaired in patients with amygdala damage (e.g. Adolphs et al. 2002). Neuroimaging studies also suggest that the amygdala plays an important role in the recognition of both face and body expressions of emotion. However, for the moment the phenomenology of emotion and the ethology of animal behaviour may tell us more about the expression of emotion than cognitive neuroscience and experimental psychology.

While our neuroaesthetic analysis may not explain what makes movements emotionally evocative, it does explain how to avoid emotional expressiveness. It therefore provides part of the theory behind the work of Merce Cunningham. As we have seen movements can be expressive, because they belong to a family of movements with specific behavioural and emotional connotations. It follows that, if one wants to abstain from any obvious emotional connotations, one should avoid certain movements and movement configurations. Cunningham famously repudiated the emotionally expressive movements and psychological and literary themes associated with the work of Martha Graham with whom he had danced for several years. By determining the sequencing of the movements and the entries and exits of the dancers literally with a throw of a dice, he disrupted the natural coherence of the body and the natural order and pairings of movements. He also dressed his dancers in uniform body suits, since dresses, trousers, ties and even jeans might have an emotional connotation. However, it is impossible to totally strip a series of movements of all emotional connotations. A spectator may see things that were unintended and are a consequence of his or her individual visual path through the choreography. A work as a whole can therefore still have a dramatic impact.

Randomization is not the only method by which movements can be defamiliarized and decontextualized. In the work of Robert Wilson movements are highly stylized and performed at an ultra slow speed. In minimal dance movements are seemingly endlessly repeated with only gradual shifts towards a different sequence. The effect of the repetition is that the individual movements are stripped of their behavioural and emotional connotations. However, since repetitive movements are associated with obsessive-compulsive disorder repetition itself can have strong emotional connotations.

The present analysis also throws a new light on the work of Charles Le Brun. Compared with the work of his contemporary Nicolas Poussin (1594-1665), Le Brun's paintings looks schematic and lifeless. They lack precisely that which, through his systematic analysis of the principles of facial expression, he had sought to achieve: a faithful representation of emotion. So where did Le Brun, the painter, go wrong and how does it relate to his theory of expression?

In the work of Le Brun each individual figure represents an emotion within a grand narrative diagram, but the figures remain isolated, they do not seem to interact with each other. By contrast, as Allen (1998: 87) argues, in the work of Poussin 'everything starts with the particularity of the situation, the unique human conjunction. More importantly still, it begins with the *significance* of the event (..) and this goes well beyond a simply *psychological* understanding of the passions.' The figures in a painting by Poussin take part in an event; they are not pieces in a puzzle. And this, according to Allen, 'explains why his figures are both more and less "expressive" than those of Le Brun: more, because they are part of something bigger and more important than a personal affective response; less, because they rarely epitomize a single or even a readily classifiable passion' (idem).

Le Brun conceived of emotions and their expression as somehow existing as independent entities. He left little room for the circumstances to modify each individual figure's emotion. If a scene required an angry figure he would simply add the facial features of anger, following his theory of expression. As Allen (1998: 101) writes: 'Le Brun approaches the expression of the passions first of all as a question of *imitation*, and more specifically as one of *description*.' Had he been alive he should have heeded Collingwood's words that 'to express the terror which something causes, you must not give it an epithet like "dreadful". For that describes the emotion instead of expressing it, and your language becomes frigid, that is inexpressive, at once' (Collingwood 1938: 112) (☞ §17.2). The same is true of facial and bodily expressions of emotion. Ultimately, it was his reading of Descartes, which led Le Brun to believe that 'he could find the solution to the artistic problem of expression in a descriptive study of the human features' (Allen (1998: 104). With Descartes a new way of thinking about the passions had taken hold and the Aristotelian tradition, which regarded emotion as part of social interaction, disappeared behind the horizon.

At the heart of Le Brun's work lies a surprising paradox. If we understand a situation we may infer a person's emotion and hence feel empathy, sympathy, sadness or joy. But if we see a facial expression, yet don't understand the situation, all we feel is puzzlement why the person's face shows the kind of contortions that it does. This is why, in a dance performance, if the dancers are showing all kinds of emotions, but the context remains unclear, we may wonder what the fuss is all about. Why the screaming? Why the running? Why the stamping feet and the waving arms? Yet if the dance sets up a context, even an otherwise meaningless movement, such as grasping a person by the elbow, can become an evocative gesture.

If you were hoping to finally discover the definitive theory that explains how movements gain an emotionally expressive quality and how they can be configured in such a way as to express a particular emotion, I have to disappoint you. There is no such theory and I doubt whether there will ever be one. With the exception of some emblematic gestures, such as crying and laughter, the most that we can do is to outline the situations that will bias some spectators to interpret a scene in a certain way. We can also define some generic movement classes that are associated with certain emotions. This, however, still leaves an enormous amount of detail to be filled in, even in a six-minute solo or a 2-minute trio.

What may look like a scientific failure is in fact an artistic blessing. It is precisely *because* there is no such thing as an emotional body grammar that choreographers seek to *choreograph* movements and body postures that express feelings of nostalgia, grief, sorrow, despair, misery, joy and so on. It is *because* body and facial expressions of emotion are not recognized with a success rate of 100 percent that both the choreographer and the spectator have room for interpretation.

This observation has an important corollary. In so far as it involves novel movement sequences and interactions between people a dance performance enriches our expressive repertoire. Even if we don't express our own emotions using the gestures we see in the theatre, it expands our mental universe in the same way that travelling, reading and standing on the observatory of a skyscraper expands our view of the world. Indeed, we come to know the finer nuances of the phenomenology of emotion through literature, cinema and theatre, provided, of course, that the artist does not deal in clichés.

KEY POINTS

☞ 'A choreographer does not need a vocabulary of expressive movements in order to create an expressive ballet.'

☞ 'It is precisely *because* there is no such thing as an emotional body grammar that choreographers seek to *choreograph* movements and body postures that express emotion.'

☞ 'In so far as a choreography involves novel movement sequences and interactions between people it enriches our expressive repertoire.'

☞ 'The ability to express and recognize emotions should be seen as part of a larger communicative process.'

☞ 'People across cultures use information from facial cues to infer a person's emotional state, but reading a face, like any text, depends on context.'

☞ 'Neuroimaging studies of the recognition of facial and body expressions of emotion are plagued by methodological problems.'

☞ ‘For the moment the phenomenology of emotion and the ethology of animal behaviour may tell us more about the expression of emotion than cognitive neuroscience and experimental psychology.’

☞ ‘To assess people’s ability to recognize emotional expressions one would have to record an episode taken from a real life situation, determine the person’s emotion at the time and then ask people to view the video to do the same.’

☞ ‘If we understand a situation we may infer a person’s emotion and hence feel an emotion. If we see a facial expression, yet don’t understand the situation, all we feel is puzzlement why the person’s face shows the kind of contortions that it does.’

☞ ‘If the dance sets up a context even an otherwise meaningless movement can become an evocative gesture.’

☞ ‘Our neuroaesthetic analysis may not explain what makes movements emotionally evocative, it does explain how to avoid emotional expressiveness.’

21

EMPATHY

In chapter 4 we encountered the simulation theory of action perception according to which the same neural systems are involved both in the perception and execution of action (☞ §4.2). In recent years various authors have extended this theory to emotion. The central idea is that there is a common neural circuit for the perception and experience of emotion and that this circuit underlies the capacity to understand others and share their feelings. This idea is usually subsumed under the heading of empathy, a concept which actually originated in nineteenth century aesthetics and is still often invoked, especially in film theory, to explain how readers and viewers are affected by works of fiction (e.g. Feagin 1996; Neill 1996). According to this view readers or spectators put themselves into the character's shoes and simulate what the character must be going through. As a consequence they feel the same emotions as the character. They get angry when the character is falsely accused and are afraid when the character is being chased down a dead alley. There is, however, something odd about the way many authors conceptualize empathy, especially with respect to the ethical connotations cognitive neuroscientists ascribe to it.

In one of the final scenes of *The Silence of the Lambs* (1991) we see how Dr. Hannibal Lecter kills the two police officers who guard his special purpose cell inside a Tennessee courthouse. When the police storm the floor they discover one of the officers crucified against the cell bars and another lying on the floor, his face heavily mutilated, but still breathing. The police officer is carried to an ambulance, while the other officers ambush the elevator. On the way to the hospital the person inside the ambulance peels off the skin from his face and reveals himself as Dr. Hannibal Lecter. He kills the paramedics and makes his way to the airport. The audience rejoices as Lecter escapes and admires his ingenuity. Going by the comments on YouTube many viewers regard it as their favourite scene of the movie. But wait. Didn't he just kill two police officers and another two innocent paramedics who are merely doing their job? Isn't he a convicted serial killer? Cognitive neuroscientists who believe that empathy is at the roots of ethics will have some explaining to do if it causes us to share the feelings of murderers. It might be objected that movies and novels hijack the affective system by making us empathize with the wrong person, but then how is the affective system hijacked? Wouldn't it be more parsimonious to abandon the entire concept rather than to try and rescue it at all costs?

Empathy in its contemporary usage in cognitive neuroscience belongs to a family of concepts, which also includes mimicry, emotional contagion, sympathy, which can be defined as an affective response that consists of feelings of concern for a person (or animal) in need, and compassion. Some authors view these concepts in an ascending order of cognitive complexity whereby mimicry and emotional contagion precedes empathy, which precedes sympathy and compassion and in the final instance so-called 'pro-social behaviour' (e.g. Preston and de Waal 2002; Singer and Lamm 2009).

If emotions were contagious and if the experience of one's own emotions and the perception of another person's emotions or their expression were to rely on a shared neural circuit, then our analysis would be finished rather quickly. As before things are not as simple as cognitive neuroscientists would like to believe.

First let's consider the concept of emotional contagion. Emotional contagion has been defined as 'the tendency to automatically mimic and synchronize facial expressions, vocalizations, postures, and movements with those of another person and, consequently, to converge emotionally' (Hatfield et al. 1992: 153-54). The authors expand on this definition by explicating that a response may be similar, such as when a smile elicits smiles, or complementary, such as 'when a fist raised in anger causes a timid person to shrink back in fear' (Hatfield et al. 1994: 5). Presumably, the person who continues beating despite the victim's screams does so because of another complementary emotion. A more parsimonious explanation is, of course, that the assailant acts out of anger, revenge or because, as a riot police officer, it is his duty. The person who shrinks back from a raised fist does so because he fears the physical consequences of being hit, not because the emotion of the other person (anger) spills over and in the process is inverted into its opposite (fear). Whether a raised fist expresses anger also depends on the context. The same gesture may express joy, enthusiasm or elation.

The evidence for the claim that emotions are contagious is mostly anecdotal. Researchers often appeal to the observation that yawning is contagious, except, of course, that it isn't. If it were then the entire audience should be yawning if a person yawns on stage or on screen, but this is something I have never witnessed.

In support of the hypothesis that emotions are contagious it has been reported that in facial electromyographical studies, which measure the electrical activity produced by muscles, the observation of smiling and frowning faces activates corresponding facial muscles in the viewer (Dimberg et al. 2000; 2002). However, if anything is contagious at all, it is smiling and laughter, not amusement, which, it should be pointed out, is rarely mentioned as an emotion. Furthermore, to repeat once more, the mere observation that in some isolated cases a single muscle or muscle group shows increased activity cannot be extrapolated to *all* emotions being contagious.

One may also wonder about all those participants in the experiments with which psychologists and neuroscientists study emotion who are exposed to whole batteries of images of people alternately expressing happiness, fear, anger, sadness and disgust. Are those poor people torn between all of the expressed emotions at an interval of a few seconds? Are the participants in studies, which measure the neural correlates of fear perception, terrorized when they leave the scanner? Do they need counseling afterwards? Do expressions of happiness neutralize expressions of fear? Experiments intended to show the neural substrates of emotion inadvertently demonstrate that the concept of emotional contagion is flawed and its explanatory value nil.

To be sure joy, fear and enthusiasm can spread from person to person, but what needs to be investigated is whether the *object* of the emotion or the *cause* of a mood is shared and can be inferred from the context, in which case the reason people cheer is not the mere fact that others do, but a shared object or cause. A fan of the New York Mets who knows that his team plays the New York Yankees and notices another person in a Mets t-shirt cheer as he walks home from work, may conclude that the Mets have won and join in the cheering. A Yankees fan seeing the same person and drawing the same conclusion will be depressed for the rest of the day. It is the shared object that causes the emotion, not the perception of the facial or bodily expressions. The same person may just ignore the sad face of a homeless person begging for money or the joyful sounds of a violin player playing inside a subway station. Even the people who flee in a panic do so because they fear that something has happened or because they are afraid of being crushed. In some circumstances there is little else one can do other than to move in the same direction as the crowd.

A brief consideration of the performing arts and cinema also tells us that the contagion account of emotion is wrong. In order to make the audience laugh comedians tell jokes and enact amusing scenes, they don't just stand there and laugh for an hour on end. Directors, writers, choreographers and filmmakers go to great lengths to emotionally engage the audience. They create storylines and invent situations in order to make the reader or viewer feel a certain emotion. If it were just a matter of contagion all one would have to do would be to show the relevant emotional expression.

But how do we understand a situation and another person's perspective? Building on simulation accounts of action perception and inspired by the discovery of mirror neurons, various authors have proposed that experiencing an emotional state oneself and observing or imagining another person in the same emotional state, activate the same neural structures (e.g. Preston and de Waal 2002; Gallese 2002; Decety and Jackson 2004). Presumably, the writer who imagines that one of his characters is jealous, feels jealous at the moment of imagining the scene and so does the reader or spectator who reads the novel or watches the film adaptation. A conceptual problem with the shared representation account is that two persons A and B who both empathize with person C and therefore share the same affective state need not empathize with each other. De Vignemont and Singer (2006) therefore specify that there is empathy if: '(1) one is in an affective state; (2) this state is isomorphic to another person's affective state; (3) this state is elicited by the observation or imagination of another person's affective state; (4) one knows that the other person is the source of one's own affective state.' In this view emotional contagion fails to meet condition (4), whereas sympathy does not meet condition (2). Since both person A and B in our example attribute their affective state to person C they would not empathize with each other. The question remains how one can know another person's affective state and how one can establish that it is the source of one's own affective state.

In support of the shared representation account of emotion one neuroimaging study reported similar responses in the anterior insula both when participants smelled disgusting fragrances and when they viewed short video clips of faces expressing disgust (Wicker et al. 2003). One may wonder though whether one feels *empathy* for a person who smells an awful fragrance. If it is a prank one may also feel amusement (indeed one may well ask what the experimenters felt, I wouldn't be surprised if they didn't feel anything at all). Another study reported increased activity in the anterior insula and the anterior cingulate cortex when participants received a small electrical shock to their hand and when they observed their partner, who was sitting next to the fMRI scanner, receive a similar shock through a mirror inside the scanner (Singer et al. 2004).[93] Again one may ask whether the experimenters felt any empathy with their subjects and whether they reflected on their own position as researchers.

A recent experiment suggests that some caution is warranted in interpreting these findings. Most experiments are designed in such a way that the stimulus automatically captures attention. But, as one neuroimaging experiment demonstrated, attention affects which brain regions are activated. Subjects were shown pictures of hands in a painful or neutral situation and instructed to evaluate the pain intensity supposedly felt by the person whose hand it was or to count the number of hands in the picture (which could be either one or two). Rating pain intensity resulted in increased activity in various brain regions, including the anterior cingulate cortex and the insula, but the activity disappeared in the hand counting condition (Gu and Han 2007).

The central claim is that empathy involves both the understanding of and the affective experience of another person's actual or inferred emotional state. However, it is not always clear what emotional state another person is in. There is no simple one-to-one correspondence between an emotion and its expression and so it is difficult to tell based on the expression alone what another person is feeling. For the same reason it is difficult to establish conclusively whether one person's affective state is isomorphic to that of another person.

It should be noted that the entire theoretical edifice rests on neuroimaging studies. Cognitive neuroscientists commonly regard their experimental findings as an explanation for why people act and feel the way they do, when in fact they are in need of explanation. It is unclear from the neuroimaging studies conducted so far whether the activation of the neural structures causes a feeling of empathy or whether a feeling of empathy arises elsewhere, for instance, in the form of a cognitive appraisal, and then causes activity in

[93] Note that the paper by Singer et al. 2004 was singled out by Vul et al. 2009 as an example of the 'non-independence error' in the statistical analysis of neuroimaging data (☞ §1.7).

these neural structures. To allow for this possibility some authors have proposed a dual model in which 'top-down' and 'bottom-up' signals are intertwined (e.g. Decety and Lamm 2006).

Neuroimaging studies of emotion typically use very short perturbations, but as we have seen emotional episodes can last longer than a few seconds. Implicitly, the shared representation account assumes that one only empathizes as long as the emotional episode lasts. But this is wrong. One can continue feeling empathy with another person without drowning in sorrow oneself. Empathy theorists might argue that, by definition, at this point one has stopped feeling empathy and instead is feeling sympathy. When the sadness kicks in once more one stops feeling sympathy and starts feeling empathy again, or perhaps one feels empathy and sympathy at the same time.

As before results obtained for one or two emotions are taken as representative for *all* emotions. Studies of empathy only refer to pain, which is not an emotion, and disgust, fear and sadness. But if empathy is a general capacity why shouldn't one be able to empathize with another person's anger? And what about other emotions such as shame, guilt, pride, gratitude, remorse and so on? People don't feel shy when they see a shy person, they don't feel feel regret if and because another person feels regret, they don't feel shame when another person expresses shame and so on and so forth. And what about love? A person may be madly in love and may express his or her love in words and through gifts and signs of affection. However, the other person may be unmoved, quite simply because he or she isn't gay.

When reading accounts of empathy one gets the impression that the authors primarily address feelings of victimhood, such as pain, fear and sadness. It is argued that empathy and emotional contagion are adaptive (e.g. Preston and de Waal 2002), but the authors all take the point of view of the prey or the victim and only consider interspecies contagion. It would be maladaptive for a predator to be emotionally affected in an identical fashion by the emotional state of its prey. In their efforts to establish a neural basis for morality and 'pro-social behaviour' (e.g. Singer and Lamm 2009; de Vignemont and Singer 2006) the authors also ignore that violence can be justified and necessary in order to restore a social order or to fend off an assailant.

All of this is not to say that people don't have a capacity for empathy. They do. People care about others. They care about their offspring, their beloved ones, their pets, their car, their clan members and their past and future generations. Empathy in the narrow sense of a shared affective state may only exist for pain and distress. Even though it may be possible to imagine what another person is or may be going through, that doesn't mean that this is the default mode of how we understand other people's emotions. Most importantly, it is not necessary to assume that people feel empathy, when they read a novel, watch a movie, attend a dance or theatre performance or watch the world go by. There is no need to simulate another person's mental state to understand his or her predicament. It suffices to appraise the situation from one's own perspective. If you see someone bump his shopping trolley into another person you don't feel angry when you put yourself into the shoes of one person and then sorry when you change perspective. You oversee the whole situation.

In everyday situations we frequently witness scenes with more than one actor. It depends on the context whether one empathizes with the chaser of the chased, or to be more precise, it depends on one's understanding and appraisal of the context. The work of Pina Bausch features all kinds of interactions between two individuals, between a group and an individual or between groups. In one scene in *Kontakthof* (1978) a couple sits opposite each other on both sides of the stage. They begin undressing but are interrupted by a group of rowdy men, after which they put on their clothes again and join the other dancers. There is no need to simulate the feelings of either the woman or the man in order to understand the scene. What is more, the spectator does not feel interrupted. The spectator does not feel humiliated either when in *Nelken* (1982) a man is instructed to undress and imitate a goat, a dog and a frog. And when I watch Dominique Mercy's solo in *Danzón* by Pina Bausch I recognize despair in some movements, yet at that moment I myself don't feel desperate.

If empathy were the main principle with which we engage with fiction, the point of view shot in cinema, which gives us direct access to the character's perspective, would be the most effective in having the audience engage with a character. However, as various authors have pointed out (e.g. Gaut 2006), it is the reaction shot, which is most effective in this respect. In one of the final scenes of *The Silence of the Lambs* Clarice Starling pursues Jame 'Buffalo Bill' Gumb who has fled inside his basement. All of a sudden the lights inside the basement go out. In the next shot the viewer is led to believe that he is looking at Clarice through the eyes of Jame Gumb, who has put on night vision goggles, through an alternating shot of a distorted field of view, a filmic device since the actual field of view is normal, and a shot of Gumb wearing the goggles. And yet the viewer relates to Clarice Starling, not Jame Gumb. Needless to say that the viewer fears *for* Clarice and is not afraid of being killed him or herself. Of course, to reiterate, the audience only understands the expression on the face of the character and his or her bodily demeanour within the context of the scene. When, earlier in the movie, Jack Crawford and Clarice Starling travel to West Virginia to perform an autopsy on one of Gumb's victims, as the body bag is opened, the film first shows the reaction of the three men in the room and then, for a full minute, we see Clarice's facial expression, allowing the audience to fill in whatever horror they can think of, we hear her trembling voice as she describes what she sees, before, at long last, the camera zooms in on the victim's heavily mutilated and decomposing body.

A reader who reads that, 'in recent years social neuroscience [has] made considerable progress in revealing the mechanisms that enable a person to feel what another is feeling' (Singer and Lamm 2009), might be inclined to believe that there is now sound empirical evidence from cognitive neuroscience that firmly roots readers' and viewers' emotional engagement with fictional characters in elementary brain processes. However, given the current state of knowledge cognitive neuroscientists can learn more about emotion from closely analysing how artists manipulate their material so as to emotionally engage the audience than the other way around.

KEY POINTS

☞ 'There is as yet little, if any, experimental evidence for the existence of a common neural circuit for the perception and experience of emotion that underlies the capacity to understand others and share their feelings.'

☞ 'A brief consideration of the performing arts and cinema tells us that the contagion account of emotion is wrong. Directors, writers, choreographers and filmmakers go to great lengths to emotionally engage the audience. They create storylines and invent situations in order to make the reader or viewer feel a certain emotion. If it were just a matter of contagion all one would have to do would be to show the relevant emotional expression.'

☞ 'Emotions can spread from person to person, but what needs to be investigated is whether the *object* or the *cause* of the emotion is shared and can be inferred from the context, in which case the reason people feel a certain emotion is not the mere fact that others do, but a shared object or cause.'

☞ 'Empathy in the narrow sense of a shared affective state may only exist for pain and distress.'

☞ 'Even though it may be possible to imagine what another person is or may be going through, that doesn't mean that this is the default mode of how we understand other people's emotions.'

☞ 'There is no need to simulate another person's mental state to understand his or her predicament. It suffices to appraise the situation from one's own perspective.'

22

THE PLEASURES OF DANCE

I think it is safe to say that most dancers took up dancing because they enjoy dancing and that, with the possible exception of critics, teachers, scholars and other dance professionals, most people who attend a dance performance do so because they hope or expect to enjoy it. Few people will go to a performance or a movie, which they know in advance they are not going to like. People don't attend just any performance either: they choose to go and see a performance by, say, Maguy Marin rather than Mathilde Monnier or Mark Morris. They may have seen and enjoyed a previous production by her or perhaps they are just curious after seeing a poster or reading a review. Pleasure provides a form of intrinsic motivation for performing a task or engaging in an activity, but motivation can also be extrinsic. A dance critic may not feel like going to a particular performance, but instead of relegating the assignment she might go because it is her job and because she receives payment for it.

A peculiar thing about pleasure is that people take pleasure in film, literature, dance and the visual arts regardless of the emotions any particular work elicits. A horror movie, to name the prototypical example, induces fear in the audience and yet people enjoy watching it. The avant-garde, if that term still has any meaning today, provides even better examples in the form of performances that seem to test the audience's endurance. As a matter of fact it is by no means self-evident why watching some people aimlessly move about on a stage should be pleasurable at all. At least in basketball and football there is a goal: scoring a point and winning the game and as a spectator one may take pleasure in seeing one's side take the lead.

This chapter reviews the psychology and neurophysiology of pleasure to try and answer why people take pleasure in watching dance. The question I will address is not why one person enjoys this and another person that – as I argued above (☞ §18.3) this depends on an individual appraisal – but how pleasure arises in the first place. As we shall see an answer to this question also tells us more about what choreographers do in order to give the audience intermittent bouts of pleasure.

22.1 KINDS OF PLEASURE

People seek pleasure and avoid displeasure. They only choose to listen to music, which for whatever reason, they enjoy. They may change the song, the album or the artist at any moment if they do not like it, regardless of whether it is one of their favourite albums or artists. As I observed above, continued pleasures wear off. Even your favourite album would get on your nerves if you were to listen to it every day. Pleasure also appears to be contingent on mood. If you're in a 'bad' mood, you may not derive pleasure from listening to your favourite music, you may not feel like continuing the book you're reading and you may not feel like going to the performance for which you have tickets. Then again, music, dance and a night out may also change your mood for the better. Pleasures are individuated by their objects: one cannot derive the pleasure of watching a performance of Jiří Kylián's *Wings of Wax* (1997) from drinking a class of wine or reading a novel by Milan Kundera.

Pleasure comes in different kinds and different pleasures come about in different ways. Sensory pleasures include sweet tastes, gentle caresses, perfumes and the pleasure of sex. People not only enjoy being caressed, they also enjoy touching the fur of cats, dogs, rabbits and fabrics such as velvet, but as the French philosopher Jean-Luc Nancy (1992) has argued, all forms of touching are a self-touching, and so, on that account, the pleasure of caressing is really a form of self-caressing. The sight of a furry animal may even create the desire to caress it, not out of the conviction that the animal will appreciate it, but because it feels nice.

Some stimuli, such as sex and sweetness, are intrinsically pleasant, while others are acquired tastes. It took me some time to discover the pleasure afforded by a good glass of wine, but I never got the taste for coffee or beer, which I still find disgusting. The intrinsic pleasantness of a stimulus does not mean that it is positively appraised on a cognitive level: it means that there is an autonomous pleasure response of the body. The body does not care by whom it is caressed, it does not care about the source of a sweet taste, but the person does. Some types of food may taste delicious until you learn what you are actually eating, in which case you may be revolted.

A number of other pleasures can be distinguished apart from sensory pleasure. The achievement of a goal, the progress towards its achievement and mastering a task are all sources of pleasure. There is gratification in achieving fluency in a foreign language, completing a mathematical proof, regardless of whether it is just an exercise, finishing a sudoku and being able to give a flawless performance. One of the pleasures of art may simply be the pleasure of figuring things out, of connecting the dots, of trying to guess for oneself who is behind those murders, and of observing how a particular piece offers a subtle deconstruction of the notion of theatrical performance. The pleasure of poetry, of reading a poem by Paul Celan or trying to decipher the lyrics of an R.E.M. song, derives at least in part from its obscurity and inaccessibility: the fact that it only discloses its meaning after some interpretive effort. I mean, why doesn't a poet just say what he wants to say, in straightforward terms, even if it would take more words? But perhaps ambiguity and indeterminacy may be a source of pleasure in itself. It *could* mean something deep and profound and offer a whole new window onto life, the universe and everything, then again maybe it doesn't. Maybe it just is what it is, whatever it is.

In chapter 3 we saw that choreographers like to create ambiguous scenes in which, for a brief moment, it is unclear which limb belongs to which body (☞ §3.4). One reason spectators and choreographers, in so far as they are spectators of their own work, take pleasure in these scenes may be that the moment the ambiguity is resolved you become aware of the ambiguity and of the clever trick that was played upon you.

The pleasure in achieving a goal and understanding something is different from the pleasure of engaging in an activity, which Csikszentmihalyi (1990) has referred to as flow, the experience of total immersion in a task and completely focused motivation. Watching a movie or a dance performance that is captivating from beginning to end may, for that reason alone, be considered pleasurable. For the duration of the performance you forget your surroundings, you forget that you should be working on your Ph.D. thesis, that you should be looking for a job and that on Tuesday you have an appointment with the dentist to have one of your old amalgam fillings replaced. You lose sense of time, you are no longer conscious of your self and your body and you seem to be one with the performance.

The end of an ordeal, such as a dreadful performance that dragged on for almost two hours without an interval, may be another source of pleasure. Social pleasures, which include the pleasure of being with friends and, perhaps, watching other people having a good time, constitute another category. People also take pleasure in looking back to pleasant events, a holiday, a concert or a meeting with friends. Although they derive from sensory or other pleasures, they originate in memories and are therefore a specific kind of pleasure.

A funny thing about looking back is that people sometimes choose *not* to repeat an experience even though they value it highly. A possible explanation for this phenomenon is that people cherish the memories, which they want to protect for later consumption and don't want to contaminate with new experiences (Zauberman et al. 2008). For example, a place you visited years ago may have changed in the intervening period, your experience at the time may have been influenced by the presence of your then partner and you yourself may have changed in the meantime as well.

The present classification is by no means exhaustive. One may also take pleasure in learning that a person, who had been imprisoned for his opposition to his country's political regime, is released after serving 27 years in prison and a few years later one may rejoice upon learning that the same person is elected president of his country.

The form of pleasure that is most relevant to our present discussion, but also the most problematic, is aesthetic pleasure. Humans appear to be the only creatures that watch sunsets, look up to the sky at night to marvel at the stars, and climb mountains to enjoy the view. Other animals may seek out a vantage point to look out for predators or prey, but they don't gather to watch a sunrise. But why do people take pleasure in looking at the lightning during a thunderstorm? Why do people take pleasure in reading fiction? As Frijda (2007: 84) observes, 'aesthetic pleasure forms a problem and a challenge for any theory of pleasure.'

In neurological terms wherever there is pleasure there has to be a reward somewhere. In chapter 15 I referred to a study, which reported increased dopamine release in the striatum at peak emotional arousal while participants listened to music (Salimpoor et al. 2011). I also referred to another study, which reported increased activity in the nucleus accumbens and the striatum while the participants watched video clips of eight stand-up comedians (Franklin and Adams 2011). If we extrapolate these findings then 'off-peak' experiences may similarly involve a release of dopamine, albeit a more subdued release than during peak experience. However, one may take pleasure in reading a 400-page novel without explicitly taking pleasure in every single sentence or paragraph. One may take pleasure in attending a dance performance or visiting an exhibition without experiencing any pleasure at all. One may even take pleasure in a novel that makes one angry, such as J.M. Coetzee's *Disgrace* (1999) or a movie whose ending makes one cry, such as *Titanic* (☞§15.4; §23). I will have more to say about aesthetic experience in chapter 29. For now it is important to remember that aesthetic pleasure is a complex concept.

It is important to keep in mind the distinction between different kinds of pleasure, because the pleasure of dancing oneself and the pleasure derived from attending a dance or theatre performance may have multiple sources. Coordinating one's body may be a sensory pleasure, dancing may result in a state of flow and dancing with others can be a social pleasure. Watching other people dance and having a good time may also be a social pleasure, even in the institutionalized world of choreography. If a friend or a relative is performing, your experience will be quite different from that of a nonpartisan observer or a dance critic. Your pleasure may be of a social kind. Overzealous parents anxious about a possible misstep of their child and critical of every move she makes, may not enjoy the performance at all and feel envious towards the parents sitting next to them whose daughter is the star of the evening and at the tender age of 15 has already been offered a position as *élève* at a prestigious ballet company when she finishes school at the end of the year.

It also makes a difference whether you attend a performance with friends and meet during the interval for a drink and a chat or whether you go on your own and just hang around in the lobby waiting for the performance to begin again as you try to establish the relative frequency of the letters a and e in the program booklet.[94] Other circumstances also matter. I have spent many long hours in crammed seats feeling sorry for the people seated behind me trying to shift my legs every now and then to prevent my feet from tingling while trying to keep my attention focused on the stage. So when I attended a performance by the Cirque du Soleil in Las Vegas I was delighted to be able to sit back and stretch my legs and to even have a cup holder to the side of my seat for the drink I didn't buy. Did it influence my judgement of the show? That I don't know, but I certainly was positively

[94] The intervals at the Royal Opera House in London are excruciatingly long and sometimes longer than the ballets or opera acts. If you ever go on your own I recommend bringing a book.

primed. If the next time I visit a show in Las Vegas my seat doesn't have a cup holder, I will be thoroughly disappointed.

22.2 THE NEUROPHYSIOLOGY OF PLEASURE

It may seem as if the whole question regarding the neural substrate of pleasure was already answered in the 1950s. Experiments demonstrated that if a rat has access to a lever that sends electrical impulses to areas in the midbrain, it will forego eating and drinking and will press the lever until it is exhausted (Olds and Milner 1954). This finding led to the notion that there are 'pleasure centres' in the brain, a notion that has currency to this day. In his popular book *How the Mind Works* Steven Pinker (1997: 524) refers to these experiments and then goes on to argue that humans have developed a direct route to stimulate their pleasure centres by way of recreational drugs and an indirect route via the senses. As Pinker writes, 'if the intellectual faculties could identify [the] pleasure-giving patterns, purify them, and concentrate them, the brain could stimulate itself without the messiness of electrodes or drugs. (..) The visual arts are a perfect example of a technology designed to defeat the locks that safeguard our pleasure buttons and to press the buttons in various combinations' (idem: 526). However, as before things are not that simple.

In the original experiments carried out by Olds and Milner the rats quickly learnt how to activate the electrode. Since the rats continued to press the lever to deliver electrical stimulation to their brain it was inferred that they must like it, why else would they continue pressing it? However, recent findings suggest a distinction between 'liking' and 'wanting' (Berridge 2003; 2007; 2009). This distinction may, of course, prove to be either wrong or too crude still, but it offers a novel perspective on the experimental results obtained in the 1950s.

'Wanting', with quotation marks, or incentive salience, to use the technical term coined by Berridge (2007; 2009), differs from the common sense notion of wanting as subjective conscious desire. It refers to a salience marker that is added to a stimulus, especially conditioned stimuli and reward cues, by some specific brain structures. 'Wanting' does not reflect positive affect or sensory pleasure, it is not necessarily experienced as a feeling of wanting, does not require any cognitive intermediation and is essentially nonhedonic in nature. It is pure drive. In the same vain 'liking' as an objective hedonic reaction differs from the everyday sense of liking as the subjective feeling of pleasure. 'Liking' lacks an incentive target or drive, it is just a pure state of hedonic pleasure or positive affect. Incentive salience therefore complements pleasure, adding 'wanting' or desire to mere pleasure or 'liking'.

Normally, 'liking' and 'wanting' combine, but occasionally 'wanting' or incentive salience can be dissociated from 'liking' and result in seemingly irrational and compulsive behaviour, as is sometimes observed in drug addiction, when a drug is wanted even though it is not enjoyed. It may also explain why the rats in the electrical stimulation experiments continued pressing the lever: The electrodes are likely to have stimulated a component of the reward circuit involved in 'wanting' and not 'liking' (Berridge 2003).

If you have activated an email alert on your computer which gives off a sound or starts blinking whenever an email arrives in your inbox, you will probably have experienced 'wanting'. The sound or the blinking attracts attention (☞ §9.1), but this in itself does not yet induce any subsequent action. It is its function as a cue that triggers a hard to suppress impulse to instantly check your email. However, it is unlikely that the cue itself will cause much pleasure, unless you're one of those persons who celebrates whenever they receive mail. But when you go to your inbox and read the following message 'thanx for everything. i had a wonderful evening. talk to you soon. xxx' your body may begin to glow, a smile may form on your face and even though the message itself is pretty clear, you may reread it several times just to taste the words, you may find it hard to concentrate on your work and an hour later you may open the message once more to convince yourself that it really does say what it says.

In laboratory animals the 'wanting' peak can be artificially enhanced by delivering a drop of amphetamine at exactly the right spot in the nucleus accumbens, a structure within the striatum, which itself is part of the basal ganglia. This causes an increase in the amount of dopamine that is released and projected to target neurons in other areas. If the cue was a beep and if the rat had to press a lever to obtain its reward, what happened in the experiments was that upon hearing the beep the rat would press vigorously at the lever. It did not become more motivated to press the lever in the absence of a cue though: all that happened was that the cue related 'wanting' peaks were higher. The authors therefore interpret the result as an increase in incentive salience (Wyvell and Berridge 2001). Recreational drugs, which artificially boost dopamine levels in parts of the midbrain may similarly produce intense 'wanting'. Prolonged use may cause an increase in sensitivity of the dopamine structures in the midbrain, which may increase the incentive salience or 'wanting' for drugs.[95]

People express their pleasure with words like 'yummy' or 'wow' or by giving a rating, but pleasure also manifests itself in behavioural responses. Newborn children express their liking by smacking their lips and protruding their tongue. The same behaviour has been observed in rats, apes and monkeys. It has also been found that sweet tastes elicit a different set of behavioural reactions than salty or bitter tastes. It should be noted that the signal value of these expressions is limited to the distinction between pleasure and displeasure. It is not possible to infer from an expression of displeasure whether the stimulus was bitter, salty or sour. With these behavioural measures it is therefore possible to investigate the neural substrates of unconscious pleasure or core 'liking'.

A number of brain regions have been associated with 'liking', but only a few of these appear to be causally implicated in core pleasure. In laboratory rats these so-called 'hedonic

[95] Dopamine sensitization may spill over to other rewards and cause compulsive gambling or sexual behaviour.

hotspots' produce enhanced 'liking' responses, when stimulated with opioids. These hotspots exist in the nucleus accumbens shell, the ventral pallidum and in regions deep inside the brainstem including an area called the parabrachial nucleus (Berridge 2003; Kringelbach and Berridge 2009). They are anatomically distributed, but reciprocally connected and appear to form a functionally integrated circuit for pleasure. Only one of these regions, a section of the posterior ventral pallidum, appears to be a *necessary* component for the pleasure associated with sweetness, in the sense that damage to this region leads to either a disappearance of the 'liking' response or a reversal of liking into disliking. 'Liking' also appears to require the simultaneous and unanimous activation of multiple hotspots and to be restricted in terms of the neurotransmitters that may enhance it, since only stimulation with opioids has been demonstrated to produce a greater 'liking' response (Berridge 2009).

Since the core processes of 'liking' and 'wanting' are usually coupled, the distinction may seem of little practical relevance to our present discussion. But consider what happens when you browse an online photo collection or YouTube. If a clip does not provide instant gratification you move on to the next site or do something more productive. If you like it you may find yourself clicking link after link and thumbnail after thumbnail until you reach a video or picture that is not to your liking and does not trigger the desire for more of the same or until you realize with a shock how much time has passed.

During a dance or theatre performance you are basically stuck for the entire duration of the show, but the mechanisms that drive 'wanting' still operate, it's just that their effect may not become obvious until the events on stage fail to arouse the desire for more. This is one reason why site specific productions in a gallery or a space where the audience can just come and go are always a challenge. The audience has the option to leave and will do so if they are not triggered into 'wanting more'.

There is some tentative evidence that subliminal stimuli activate 'wanting' circuits. In one experiment participants were asked to identify the gender of a face that was briefly flashed on a computer screen for 1/2 second. Unbeknownst to the participants occasionally faces with a happy or angry expression were flashed at 1/60 of a second, too fast to be consciously perceived. Following the experiment the participants were asked to judge a new fruit drink. Even though subjective reports didn't show any change in mood, participants who had been exposed to the happy faces found the drink more appealing, drank more of it, rated it more highly and indicated they would be willing to pay a higher price, should the drink be on sale, than participants who had been exposed to angry faces (Winkielman et al. 2005). These findings may reflect the activation of brain regions associated with 'wanting' (Berridge 2009), although of course no brain activity was measured in this experiment and so this is mere speculation.

The goal of this experiment was to investigate and demonstrate the effects of the *subliminal* exposure to emotionally salient stimuli. Now if subliminally presented stimuli activate 'wanting', then what about stimuli that are plainly visible? In film, dance and theatre everything happens in full view, but not everything is consciously perceived. If we extrapolate these findings, could it be that emotionally salient images and events that register without necessarily being consciously perceived, bias the viewer towards a state of pleasure?[96]

The subjective feeling of pleasure may build on the core processes of ‘liking’ and ‘wanting’, but most likely requires the recruitment of additional brain mechanisms. In human functional neuroimaging experiments a lot more regions are activated in tasks designed to incorporate a form of reward or pleasure than the regions implicated in core ‘liking’ in rats. These include the orbitofrontal, cingulate, medial prefrontal and insular cortices. One possible explanation for this finding may be that reward signals need to be translated into signals subserving other functions such as learning, memorization, consciousness, decision, action selection and so on. Kringelbach and Berridge (2009) therefore distinguish between brain activity coding and causing pleasure. As discussed above, the orbitofrontal cortex appears to be a key region in the coding network. The finding that the pleasure rating of food declined as people were fed to satiety makes it a prime candidate for the coding of the subjective feeling of pleasure. However, even though damage to the orbitofrontal cortex has been found to cause impairments in emotional behaviour, it does not abolish the capacity for pleasure and positive affect. It is therefore neither necessary nor sufficient to generate feelings of pleasure.

On a more speculative note Biederman and Vessel (2006) have proposed that the pleasure of watching a visual scene originates in the modulation of opioid receptors in some selected brain regions. These opioid receptors are activated by morphine, the active ingredient of opium, but also by endogenous neurotransmitters, so called endorphins. In the early 1980s it was discovered that the density of mu-opioid receptors increases along the ventral visual pathway and are densest in the parahippocampal cortex, commonly referred to as an ‘association area’ for lack of a better term, where signals originating in the visual cortex are presumed to be integrated with signals from other parts of the cortex. Biederman and Vessel (2006) conjecture that a scene with a great information density leads to greater activity in association areas and thereby a greater release of endorphins[97], which in turn leads to increased stimulation of mu-opioid receptors. But as they write ‘we are not sure what the next stages might be, but they may ultimately increase the release of dopamine in the corpus striatum’ (Biederman and Vessel 2006: 252). Then again, maybe they don’t.

22.3 CONCLUSION

Feelings of pleasure are caused by a myriad of physiological and neurophysiological processes, but it would be wrong to reduce pleasure to the activity of a particular brain

[96] Of course, this is one reason for the use of product placement in movies and television series.
[97] The authors refer to endomorphins but endorphin is the more general term.

region or the release of some neurotransmitter. It explains too much, as it would entail that people take pleasure in, for instance, all novel, information rich scenes, and it explains too little, since people may take pleasure in listening to music they know by heart. Kringelbach and Berridge (2009) also warn against a phrenology or chemo-phrenology of pleasure, equating opioids with pleasure, the nucleus accumbens with reward and the amygdala with fear. As they write, 'the nucleus accumbens causes pleasure "liking" when stimulated with opioid or cannabinoid neurotransmitter signals, but the same spot only amplifies "wanting" without "liking" when stimulated by dopamine.' Similarly, opioids only directly cause pleasure when injected at exactly the right spot. For the same reason it would be wrong to reduce the pleasure of dancing to the release of endorphins, which has famously been implicated in the euphoric state associated with intense physical activity also known as the 'runner's high' (Boecker et al. 2008). It does not explain why some people pursue dancing instead of a daily workout, or why some dancers choose to work with Netherlands Dance Theatre and others with Pina Bausch Tanztheater Wuppertal or the Merce Cunningham Dance Company.

Some caution is warranted in translating these laboratory experiments to dance. Most neurophysiological findings about emotion and pleasure are based on experiments with rats and primates. But surely the goal is to understand *human* emotions? Researchers rely on the assumption that there is an evolutionary continuity between the brains of different animals and that therefore findings about, say, the rat nucleus accumbens, also apply to the human equivalent (☞ §1.6). I'll leave it to others to debate this issue, but it is worth keeping in mind that there is as yet no direct neurophysiological evidence in humans of the 'wanting' and 'liking' circuits.

It is worth observing in this respect that increased activity in the striatum has also been associated with the chills people sometimes experience when they listen to a piece of music (Blood and Zatorre 2001). A recent study that used the neurochemical specificity of [^{11}C]raclopride positron emission tomography scanning reported that peak emotional arousal while listening to music is indeed associated with increased dopamine release in the striatum (Salimpoor et al. 2011). This would put music and perhaps dance accompanied by music on the same level as chocolate and cocaine, in neurological terms that is.

A major shortcoming of research into reward is that it is based on what, for lack of a better term, might be called singular stimuli: a single touch, a single shock and a single drop of some sweet substance. The actual stimuli we encounter in daily life are all composite. Food not only has a flavour, it also has shape, colour, texture and fragrance. Each sensory property adds to one's experience and each mouthful contributes to an overall feeling of pleasure. To explain why one sweet substance is preferred over another, neurophysiological theories would have to take into account these other factors as well. Only then would it be possible to account for the difference between chocolate and vanilla. Similarly, pleasure in dance, music, cinema and life in general, does not depend on a single note, movement, event or bite, but on a composite sequence of stimuli. It is not any particular note or movement that is a source of pleasure, but their arrangement into a composition.

Despite these reservations, I believe that the distinction between 'wanting' and 'liking' has interesting conceptual implications for how one can think about dance and the performing arts in general. When watching a dance performance, *during* the show salient scenes and events provide for intermittent bouts of pleasure and 'wanting', the desire for more, *after* the show what rests is a lingering feeling of pleasure 'liking', assuming that the show was a pleasure, that is. One may feel a strong desire to see another performance by the same company or the same choreographer, but since the show is over and the stimulus has been removed, that is all there is to want for. A typical Cirque du Soleil production is essentially a series of spectacular scenes strung together by thematic, musical or acrobatic interludes that take the foreground during the intervals between scenes. I don't think that, from this abstract point of view, the dramaturgic structure of most dance and theatre performances is much different. The feeling that the dramaturgic tension in a show disappears emerges when the desire 'wanting' for more subsides (☞ §10.1). This is what artists monitor their work for during the rehearsals.

After the show spectators make up some sort of a profit and loss account, whereby distant events are discounted at a different rate than recent events and salient events that stuck in one's memory feature prominently. They do so unconsciously, but also in conversation with friends and when writing a short note on a blog: 'the opening scene was great', 'I loved the music', 'that trio in the middle was amazing'. Even though the performance as a whole need not contain any individual movements or movement sequences of particular merit in order to be liked, it does help, so to say.

Pleasure is governed by the same laws or principles as all other emotions. For one thing, pleasure is subject to the law of diminishing returns. There comes a moment when you no longer want any 'more', no matter how much pleasure whatever it is you are consuming, whether chocolate or potato chips, promises to deliver. There may even come a point where the thought of eating one more chunk of that dark chocolate cake causes a feeling of nausea, instead of the mouth watering anticipation you felt just minutes ago when your dessert arrived.

People not only get satiated from overindulgence in food, but also from engaging in mental tasks. Mental satiety has various causes. One prominent cause is the prolonged repetition of an action. But then why don't people get fed up with walking or chewing? Mojzich and Schulz-Hardt (2007) propose that this is because the action is not consciously performed. They suggest that if the task is represented at a hierarchically higher level, such as training for an important tennis tournament or rehearsing for a new dance production for that matter, or if one's attention and thoughts can freely wander while performing the task (☞ §11.1), people may not get satiated. Monotony in itself, therefore, need not lead to a loss of intrinsic motivation. Crucially, mental satiation and monotony are two related but distinct concepts. Mental satiation results if the task demands ongoing attention. A monotonous task that does not allow attention to drift or that cannot be incorporated within a grander scheme, such as training for Wimbledon, may therefore lead to mental satiation.

It is not just monotonous tasks that lead to mental satiety. A complex and otherwise highly differentiated task may equally lead to mental satiety. To be more precise, what I would like to propose is that dance and the performing arts in general may on occasions produce a form of mental satiety, either because of sensory overload or because of sensory deprivation.

During a dance performance or a concert one's thoughts may drift, but the activity on stage is usually such that it is difficult to concentrate on something else. I argued before that in the late 1960s and early 1970s minimal music and dance provided a radical departure from existing styles (☞ §10.2). Even though within an individual piece differences and transitions between sections were 'minimal', each work taken as a whole differed from works in other styles and traditions. And so some spectators may have found the work of Philip Glass, Lucinda Childs and Terry Riley interesting and they may have been intrigued until the end. Since it does not have any distinguishing, individual features and does not offer periodic doses of pleasure in the form of notable events, after a while other spectators may have grown fed up. Now, more than thirty years later, the novelty has worn off. Audiences familiar with the genre may therefore be more likely to get bored, because they know a piece may go on for another half an hour in much the same way. The effect may be more prominent with minimal dance and music, because repetition is inherent to it, but it applies to all genres and styles. If a performance just goes on at the same high speed and with the dancers going from one contortion to another, after a while some spectators may knock off. After playing it too often people may even grow tired of an album they once counted among their all time favourites and they may tire of the work of a particular choreographer or indeed of contemporary art or dance at large (☞ §14.4). The mere thought of attending a performance can be enough to cause anger and despair. Not another one of those conceptual pieces aiming to deconstruct the notion of dance!

In contemporary Western society the performing arts are generally regarded as leisure activities and performances are typically scheduled in the evening, after people have finished their daily job duties. From a cognitive point of view this may not be the best time of the day. People's performance at cognitively demanding tasks depends on the time of day, fatigue, circadian rhythm and general arousal level and varies with their so-called chronotype: morning-types perform better in the morning than later in the day, while evening-types perform better later in the day than in the morning (Schmidt et al. 2007). After a long day at the office people may be tired, their cognitive resources for the day may have been depleted and they may have reached a state of mental satiety. If pleasure is contingent on psychological factors such as mental satiety, fatigue and arousal level and the degree to which people can cope with a task, then some spectators may not enjoy intellectually demanding pieces, because they have difficulty following them. Had they been at home they may not have picked up a book either and they may have postponed finishing that sudoku until the next morning. The same persons might have no difficulty following the show if it were performed during the morning. Of course, this is purely speculative, but the null hypothesis that time of day, fatigue, mental satiety and so on have *no* effect on cognition and emotion has to be rejected.

Consequently, the assumption that one's pleasure depends only on the input, whether it is a dance performance or a novel, is mistaken. That may not be the most shocking conclusion. A perhaps more intriguing thought is that in the performing arts, the art and the audience are misaligned. Dance and theatre performances are created during the day by artists who are hyperalert and well prepared and are watched in the evening by a public that is tired from a long day at work.

KEY POINTS

☞ 'The pleasure of dancing oneself and the pleasure derived from attending a dance or theatre performance may have multiple sources.'

☞ 'Pleasure is governed by the same invariant principles as all other emotions.'

☞ 'Feelings of pleasure are caused by a myriad of physiological and neurophysiological processes. It would be wrong to reduce pleasure to the activity of a particular brain region or the release of some neurotransmitter.'

☞ 'Pleasure in dance, music, cinema and life in general, does not depend on a single note, movement, event or bite, but on a composite sequence of stimuli. It is not any particular note or movement that is a source of pleasure, but their arrangement into a composition.'

☞ 'The distinction between "wanting" and "liking" has interesting conceptual implications for how one can think about dance and the performing arts in general. When watching a dance performance, *during* the show salient scenes and events provide for intermittent bouts of pleasure and "wanting", *after* the show what rests is a lingering feeling of pleasure "liking".'

☞ 'After the show spectators make up some sort of a profit and loss account, whereby distant events are discounted at a different rate than recent events and salient events that stuck in one's memory feature prominently.'

☞ 'Dance and the performing arts in general may produce a form of mental satiety, either because of sensory overload or because of sensory deprivation.'

☞ 'If pleasure is contingent on psychological factors such as mental satiety, fatigue and arousal level and the degree to which people can cope with a task, then some spectators may not enjoy an evening performance of intellectually demanding piece, because they have difficulty following it.'

☞ 'Dance and theatre performances are created during the day by artists who are hyperalert and well prepared and are watched in the evening by a public that is tired from a long day at work.'

23

IT WILL END IN TEARS

Hable con Ella (2002), a film by Spanish director Pedro Almodóvar, opens with a scene from *Café Müller* by Pina Bausch. After about one minute and twenty seconds the movie cuts to the audience for a little less than five seconds to focus on the faces of the two men who will become the movie's male protagonists and who happen to be sitting next to each other. A minute or so later the movie cuts to the audience once more to reveal that one of the men, Marco Zuluaga as we will learn later on, is crying. The movie then briefly returns to the stage to show a close-up of a female dancer. In the next scene we see the other man, Benigno Martín, as he nurses a pretty girl, Alicia, a former dance student who has been in a coma for more than four years following a car accident, all of which will be revealed later in a series of flashbacks. He tells her about the performance, that the stage was filled with wooden tables and chairs, that two women in nightgowns entered, their eyes closed as if they were sleepwalking, that he was afraid they would hurt themselves and how suddenly a man appeared, with a sad face, the saddest face he has ever seen in his life and how this man pushed the furniture aside so that the women wouldn't bump into them. He tells her how several times during the performance the man sitting next to him, a forty-year old good-looking guy, cried out of emotion. 'You don't realize how moving it was,' Benigno says, 'there was a reason, it was so beautiful.'

Obviously, it is Marco who cries, not Darío Grandinetti who plays his character and of whose emotions we know nothing. As a matter of fact, the close-up of his tears may not even have been filmed during the performance and they may not have been real either. Even so, Marco may not have been the only person in the audience who was crying. It is not uncommon for people to cry when they finish a novel or experience something of dazzling beauty. But why do people cry when they are moved? And why do they cry when they see or hear something beautiful? Indeed, why do people cry at all?

23.1 THE BEHAVIOURAL NEUROSCIENCE OF CRYING

Crying is a curious phenomenon and the fact that people cry during a movie or a dance performance, even when they have seen it before or know how it ends, makes it even more curious. Sure, a movie may bring back memories of an emotional event, but when you remember something painful you don't feel pain and when you think of something disgusting you don't feel nauseated, at least I don't, and if you do I know some people who would love to scan your brain.

Crying can be scientifically defined as a secretomotor response whose most characteristic feature is the shedding of tears from the lacrimal apparatus. It may be caused by the irritation of the eyes, for example by a contact lens that has shifted behind an eyelid, and various emotional perturbations.[98]

Throughout history various theories attempting to explain the nature and origin of crying have been proposed. In *The Expression of the Emotions in Man and Animals* (1872) Darwin wrote that 'we must look at weeping as an incidental result, as purposeless (..) yet this does not present any difficulty in our understanding how the secretion of tears serves as a relief to suffering' (Darwin 2009: 163). The idea that crying offers relief constitutes the common sense view of crying. It is not quite clear though what might have caused Marco to be relieved during the opening moments of *Café Müller* nor why encountering a beautiful object might offer relief. Apart from that there is little empirical evidence that crying actually does offer relief (Rottenberg et al. 2008).

Crying has also been interpreted as a sign of defencelessness and helplessness, indicating a person's inability to cope with a situation (Frijda 1986). It may elicit sympathy, empathy, comfort and consolation from others and thus strengthen the social bonds between people. In line with this view Frijda (1989) has suggested that, when one perceives a work of art, 'one may cry because the character in the play lost her or his beloved, and one may cry because one witnesses perfect form, a perfect realisation of an idea.' This perfect form, as Frijda notes, is real: we have it right in front of us, even though we know that it is a product of the artist's mind. A work of art may thus remind us that perfection exists, that it is possible and attainable. We may not be able to achieve it ourselves, but we can witness it and thereby feel part of it. It may fill us with humility in the same way that looking up towards the sky on a clear night may make us aware of our own insignificance within the greater scheme of things. According to this view Marco may have recognized in *Café Müller* a form of perfection, although we would have to figure out what exactly this perfection might consist in. Feeling helpless and humbled his eyes spontaneously filled with tears.

The view that crying is a sign of defencelessness and helplessness is attractive, not in the least because it offers an answer to our original question. However, some studies report that people cry more often when they are alone than when they are in the company of others (Vingerhoets et al. 1997). One possible explanation for this finding is a cultural taboo on crying in public. As a consequence, when they are in the company of others, people conceal their emotions and cry less than they would if they were alone. Since Marco may have assumed that no one spotted him in the darkened auditorium he may have felt free to let his tears flow. It may also be that people are biologically disposed to cry more

[98] Infants cry when they experience pain, hunger or thirst, when their diapers are wet, when they sense the absence of a parent and when they are ill.

when they are alone so as to draw others near. From an evolutionary and developmental point of view this is an attractive idea. Babies who cried loudest may have been at an advantage in drawing the mother's attention. The behaviour may then have been retained in adulthood. It should be noted though that, like all evolutionary accounts in psychology, this hypothesis is necessarily speculative. According to this view, even though he would have been unaware of it himself, Marco's tears were a cry for consolation.

Paradoxically, crying accompanies two essentially contrary emotions. People cry out of sadness, because they have lost something precious or because their relationship has ended (Orbison 1961), they cry in situations of conflict and personal inadequacy, but they also cry with joy when they are reunited with a beloved person or upon accomplishing a longed for goal that required considerable effort. It might be argued that the situations in which people cry with joy are all different instances of helplessness in which a person does not know how to express his or her emotions, such as after winning a Grand Slam title or an Olympic gold medal. It might also be argued that tears of joy are not really caused by a positive appraisal, but instead reflect a delayed response to a negative appraisal. In this interpretation the tears at a reunion would substitute for the tears that were *not*, or not constantly, shed when the person was away, and the tears after a victory would reflect the hardships a person had to endure and the obstacles that had to be overcome in order to achieve the longed for goal. Perhaps this wasn't the first time Marco attended a performance of *Café Müller*, perhaps he was pleased to be able to see it again.

Vingerhoets et al. (2000) summarize the complex, heterogeneous nature of crying in a model, which views crying as the outcome of different appraisals (that a situation is threatening and that one cannot deal with it) associated with different situations (loss, rejection, reunion) and different emotional states. Whether or not a person will cry depends on a number of other personal, social and cultural factors (e.g. gender, age and the presence of others). However, like other appraisal models it only summarizes the contributing factors, it does not explain why people cry rather than tremble or sweat profusely.

To understand why people cry we would have to look into the neural correlates of crying. Unfortunately this is an even less researched area than the psychology of crying. The release of tears is controlled by the parasympathetic nervous system, a subdivision of the autonomic nervous system (☞ §19.1) and the lacrimal glands themselves are innervated by nerves originating in a section of the brainstem, that much is known. Beyond this stage all accounts become speculative. In recent years a number of neuroimaging studies used movie excerpts to elicit sadness in subjects, however since the reports do not tell us whether the participants actually cried they do not reveal anything about the neural correlates of crying.

Research into crying is guided by the notion that it is either caused by irritation of the eyes or by an emotion. It fails to consider the possibility that the release of tears may also be the physiological concomitant of an affective disturbance on par with the chills that some people experience at precise intervals in a piece of music. These chills may manifest themselves in the form of goosebumps, shivers running down the spine or indeed the spontaneous release of tears. Like a startle response these physiological responses are caused by an agitation and not by an emotion (☞ §17.1). It seems unlikely that people feel helpless at exactly the same moment whenever they listen to a song. It is far more likely that in this specific case the release of tears is a result of the build-up of a sense of anticipation and its subsequent resolution (☞ §15.4; §15.5). Indeed, perhaps it was the music that made Marco cry and not so much the dance.

23.2 CONCLUSION

Crying is a complex neurobiological phenomenon about which surprisingly little is known. The scientific study of crying out of emotion is complicated by the fact that people cry out of sadness and out of joy and by the fact that crying depends on various social and cultural factors. As far as I can tell Frijda (1989) has provided the only direct explanation of why people cry when they consider something beautiful. People may cry because of some unfortunate event that befalls a beloved character and because one witnesses perfect form. In the presence of perfection one may feel overwhelmed and not knowing how to express one's emotions one may feel tears welling up in one's eyes. I would like to speculate that, depending on the context, people may also cry because of the match between an internally generated prediction and the actual stream of sensory input of which the perfect execution of a movement would be a special case (☞ §15.4; §31.1).

It may also be that, because of its power to elicit an emotion or to bring forth tears, viewers who are deeply moved judge the object of their emotion 'poignant', 'compelling' or indeed 'beautiful'. And so an alternative explanation is that, in a Jamesian fashion, people do not cry because they consider something intensely beautiful, they consider something beautiful because it makes them cry, provided that it qualifies as an aesthetic object or event (☞ §29). Marco may have cried for all kinds of reasons. Since Benigno considered the performance beautiful he attributed Marco's tears to the performance rather than the cold draught in the theatre.

One of the principal theses of the present inquiry is that there is a dual relation between an observer's aesthetic experience and a work's aesthetic properties. An artist moulds the aesthetic properties of his or her work so that and until it produces the desired aesthetic experience. As I have argued, it follows that we may learn more about the nature of aesthetic properties by studying the components of aesthetic experience and that, conversely, we may learn more about the nature of aesthetic experience by studying aesthetic properties.

Instead of asking why people cry when they consider something beautiful we may therefore also ask what Pedro Almodóvar has done to make Benigno's assertion, that Marco cried because he considered the performance beautiful, acceptable to the audience.

The audience should understand that people sometimes cry when they see or hear something beautiful. It would have made little sense if Benigno had said something like 'it was so boring, the guy sitting next to me had to cry' or 'he cried, it was that appalling'.

The performance, the fragment and the way it was filmed were, of course, carefully chosen. Pedro Almodóvar could have picked any dance production. He could have opted for *Swan Lake*, which most people will recognize as classical ballet, or a work by Nacho Duato, at the time artistic director of Spain's Compañia Nacional de Danza or another production by Pina Bausch, such as *Sacre du Printemps*, which is usually performed in the same programme as *Café Müller*. He may have had an additional, more mundane reason for including the second fragment, which shows both dancers in full view. As a Pina Bausch fan he may have wanted to pay homage to her by including a close-up of her in his film, and at the time *Café Müller* and *Danzón* were the only two pieces in which she still danced herself. It is unlikely though that Almodóvar would destroy the opening scene of his movie just because he admired Pina Bausch. He needed Marco to be crying and he needed a ballet and a scene that would make it understandable to the audience that he was crying because he was moved and not because of a problem with his new contact lenses.

The film opens with a close-up of the face of an elderly woman, Malou Airaudo, her eyes closed, her right hand held more or less in front of her heart. She moves her head backwards and in a slow movement bows forward, bending her head so that her long hair falls across her face. She briefly covers her face with her right hand after which she holds her hand against her heart again. She turns to the right, the look on her face is dramatic, if not pained, and walks away, her arms stretched to the side of her body, the palms of her hands opened. After taking a few steps she bumps into a wall, which borders the left side of the stage. In the background another woman, also dressed in a nightgown, can be seen walking in the same manner.[99] The first woman turns around, leaning with her back against the wall, she gently turns her head to the left and to the right, still with her eyes closed and a pained look on her face, she sinks to the floor, then falls sideways, her arms and legs stretched. I should add that the average spectator seated in row 14 or 21 will not get this close-up view. Only cinema, photography and painting can highlight a facial expression this way and bring it up close. As a matter of fact, judging by the different angles from which we see them, in the scene in which the dancers fall to the floor the camera had to be on stage.

Almodóvar could have opened his film with another shot, he could have zoomed in on another part of her body, but as we saw above, facial expressions are instantly recognizable, though not necessarily identifiable, and inescapable. Faces also carry a stronger emotional

[99] The image of the two sleepwalking women with their eyes closed mirrors the two women in coma. The audience does not know this at this point and may not realize it either.

connotation than the legs or the feet.[100] The image therefore serves as a cue to the audience saying something like 'this is emotional' or even 'this is sad'. The ballet itself is also full of dramatic markers. The café in which the piece is set is deserted. The lighting is cold and clinical. The music, female arias from Henry Purcell's *The Fairy Queen* and *Dido and Aeneas*, are laments that speak of grief, despair, and unrequited love. The two women are dressed in nightgowns and dance with their eyes closed. Each element is a powerful emotion marker in itself. Smith (2003) argues that in movies such as *Raiders of the Lost Ark* different fear cues are combined to increase the viewer's state of arousal. In *Café Müller* different sadness and melancholy cues are combined into a hybrid assemblage. Because the cues are more abstract and less obvious than the spiders and the voodoo sculptures in *Raiders of the Lost Ark* they leave more room for interpretation and so not every person in the audience will be equally touched. To reiterate once more, emotions depend on an appraisal. Some spectators may just see six people moving around on a stage, while others may recognize in *Café Müller* a form of existential Angst and dismiss it for that. However, as I argued before (☞ §17.2; §18.2), even though one may not be moved oneself, one may understand that another person is.

And so, even though Marco's tears may have been brought on by an agitation rather than an emotion, to make the audience understand that he cried because he was affected by the performance Almodóvar had to fill the scene with *emotion* markers.

We are still left with one puzzle though. In the introduction to this chapter I observed that one of the main reasons people read a novel, watch a movie or attend a dance or theatre performance, is that it elicits a series of emotions. But why do people listen to a song or watch a movie that makes them cry? Why do they want to watch the same scene, movie or ballet again, even though it fills them with sadness? Surely, one would expect people to seek out stimuli that make them feel good?

I would like to propose four possible answers to this question. *First*, it might be argued that art engages us in an *as if* loop. It allows us to experience an emotion and afterwards to disconnect from the event that causes it. When the movie is finished we leave the cinema or turn off our DVD-player. The emotions one experiences while watching the movie are no less real for that, but the events that elicit them have no further consequences. *Second*, people may recognize the pattern in their own sense of anticipation and take pleasure in the controlled release of an emotion. People may even be disappointed if a movie or a dance performance they once considered moving, fails to touch them when, several years later, they see it again. *Third*, art shows a form of closure that is often missing in real life, in which people just leave or pass away. As such art can offer hope, because it reminds us that a happy ending is possible. *Finally*, art can offer consolation by reminding us that we are not alone. Even though the characters in a work of fiction are imaginary, the fact that they

[100] A camera man or a photographer recording a bharata natyam dancer might take a close-up of her richly decorated feet. In ballet and modern dance the hands and feet are rarely choreographed, they are mere end points of the body.

exist as fictional characters is enough to show the possibility of other people like us, if only because someone must have imagined them as they are.

And so, even though he had been crying during *Café Müller* and perhaps because he had just lost a close friend, Marco felt compelled to attend another performance by Pina Bausch. Sure enough, at the start of the performance he wipes the tears from his eyes, perhaps he is reminded of the last time he sat there next to Benigno, perhaps he is moved by the dance, which, as I'm sure you will understand by now, is another carefully chosen fragment[101], but this time Almodóvar may not only have wished to make it understandable to the audience why Marco cried, he may also have wished to bring the audience to the verge of tears.

23.3 POSTSCRIPT

Towards the end of *Hable con Ella* we learn that Benigno has had sexual intercourse with Alicia while she was lying in a coma. He is dismissed from his job at the hospital and sent to prison to await his trial. There he collects sleeping pills in order to get into a coma so that he can be united with Alicia. Instead of getting into a coma he dies of the overdose. In one of the movie's final scenes a weeping Marco stands at Benigno's grave. 'Alicia lives', he says, and Benigno 'woke her up'. The movie ends as it started, with Marco sitting in the audience during a performance of a production by Pina Bausch. We first see a full frontal close-up of Alicia's face and then Marco's head filmed from behind as he wipes the tears from his eyes during the performance's opening scene. During the interval Marco and Alicia exchange a few words. In the movie's final scene the dancers enter the stage in couples. Now there is a slight smile on Marco's face. He looks back at Alicia, who is sitting two rows behind him next to her ballet teacher. Quite miraculously the seat that separates them is unoccupied. A light lights up her face. She smiles back at him, as the words 'Marco y Alicia' (Marco and Alicia) are projected onto the screen. These words suggest a union of Marco and Alicia, which was perhaps already announced by the entrance of the dancers as couples.

Of course, Benigno's intention to get into a coma so as to be united with Alicia is romantic nonsense and the notion that he 'woke her up' is distasteful and offensive. The favourable, but unintended consequence of a morally wrong action cannot serve to justify the action. Benigno sexually abused a woman who was in a coma and who he was trusted to take care of. Marco's tears, his monologue at Benigno's grave and the movie's ending turn Benigno into a martyr and lead the audience to get emotionally involved with Alicia's miraculous resurrection and to forget the wrongful deed that preceded it. The audience's emotional response stands in the way of a critical appraisal of the film's plot structure and questionable ethical premise. There are no signs that Almodóvar wants the audience to

[101] It's the second scene from *Masurca Fogo* (1998).

adopt a critical distance and, in a Brechtian fashion, wants them to become aware of how they have been carried away by his craftsmanship as a director.

Like many other movies *Hable con Ella* offers a severe misrepresentation of coma and awakening (Wijdicks and Wijdicks 2006). Alicia has been in a coma for more than four years at the moment of the movie's principal action. Yet within weeks of awakening she can walk again, albeit with crutches. She does not show any signs of further cognitive impairments or any negative effects of the accident that caused her to get into a coma. While she is in a coma she is depicted as beautifully groomed, she does not have muscle atrophy, her eyes are closed as if she were asleep even though patients in a coma frequently have their eyes and mouth open and seem to gaze into space. This misrepresentation may promote a misperception of coma and the chances of a successful recovery, since cinema portrayals may be a primary way in which viewers are confronted with comatose states.

The targets of my criticism are all directorial decisions. Almodóvar wanted the audience to feel a certain way and to that end he manipulated every aspect of the movie until it had the desired property (☞ §30). I can understand the possible reaction to my criticism. It's only a movie and we should grant artists the artistic licence to do what they want. *Hable con Ella* is a work of fiction. It is not a documentary and not meant to be a scientifically faithful representation of coma. But that is too easy. There are artistic and narrative opportunities in an accurate depiction of a comatose state as well.

Hable con Ella is full of scenes that, when looked at from a critical distance, seem rather silly, to say the least. In one scene, when he is alone in his apartment, Marco's cell phone sounds a text message alert. Marco looks at it and says out loud: 'a message'. I don't think anyone who is alone in his apartment says 'the telephone' when the telephone rings or 'the doorbell' when the doorbell rings. The statement has been included to inform the viewer of what is already obvious, yet I doubt whether many viewers will notice anything odd about this particular scene. The scene in which Marco hails a taxi, rushes to the prison, storms up the stairs to the office of the director and reads Benigno's farewell letter is equally ridiculous, but it works. It works, because each element has been carefully crafted to manipulate the viewer's emotional response. As we have seen emotion may override reason, which is why viewers may fail to notice that the scene doesn't make a whole lot of sense.

Movies, novels and dance and theatre performances are part of the world in which we live. As such they condition us, they provide us with paradigms and schemas, which become part of the general framework within which we interpret the world and the people around us. There is a constant interplay between art, culture and the mind. Works of art are products of the mind, but they also shape the way we think and feel. Understanding how art hijacks our mental capacities is therefore of critical importance. Art is too important to be left to artists alone.

KEY POINTS

- ☞ 'Crying is a complex neurobiological phenomenon about which surprisingly little is known. The scientific study of crying out of emotion is complicated by the fact that people cry out of sadness and out of joy and by the fact that crying depends on various social and cultural factors.'

- ☞ 'Crying can be regarded as the outcome of different appraisals and is associated with different situations and different emotional states. Whether or not a person will cry depends on a number of other personal, social and cultural factors.'

- ☞ 'When one perceives a work of art "one may cry because the character in the play lost her or his beloved, and one may cry because one witnesses perfect form, a perfect realisation of an idea" Frijda (1989).'

- ☞ 'The reasons people listen to a song or watch a movie that makes them cry are fourfold. *First*, art engages us in an *as if* loop. It allows us to experience an emotion and afterwards to disconnect from the event that causes it. *Second*, people may recognize the pattern in their own sense of anticipation and take pleasure in the controlled release of an emotion. *Third*, art shows a form of closure that is often missing in real life. As such art can offer hope, because it reminds us that a happy ending is possible. *Fourth*, art can offer consolation by reminding us that we are not alone. Even though the characters in a work of fiction are imaginary, the fact that they exist as fictional characters is enough to show the possibility of other people like us, if only because someone must have imagined them as they are.'

- ☞ 'Understanding the emotions not only helps the orator to prepare his speech, the director to direct his film, and the choreographer to choreograph his ballet, it also helps the audience to see through the strategies used by artists and advertising agencies to manipulate the viewer or reader.'

Part 5

Understanding

24

INTRODUCTION

We often finish reading a novel or watching a movie or a dance performance thinking that we know what it was about. We understand that Edmond Rostand's *Cyrano de Bergerac* (1897), Victor Hugo's *Notre-Dame de Paris* (1831) and Goethe's *The Sorrows of Young Werther* (1774) are stories of unrequited love. We understand that *Once Upon a Time in the West* (1968), *Kill Bill* (2003) and *Oldboy* (2003) are about revenge and that *Swan Lake* has something to do with swans. It also happens from time to time that we leave the theatre or the cinema wondering what we have just watched. The ending of *Caché* (Hidden) (2005) by Michael Haneke left many people puzzled, but of course, this may well have been the artist's intention. And sometimes there simply isn't much to understand. William Forsythe's *In the Middle Somewhat Elevated* (1987) isn't about anything: it's just 25 minutes of exhilarating dance. But what do we understand when we say that we understand a novel, a movie or a ballet? And where does this understanding come from? How does it emerge? And what happens inside our mind when we try to understand something?

Understanding is commonly taken to refer to the process by which what was obscure becomes intelligible. To understand something means to see things more clearly and to be able to integrate it into a larger frame. As the German philosopher Hans-Georg Gadamer observes in *Truth and Method* (1960), following Heidegger's analysis in *Being and Time* (1927), understanding may also refer to the acquisition of the ability to exercise a practical skill. Understanding a game means knowing how to play it; understanding a theory means knowing how to apply and reproduce it. According to Gadamer understanding carries another connotation, that of coming to an agreement (Gadamer 2004: 180). This notion derives from Gadamer's model of understanding as a dialogue or conversation. When we understand another person there is no longer any gap, any friction, between us and the other person concerning the matter at hand. The same can be said of understanding a text or a work of art.

What matters in understanding, according to Gadamer, is not so much the author's original intention but the subject matter. Gadamer does not deny that there are different modes of understanding. For example, one can understand a text as a document of its time or as an expression of the author's state of mind. Knowing that Jiří Kylián created *Heart's Labyrinth* (1984) shortly after one of the dancers in the company had committed suicide one can understand it as an expression of Jiří Kylián's emotions. However, Gadamer maintains that understanding is first and foremost guided by the subject matter. When trying to understand something one's first inclination is to try and understand the matter at hand, it is only at a later stage that one may look for a different understanding.

As Gadamer doesn't fail to emphasize we always already have a prior understanding of every object we encounter and of every situation we find ourselves in. When watching a dance performance, as opposed to watching the pedestrians at a railway station, we know that it might have a symbolical meaning. We can, of course, also interpret the pedestrian flow – if people are running up the stairs it might indicate that a train arrives at a different platform – but this interpretation, too, is contingent on a prior understanding of people's behaviour at railway stations.

Understanding is an ongoing process that is never completed. It is always provisional and subject to revision and refinement. Historians and economists are still trying to understand the causes of the industrial revolution and literary theorists still pour over James Joyce's *Ulysses* (1922). Understanding can be the result of a long conscious thought process and it can just happen out of nowhere. Years later one may suddenly understand that scene in *Palermo, Palermo* (1989) by Pina Bausch or the ending of *Quintett* (1993) by William Forsythe.

What we do when we understand or try to understand something is to bring it under a concept. This is why, according to Gadamer, understanding is fundamentally linguistic in nature. As he writes, 'the way understanding occurs – whether in the case of a text or a dialogue with another person who raises an issue with us – is the coming-into-language of the thing itself' (Gadamer 2004: 371). In *Sarcasmen* (1981) by Hans van Manen we don't just see a man and a woman going through some movement variations, we see a relationship unfold. In seeing the actions on stage as a relationship we bring it under a concept. At first the man is trying to impress the woman, who just stands there watching while the man performs an elaborate solo, then the roles are reversed and the woman shows that she can do that too. In the ensuing duet both partners are well matched, which is perhaps most clearly visible in the scenes in which they hold hands and lean backwards, thus keeping each other in balance. Of course, this is just my interpretation, another person may have a different interpretation, but the process whereby each person arrives at his or her interpretation is the same. I should add that I find some of the mimetic movements a bit banal, precisely because they are instantly recognizable.

Understanding a novel, a movie or a dance performance comes down to articulating its meaning. This is also what Wittgenstein suggested when he remarked that, 'meaning is what an explanation of meaning explains' (Wittgenstein 1974: 59; 69). One can express one's understanding in a single sentence and one can couch it in an essay, if that's what it takes to articulate all of one's thoughts. It is not necessary to actually give voice to one's understanding though. All that matters is that one is capable of doing so by whatever means. In trying to explain oneself one is not bound by words either, one can also draw a diagram or resort to gestures.

Neither Wittgenstein nor Gadamer was concerned with the cognitive underpinnings of understanding, let alone its evolutionary origin. Indeed, Wittgenstein (2005: 251e) states explicitly that the psychological process of understanding simply doesn't interest him. What we would like to know is how we arrive at an understanding, how we make the leap from observing something to grasping its meaning. Before I delve into this question I will first address the related issue of the relation between dance and language. It is often said that dance is a form of language; that it is the 'true' language; that it speaks to us directly and so on. I will analyse this claim drawing on recent insights from cognitive linguistics, which studies the ways in which features of language reflect other aspects of human cognition. As a corollary I will show how the analytical tools with which language can be analysed can be put to artistic use as instruments of choreographic creation. In a long chapter I will analyse whether dance and language share the same cognitive and neural infrastructure and engage in a bit of speculation about the evolutionary origin of dance and language. These two chapters set the stage for the final chapter of this section in which I will address the question of how one may grasp the meaning of a gesture, a scene and an entire ballet.

25

DANCE AND LANGUAGE

There is a long history of comparing dance to language. In one of the oldest discourses on dance Plutarch (46-120 CE) wrote that 'we may aptly transfer what Simonides said of painting to dancing, and call dancing mute poetry, and poetry speaking dancing' (Plutarch 1909). In his treatise on sixteenth century renaissance dance, first published in 1589, the French cleric and dance theorist Jehan Tabourot, writing under the name Thoinot Arbeau, wrote that 'most of the authorities hold that dancing is a kind of mute rhetoric by which the orator without uttering a word, can make himself understood by his movements' (Arbeau 1966: 16). Three centuries later the French poet Stéphane Mallarmé (1842-1898) declared that, '[the ballerina] writing with her body, suggests things which the written word could express only in several paragraphs of dialogue or descriptive prose. Her poem is written without the writer's tools' (Mallarmé 1983: 112). The twentieth century philosopher R.G. Collingwood (1889-1943) even went so far as to argue that all kinds of language have a relation to bodily gesture – painting, drawing and music, for instance, imply the movements of the artist's or musician's hand – and that 'in this sense it may be said that the dance is the mother of all languages' (Collingwood 1958: 244).

Various authors have contemplated these claims, arguing that, no, dance is not a language (e.g. Sparshott 1995), or that yes, we can meaningfully compare our understanding of dance with our understanding of language, as long as we abstract from the natural language analogy (e.g. McFee 1992). The fact that for centuries scholars have compared dance to language suggests that there may be good reasons for doing so. As we shall see there are equally good reasons for rejecting any comparison between dance and language.[102]

25.1 DANCE AND THE LANGUAGE METAPHOR

When analysing the parallels between dance and language we would need to explain what we mean both by 'dance' and 'language' and make explicit the nature of the connection we are trying to make. Are we talking about natural languages or about a formal language in the mathematical sense? And when we talk about dance do we mean dance as an art form or any form of dance?

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[102] An earlier and much shorter version of this section was published as Hagendoorn (2010).

It could of course be that, when dance is referred to as a language, language is merely used as a metaphor just as when we speak of the language of love or the lost language of cranes. But that begs the question. Why not say that dance is geometry in the flesh or that it is architecture in motion? Why not say, as the eighteenth century French choreographer and dance theorist Jean-Georges Noverre wrote in his *Lettres sur La Danse et sur Les Ballets* that, ‘a ballet is a picture, or rather a series of pictures connected with the other by the plot which provides the theme of the ballet’ (Noverre 1983: 10)? Indeed, why not say that dance is like cooking without food? After all, a choreography is a recipe for the organization of one or several bodies in space and time.

As George Lakoff and Mark Johnson argue in *Metaphors We Live By* (1980), metaphors highlight some aspects of our experience while masking others. Each of the above metaphors makes sense, although some more than others, because each highlights a different aspect of dance. The language metaphor highlights the fact that dance employs gesture to express and communicate intention and emotion. People gesture when they speak, raise their fists in anger, shrug their shoulders in doubt, frown upon a question, jump with joy and use elaborate body movements to make themselves clear when misunderstood. Dance may then be regarded as an exaggerated or derivative form of body language in which gestures are intensified, elaborated and taken out of their usual context and in which the number of gestures is greatly expanded. Of course, when dance is described in terms of body language we merely replace one metaphor with another, but if language is fundamentally metaphorical we will be haunted by metaphors no matter what we say.

The language metaphor is not just confined to the word language as such, but includes the use of language related notions such as speaking, writing, words, phrases, vocabulary, grammar, syntax, poetry and so on, each of which draws attention to a specific analogy. Thus, when dance is referred to as poetry in motion or the poetry of human motion, what the author or speaker may mean is that dance is to ordinary movement as poetry is to everyday speech or that dance is to mime as poetry is to prose.

It is not just language that is used metaphorically; dance and choreography are sometimes used in a metaphorical sense as well. Flocks of birds, schools of fish and pedestrian flows, for example, are often referred to as exhibiting an intricate choreography. In this case the term choreography is appealed to because the observed pattern of collective motion looks as if it were controlled by a higher-order external agent. In his book *The Dance Language and Orientation of Bees* (1965) the biologist Karl von Frisch even merged dance and language into a single metaphor to describe the behaviour of bees.

To further substantiate the analogy between dance and language one could also refer to sign languages, which are full-fledged languages with a grammar, a syntax and a vocabulary. Since in dance not every movement has a meaning one might say that dance is somehow ‘less full-fledged’ than sign language. One might also say that the use of movement in dance is poetic in the same way as the use of words and phonemes in *The*

Jabberwocky by Lewis Carroll. It is worth pointing out that some choreographers have employed phrases in sign language for their visual effect, for example, Pina Bausch in *Nelken* (1982) and Jiří Kylián in *As If Never Been* (1992). While this doesn't prove anything it does explain why the analogy between dance and language endures.

Language itself has different meanings depending on the context in which it is used. We speak of natural languages, but also of programming languages like C++, Perl and Java and this provides us with another sense of the language metaphor. Although one cannot translate everyday language into a programming language like C++, code written in one programming language can, in principle, be translated into another programming language. The code itself expresses an algorithm that specifies the behaviour of a computer. If choreography is viewed as a set of instructions that specifies the actions of the dancers, we might therefore similarly speak of a certain choreographer's choreographic language.

25.2 VOCABULARY, PHRASES AND SYNTAX

In dance terminology movement sequences are often referred to as phrases, while the collection of individual positions and movements is referred to as a vocabulary. As the American choreographer Doris Humphrey (1895-1958) wrote in her book *The Art of Making Dances* '[a] good dance should be put together with phrases, and [a] phrase has to have a recognizable shape, with a beginning and an end, rises and falls in its over-all line, and differences in length for variety' (Humphrey 1959: 68). A dance phrase is therefore more than a mere sequence of movements. It has a structure, a beginning and an end.

The classical ballet vocabulary is a prime example of a dance vocabulary. It consists of numerous movements and positions, which can be combined in an infinite number of ways, although various rules restrict the ways in which movements can be performed, just as the rules of grammar limit the number of correct phrases in English and other natural languages. Thus, a *battement*, which can be described as a kicking or beating movement of the working leg, is performed in front, to the side or to the back of the body, but never diagonally. The rules of ballet, what we might refer to as its grammar or syntax, are largely implicit. They are handed down from teacher to student and determine what is 'proper' ballet. Teachers correct their students if their *épaulement* is wrong and when they themselves become teachers the students will do the same.

Equally extensive but less known dance vocabularies can be found in the traditional Khmer dance from Cambodia (Cravath 1986) and Balinese dance (Davies 2007). Breakdance, too, consists of a set of movements that every b-boy knows by heart and that make it directly recognizable as breakdance.[103] Indeed, some moves are so characteristic of breakdance that incorporating them into a modern dance performance may look contrived.

[103] E.g. toprocks, floor rocks, flares, windmills, freezes, spins, handhops and so on.

Perhaps the oldest and most elaborate dance system is the classical Indian dance form *bharata natyam* from Tamil Nadu, a state in the South-East of India, which was first described in the ancient Sanskrit text Natya Shastra, dating back to between 200 BCE and 200 CE. There is some debate among dance scholars as to the authenticity of what is today known as bharata natyam. What is beyond dispute, though, is that there *is* a tradition, which goes back many centuries. The dance was originally performed by temple dancers, so called *devadasis*, and accompanied by music and lyrics, but the practice was banned by the British colonizers towards the end of the nineteenth century in an effort to 'civilize' Indian women. Around the 1930s there was a resurgence of interest in bharata natyam and various efforts were made to revive the tradition. These efforts involved a re-construction, a re-naming and a re-situation, as the dance was moved from temples to theatrical stages, as well as a re-population, as the dance was transferred from one social class to another (Allen 1997). Bharata natyam today is a living art form. There are various styles and traditions and any account depends on the dancer or *guru* consulted.

The basic element of bharata natyam is the *adavu*, a composite movement in which the torso, arms, hands, legs and feet move in a coordinated pattern. A series of adavus can be combined to form a phrase called *jathi*. The adavus can be punctuated with a number of expressive hand movements, the *hastas*, performed with either one or both hands. Additionally, there are a number of head, neck and eye movements, the *bhedas*, as well as a number of transitional movements of the whole body called *karanas*, which are usually maintained for a fraction of a second, contributing to the characteristic, slightly staccato look of bharata natyam. Even though some of the hastas are mimetic – a diagonal top-down zigzag movement of the hand depicts lightning, making waves with the hand depicts a river and so on – bharata natyam is different from mime in that movements can also be used symbolically. A sudden release of the head and arms may symbolize death and a stretched arm drawing the upper half of a large circle may stand for heaven. What is more, the same gestures that refer to an object – a bee, the moon or a lotus flower – can also stand for longing, anger and so on, just as the words in written and spoken language can be descriptive as well as metaphorical.

There are two basic strands of bharata natyam: *nritta* and *nritya*. Nritta is abstract in that it is performed solely for the pleasure of movement. The dance is an end in itself and the dancer is free to play with the rhythm of the music and the various adavus, hastas and bhedas. In nritya the dance is representational and built around a theme, usually a legend from Indian mythology. The dancer still has a certain degree of freedom to interpret the music and use different gestural metaphors to convey the story, but the dance is bound by a narrative structure. As in ballet there are numerous implicit rules. For example, bharata natyam is performed standing up, with a straight spine and a left right balance is respected throughout the dance, meaning that if a movement is performed with the left arm or leg, the same or a balancing movement is performed with the right arm or leg, or so my *guru* told me.

While the analogies between dance and language are striking, especially in the case of bharata natyam, there are also numerous disanalogies (Sparshott 1995: 253-58). For one thing, dance is tied to the body. Whereas language can be spoken or written down without altering its content, dance can only be danced. Of course, dance can be recorded on video and it can be notated, but what makes dance into dance is the presence of a physical body. As also pointed out by Sparshott (1995: 253) language is essentially linear. By contrast, dance may consist of several independent movements performed simultaneously by any number of people. Furthermore language has tenses, nouns, verbs, adjectives, particles and so on for which there are no obvious equivalents in dance.

However, now that the full extent of the diversity in the world's languages is becoming clear many arguments against viewing dance as a language, which implicitly take English or another modern European language as a point of reference, no longer hold. It is true that dance doesn't have tenses and pronouns, but neither does each and every language. Indeed, the diversity in the world's languages is so great that the existence of language universals, once the principle axiom of linguistics, has become a matter of contention (Evans and Levinson 2009). Instead of comparing a particular form of dance and a particular language, we should therefore look at the structural similarities and differences between dance and language.

Following Jackendoff (2002) we might say that, in the terminology of linguistics, in dance too there are *formation rules*, which determine how individual movements can be recombined; *derivational rules* or *transformations*, which determine how a string of movements can be altered while leaving its structure intact; *constraints* in the form of anatomical and aesthetic restrictions, which limit the number of configurations that can be made; and a *lexicon* of movements, which varies from one dance form to another. An example of a derivational rule would be a left – right reversal, which leaves the structure of the movement sequence intact, but changes its orientation. The best *counter*-example for the existence of formation rules in dance is the work of Merce Cunningham, who liked to use chance operations to determine the order of movements.

In summary we might say that, despite numerous differences at the level of natural languages, at a more abstract level of combinatorics there is a clear analogy between dance and language. However, grammar and syntax are only one aspect of language. For a complete comparison we also need to consider semantics.

25.3 REFERENCE, TRUTH AND FUNCTION

Legend has it that the American author Ernest Hemingway once won a bet with a short story consisting of only six words: 'For sale: baby shoes, never worn.' Regardless of its origin it is a perfect example of what has become known as flash fiction. It illustrates the power of words to bring into being an entire world and to evoke a range of emotions. Upon reading the line 'For sale: baby shoes, never worn' you instantly understand the tragedy behind those six words. A speaker may add some drama to his or her delivery by pausing just a little bit longer than necessary at the comma after shoes, but the story's emotional impact depends first and foremost on the meaning of the words and the syntactical structure of the sentence, not on the typeface, the font size or the speaker's intonation. When translating the story into another language its meaning may be lost, because speakers of an indigenous language from New Guinea may be unfamiliar with the concept of baby shoes or the legal transfer of ownership involved in a trade, but that does not alter the fact that, in principle, the story can be translated into any other language. It is, however, impossible to translate it into music, dance, architecture or perfume without losing its content, that is, without losing what the story is about.

One of the primary differences between literature, music, dance and architecture is that literature has propositional content, whereas dance, architecture and music, or at least instrumental music, do not. The statement 'For sale: baby shoes, never worn' has meaning and is either true or false. Someone interested in buying the shoes might inquire about their colour, only to learn that they have already been sold. The statement would thus cease to be true, since the shoes are no longer for sale. However, dance, music and architecture do not communicate propositions that can be true or false. A ballet teacher may correct a student if her *port de bras* is wrong and a performance can be wrong if a dancer turns right instead of left, but that doesn't make the phrase, the sequence of movements, false. A choreographer can choreograph a dance phrase, but he cannot choreograph another phrase that negates it. An architect can make a statement with a bold building proposal, but that doesn't mean that the building is true. Music can depict or evoke a scene or a series of events, such as Claude Debussy's *La Mer* (1905), but it cannot refer to an object or denote a concept the way a word does. I am aware that, in the sense of Heidegger or Adorno, a work of art can be seen as manifesting its own 'truth', precisely because there are no criteria to determine its truth or falsehood by, but in the ordinary sense of the word it still would not make sense to say of a piece of music or dance or a work of architecture that it is true.

The differences between dance and language do not stop here. Whereas two speakers can argue and come to an agreement, two dancers can at best converge upon a sequence of movements that flows nicely, feels good or is aesthetically pleasing. Dance can tell stories, as in bharata natyam, but it cannot be used to gossip or to pass on knowledge about another subject. There are no proper names in dance. There are no equivalents in dance either of first-order logic and you cannot solve differential equations in dance. The same can be said of the gestures that are often referred to as body language, which for that reason doesn't constitute a language proper either.

Language theorists tend to be obsessed with declarative sentences and their truth-value, but as Jackendoff (2002: 328) notes, there is more to language than simple assertions. We ask questions, make requests, formulate problems and give orders. We acknowledge, threaten and make promises all by uttering a few words. We may let $x = 4y$, offer to take a break, give instructions as to how to proceed and, delighted by an exhilarating dance performance, exclaim that it was great! It is hard to think of equivalent phrases in dance that perform the same function.

This is not to say that dance cannot have meaning and tell stories, it can, but it does so by other means than language. To convey a story in dance one would have to enact it. In doing so one could imitate perceptual features of the actions relevant to the story and one could employ iconic gestures with a known meaning. As we saw in the previous paragraph bharata natyam is one of a small number of ancient dance forms in which single movements are endowed with meaning and in which entire stories can be enacted.[104]

There is, however, a limit to the kind of stories that can be enacted in dance. Dance exists in the present. It conveys whatever meaning it has directly. To refer to an angry person one would have to express anger, to refer to a fight one would have to take on a fighting pose. One could enact a historical fight, but it would take place in the present. Language allows us to transcend the here and now. It can refer to objects and events in another place and time. It can refer to absent, non-existent and imaginary objects and it can evoke abstract concepts such as space, time, negation and contradiction, all of which lies beyond the scope of dance.

25.4 CONCLUSION

Throughout history various authors have drawn attention to the analogies between dance and language. This chapter has examined the merits of this analogy taking into account recent insights from linguistics. In so far as language is used as a metaphor it highlights various surface similarities between and dance and language. There are, however, also structural similarities between dance and language. At a high level of abstraction in each natural language there are formation rules, derivational rules, constraints and a lexicon. The same concepts can also be applied to the analysis of dance. At a formal level of sentence construction the analogy between dance and language can therefore be sustained. The analogy breaks down at the level of meaning, reference, truth and function. To put it differently, at the level of syntax there is a clear analogy between dance and language, at the level of semantics dance and language differ.[105]

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[104] With respect to the ability to tell and read stories in bharata natyam I rely on reports by individual dancers. I have been unable to find a systematic study that puts side-by-side one dancer's intention and another dancer's understanding for a number of legends.

[105] The German dance theorist Rudolf von Laban similarly asserted that, 'although it is obvious that the words and phrases of the language of movement (for so the shapes and rhythms of dance may be called) have no determinable verbal meaning, they are nevertheless subject to an ordered principle, viz., the balanced flow and harmony of movement' (Laban 1956: 16).

25.5 COROLLARY: TOOLS OF ANALYSIS AS TOOLS OF CREATION

The development of transformational generative grammar by Noam Chomsky revolutionized the study of linguistics, introducing a series of concepts that allowed language to be studied as a formal system. The same theoretical apparatus can also be applied to dance, but since dance performances usually last 20 minutes or longer and feature multiple dancers, its use is limited to simple and stable systems, such as the indigenous dances studied by dance anthropologists (Williams 2004). The tools of linguistics can also be put to artistic use, that is, they can be used not to describe, but to create.

In mathematics a formal language is defined as a set of strings from an alphabet. A string or word is a finite sequence of symbols from an alphabet. An alphabet is a finite set of symbols and a symbol is an abstract entity that has no meaning by itself. We can also define a grammar $G = (V, T, P, S)$ with V a set of symbols called variables, T a set of symbols called terminal, P a set of productions and S the starting or goal variable from V.

The beauty of this formal approach is that it doesn't matter what we take as symbols. For example, we could define a set of movements as our symbols and a production 'concatenate', which creates a string, that is, a sequence of movements from our alphabet. We could also define a production called 'combine', which combines two or more movements from our set into a composite movement (think of moving the arm while walking). Another production might be 'transpose'. Taking advantage of the bilateral symmetry of the body, if a movement is defined for the right arm, 'transpose' transforms it into a movement of the left arm. In case you wonder, I do indeed use these operations in my own work. Another operation that I have found very useful is 'reverse', which takes a movement and runs it backward.

When defining our own generative dance grammar along these lines at some point we may encounter problems that will challenge our creativity. We may, for instance, run into some anatomical constraints. And does a movement from our alphabet have the same beginning and end point? What if we take a movement such as 'raise arm above head' as a symbol? The arm will remain raised above the head until another operation is applied to it. But, since we are now artists, we can bend our self-defined rules to fit our artistic purposes.

For *Self Meant to Govern* (1994) and *Eidos:Telos* (1995), of which *Self Meant to Govern* is now the first part, William Forsythe created a lexicon of about 130 movements. In this lexicon every letter of the alphabet stands for one or several words, such as 'brick', 'bottle', 'oyster' or 'zebra', each of which refers to a movement sequence. The movement sequences were choreographed by Forsythe in collaboration with the dancers and were improvised around the words. Thus 'shower' might take some movements from the shower scene in *Psycho* and 'pizza' might be improvised around opening a pizza delivery box, sticky cheese and so on. Once defined these movement sequences became the building blocks for the piece. During the performance the dancers could perform the movement sequence connected with the word ‘pizza’ and subsequently perform ‘atlas’, which begins with the last letter of the previous word or they could perform ‘honey’, because it also consists of five letters or because, like pizza, it is food. The dancers could also notice that, while performing one movement sequence, say, ‘wallet’, the elbow and knee might be in the same configuration as in another movement sequence, and then continue with this movement. In this case the overlapping body positions create a bridge between two remembered movements. Additionally, the dancers could transform a movement sequence using one of the many dance improvisation techniques Forsythe has developed over the years. During the actual performance clocks, with letters instead of digits, were dispersed across the stage and, invisible to the audience, banners with the names of the various improvisation techniques were displayed on both sides of the stage. The dancers navigated through this high-density information environment taking cues from the clocks and, armed with a shared language, from each other. The audience, unaware of the concepts that informed the piece, created its own blends of dance and music.

In my own work I have taken both of these ideas into different directions, while adding some ideas that I borrowed from linguistics and cognitive science. I have created a vocabulary of everyday movements, which the dancers know by heart because they are already part of everyone’s motor repertoire (☞ §3.2.2). In addition I have created an ever-expanding collection of choreographed phrases or schema assemblages, which can be taken apart and recombined into new configurations. All choreographed duets, trios and other group scenes are rehearsed such that every dancer can perform each part. I have also defined a set of improvisation techniques that can be used to generate novel movements or transform pre-rehearsed movement sequences. Additionally, I have developed a number of techniques that describe spatial and temporal dynamics and the interaction between dancers. Finally I have developed a sign system, incorporated into the dance, which the dancers use to signal to another dancer that they intend to initiate a duet or trio. The other dancer can accept the invitation with another sign. Introducing these signs was necessary because a dancer might lose his or her balance if he or she needs support and the other dancer pulls away. The dancers can use the entire action vocabulary and all improvisation techniques at all times. An individual piece acquires its identity from the choreographed phrases and the choice of music, the costumes and the stage and lighting design.

In *Field Study No. 1* (2009), a choreographic installation for a gallery space, I have adopted the concept of conceptual integration (☞ §27.4), or rather the basic scheme in figure 27.1, as a construction technique. I have always wondered how large-scale installations such as those of the American artist Jason Rhoades, whose work I greatly admire, were actually set up and wished that the construction process were not hidden from public view. This idea became the starting point for the piece. During the performance the dancers build an installation out of a collection of found objects, which can be viewed as such after the performance. The piece is based on a number of concepts, such as ascending and descending order, metaphor, stacking, aligning, gathering, folding and inserting, which are applied to the objects. Thus all of the dancers' actions, in so far as they involve an object, are systematic and, in principle, reproducable. The connections between the objects give rise to a rich field of associations and conceptual blends. The intermittent dance movements derive from the objects and their interrelations through various direct or metaphorical operations.

KEY POINTS

☞ 'In dance, as in language, there are formation rules, derivational rules, constraints and a lexicon.'

☞ 'Metaphors highlight some aspects of our experience while masking others. The language metaphor highlights the fact that dance employs gesture to express and communicate intention and emotion.'

☞ 'At a formal level of sentence construction dance and language share many characteristics. The analogy breaks down at the level of meaning, reference, truth and function.'

☞ 'The tools of linguistics can also be put to artistic use, that is, they can be used not to describe, but to create.'

26

DANCE AND THE LANGUAGE FACULTY

The similarities *and* differences between dance and language raise the question of whether dance and language might have a common evolutionary origin and share the same cognitive and neural infrastructure. Is dance cognitively related to the capacity for language? Does it build on an evolutionarily more ancient language capacity? Did language, dance and perhaps music, have a common evolutionary origin and did the evolution of dance and language move in separate directions with the emergence of speech and with story-telling taking over the role of mime? In order to analyse these questions we will have to weave together two stories: the evolution of dance and the evolution of language. Doing so in little more than a few pages will require a few shortcuts. I should add in advance that the present account is highly speculative and no doubt it will raise more questions than it answers.

26.1 FROM ANIMAL PLAY TO HUMAN DANCE

Throughout history various authors have proposed that the arts originated in play. In *On the Aesthetic Education of Man in a Series of Letters* (1795) the German playwright and poet Friedrich Schiller (1759-1805) argued that art is the product of a play drive (*Spieltrieb*), which reconciles the sensuous drive (*Sinnestrieb*), which stands for man's material nature, and the form drive (*Formtrieb*), which stands for reason. Johan Huizinga, the great Dutch cultural historian who coined the term *homo ludens*, regarded play as one of the defining characteristics of modern human beings. Huizinga's objective in his book *Homo Ludens* (1938) was not to study play alongside other cultural expressions, but to investigate the extent to which culture itself is characterized by play. As Huizinga points out, play is older than culture, since culture assumes a form of society and 'animals have not waited for man to teach them their playing' (Huizinga 1971: 1). Huizinga observed that of all the arts the element of play is still most evident in dance. As he wrote, 'the connections between playing and dancing are so close that they hardly need illustrating. It is not that dancing has something of play in it or about it, rather that it is an integral part of play: the relationship is one of direct participation, almost of essential identity. Dancing is a particular and particularly perfect form of playing' (Huizinga 1971: 164-65). I should add that, when writing about dance, Huizinga refers to the dancing people do when they are just dancing around, not to ballet or the modern dance of his time. Indeed, he deplored the fact that in modern forms of theatre dance the element of play is all but lost.

There are few words that have as many meanings as the English word *play*. We speak of the play of light and the play of the imagination. One can play a musical instrument and one can play first base. One can play a joke on a friend and one can play the matter quietly. One can play one's opponents against each other and one can play down the consequences. One can play the fool and one can play for time. In English play can also refer to fun or jesting, when something is done in play, to the manner of dealing with others, to the participation in gambling, to freedom of action, such as when one is given full play to explore one's talents and to a theatrical production. The Dutch *spel/spelen*, the German *Spiel/spielen*, the French *jeu/jouer* and the Spanish *juego/jugar* have different connotations and some languages may not have a word that captures the various meanings of *play* in English.

The degree of variability in play *behaviour* is as great as the number of meanings of the word *play*. A group of men engaged in a game of mahjong, a kitten rolling about with a ball of wool, a dolphin jumping out of the water, a girl dressing her Barbie doll, a group of sea lions frolicking underwater, a young investment banker absorbed in a game of Angry Birds on her iPhone while she is waiting to board her plane to Frankfurt, twenty-two men in colourful jerseys chasing a ball around a field, a group of students staging Shakespeare's *A Midsummer Night's Dream*, a child building a sand castle on the beach – are all of these events play? What, if anything, do they have in common?

In the light of this variability psychologists and biologists have struggled to come up with a suitable definition of human and animal play. In *Sociobiology* (1975) Edward O. Wilson declared that 'no behavioral concept has proved more ill-defined, elusive, controversial, and even unfashionable' (Wilson 2000: 164). In his book *The Genesis of Animal Play* (2005) the psychologist and biologist Gordon Burghardt remarked that, 'the problem with play is that we are unclear as to what it is, what it is good for, how it originated, and how it evolved' (Burghardt 2005: 6). The play theorist Brian Sutton-Smith (1997: 221) has suggested that, given the manifold ways in which play manifests itself in both animals and humans, perhaps the essence of play is its diversity and variability.

Instead of trying to formulate a one-size-fits-all definition Burghardt (2005) lists five criteria that have to be simultaneously satisfied for a form of behaviour to count as play: (1) the behaviour is not fully functional in the form or the context in which it is expressed; (2) the behaviour is spontaneous, voluntary, intentional, pleasurable, rewarding, reinforcing or autotelic; (3) the behaviour is either incomplete, exaggerated, awkward or precocious or involves behaviour patterns with modified form, sequencing or targeting; (4) the behaviour is performed repeatedly in a similar, but not rigidly stereotyped form during at least a portion of the animal's ontogeny; (5) the behaviour occurs when the animal is well fed, safe, healthy and free from stress (Burghardt 2005: 70-78).[106]

Animal play can be distinguished into three different categories: locomotor play, object play and social play. Locomotor play is mostly performed by juvenile animals and is characterized by an exploration of the body's motor repertoire and attempts at imitating the movements of adult animals. Foals make all kinds of jumps and randomly switch between walking and galloping, cats chase their own tail and dolphins perform rolls and twists as they jump out of the water. Object play is what dogs engage in when they fetch a ball and what cats engage in when they fool around with a ball of wool. Social play is a form of play directed at conspecifics. It can take many forms, but chasing and wrestling are its most common manifestations. Social play is found among mammals, amphibians, reptiles, insects and invertebrates. It turns out that some fish engage in games of chasing and wasps and ants engage in mock fighting (Burghardt 2005).

An interesting aspect of social play is that animals use play signals to invite a conspecific to play and to signal while they are playing that the play is still on. In an essay on animal play in *Steps to an Ecology of Mind* (1972) Gregory Bateson took this to mean that, in a way, the nipping and pawing during social play is therefore untrue or not meant. From this Bateson concluded that 'the evolution of play may have been an important step in the evolution of communication' (Bateson 1972: 181).

With the above criteria and the different types of play in the back of our minds the similarities between animal play and human play are readily apparent. Ball games involve elements of object play and social play. Surfing, skating, freestyle skiing and parkour can be regarded as a form of locomotor play. Capoeira is a form of mock fighting in which the participants avoid bodily contact. Hoop rolling, skipping rope and twister contain elements of object, locomotor and social play.

As you may have noticed two of the above activities, parkour and capoeira, are also considered a form of dance. In so far as it consists in a free exploration of the movement possibilities of the body breakdance, too, can be regarded as a form of locomotor play while breakdance battles constitute a form of social play. And of course, gymnastics can be considered a form of locomotor play and a form of dance. From classifying an activity as either play or dance it is only a small step to the hypothesis that dance originated in play and had an evolutionary precursor in animal play.

There are also some obvious differences between human and animal play. When a group of animals play with an object it is each on its own. By contrast, in many forms of human play the participants divide themselves into two or more teams. Humans have also designed rules which define different forms of play: in football one is not allowed to touch the ball with one's hands, in handball and basketball one is not allowed to touch the ball with one's legs or feet, in judo one is not allowed to hit or kick one's opponent and so on.

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[106] When a criterion contains more than one attribute, only one needs to apply for the criterion to be satisfied.

Humans also demarcate the boundaries within which the play is to occur, they forbid playing with some objects, such as food, and design objects with the specific purpose of being played with.

There is another crucial aspect in which animal and human play differs: humans form an audience to watch others play. Birds don't gather in the trees to watch two monkeys play; dogs don't stop to look at a horse frolicking in a field and cats just sleep on while children play with their toys. Only humans take an interest in the play behaviour of other humans and other species. People gather around a breakdancer or a group of capoeiristas showing off their skills on the Third Street Promenade in Santa Monica, California, they go to the Zoo to watch other animals and they make video recordings of their cats and dogs, which they upload to YouTube for others to watch.

People not only form an audience to watch other people play, they also play *for* an audience. The only other species to engage in comparable activities are some bird species, such as birds of paradise, blue-footed booby birds and cranes, the males of which engage in elaborate forms of display behaviour, sometimes involving dancing, in order to attract a female. However, this is a solitary activity. It would go against sexual selection to jointly perform for a single female or a group of females.

Playing *for* an audience requires that one is aware of oneself and the audience. Usually one first draws the audience's attention to oneself and one's intention to start playing. When the audience's attention has been assured the play commences. This order of events can be observed in children who beg their parents to look at them while they showcase their skills and get annoyed when they notice that their parents or grandparents aren't watching. The same phenomenon can be observed in adult players. Following his impromptu performance inside a Washington D.C. underground station Joshua Bell confessed that the intervals between the pieces felt particularly awkward, because passers-by not only ignored his playing, they didn't notice that he had stopped either (☞ §1.5).

Apart from self-awareness playing for an audience requires what in psychology is known as joint attention, which refers to the act of mutually and intentionally orienting one's attention towards the same stimulus. It therefore involves more than a shared visual orientation. To initiate joint attention one might look at another person, point at an object, look back at the other person to check whether he or she is looking in the right direction and then look at the object oneself. The audience in a theatre also look in the same direction, but the bond is first and foremost between the spectator and the performer, not between a spectator seated in row four and another spectator seated in row sixteen. And rather than drawing the audience's attention to an object or event the performer draws the audience's attention to himself, whether implicitly or explicitly. The performer could just walk onto stage, step into the spotlight or address the audience 'Look at this ☞' and unbutton his shirt or perform a little dance routine. For the performer it doesn't matter whether the audience consists of one person or ten thousand and whether they are live present or sitting behind their television screen.

The relationship with the audience marks a discontinuity between animal and human play, which changes the nature of both the play and the players. As Gadamer points out, when a play is played for an audience 'the way [the players] participate in the game is no longer determined by the fact that they are completely absorbed in it, but by the fact that they play their role in relation and regard to the whole of the play, in which not they but the audience is to become absorbed. A complete change takes place when play as such becomes a play. It puts the spectator in the place of the player. He – and not the player – is the person for and in whom the play is played' (Gadamer 2004: 109). In order to explain the evolution of dance from animal play we will thus need to answer the question of how and when this change came about and what occasioned it. As we shall see one possible answer to this question can be found in the evolution of language.

26.2 THE GESTURAL ORIGINS OF LANGUAGE

Over the centuries numerous authors have speculated about the origins of language.[107] Some authors postulate that language is uniquely human, while others contend that language lies on a continuum with animal communication. Some authors believe that there is nothing special about language and that its emergence can be explained by the emergence of other cognitive capacities, while others insist that the capacity for language constitutes a specialized faculty. Some authors claim that humans are born with a universal grammar hardwired into their brains, while others maintain that language acquisition is based on a general learning mechanism and is acquired through interaction with the environment. Some authors have proposed that the human language faculty is the result of a single genetic mutation, while others have argued that language must have evolved gradually, through natural selection.

The eighteenth century philosopher Étienne Bonnot de Condillac (1715-1780) was one of the first to propose that language originated in gesture. As he wrote in his *Essay on the Origin of Human Knowledge* (1746), 'for me the language of action is the seed of the languages and of all the arts that can be used to express our thoughts' (Condillac 2001: 194). In support of his thesis Condillac recounted how, at the time of the Roman emperor Augustus, mime artists were able to perform entire plays by gestures alone. 'By a long process, this is how they came to imagine, as an entirely new invention, a language which had been the first that mankind spoke, or which at least differed from it only by being suitable for the expression of a much larger number of thoughts' (Condillac 2001: 133-34).

Various authors have since expressed similar ideas. For example, in *Human, All Too Human* (1878) Nietzsche wrote that gestural communication is older than speech. 'As soon as people understood one another in gestures, a symbolism of gestures could arise: I mean that people could agree upon a language of sound signals by first producing sound and gesture (the former symbolically joined to the latter) and later only sound' (Nietzsche 2000:

[107] For a survey of recent views I refer to Christiansen and Kirby (2003).

143-44; paragraph 216). In Wittgenstein's posthumously published notebooks one can find scattered remarks to the same effect. In one entry Wittgenstein observed that 'what we call meaning must be connected with the primitive language of gestures' (Wittgenstein 2005: 24e). In another entry he noted that 'the human language of gestures is in a psychological sense primary' (idem: 46e).

In recent years the idea that language has its origin in gestural communication has gained renewed acceptance (e.g. Corballis 2002; Arbib 2005; Tomasello 2008). This revival was given in by research into the gestures that accompany speech (Goldin-Meadow 1999), reports about communities of deaf children who developed their own sign language (Senghas, Kita and Özyürek 2004; Sandler et al. 2005), the discovery of mirror neurons in the monkey brain (☞ §4.4) and a growing body of research comparing language acquisition in children and primate communication.

As Michael Tomasello argues in his book *Origins of Human Communication* (2008) there are good reasons to assume that language originated in gestural communication. All forms of linguistic communication depend on a prior form of communication to establish the code by which the sign is understood (think of joining hands and lifting the tree when I count to three or shout 'Yes' or 'Go'). To account for the emergence of language one would thus have to start with an *uncoded* form of communication. According to Tomasello natural gestures such as pointing and pantomiming are the best candidates for such an uncoded form of communication.

Pointing is one of the most common and most fundamental communicative gestures. When I speak of pointing I don't just mean pointing with one's index finger. One can point with one's entire hand and one's foot, one can nod in a certain direction and one can direct one's gaze towards a particular location. Pointing can refer to an object's presence or absence and to its shape, colour, brightness and motion. It can signify that it is your turn and it can indicate that you can execute that buy order that we talked about just an hour ago. Pointing can indicate a request (can I take it?) and an order (you take it).

To refer to a specific object, attribute or action or to convey a more complex message one can revert to mimicking the object or action. One can indicate the size with one's hands and fingers and one can indicate that one needs the hammer (and not the screwdriver) by making a hammering motion. The foreman at a building site can make the same motion to indicate to the operator of a pile driver that he can start the engine. Since they share a common ground the operator understands what the foreman is trying to say. He won't get down from his cabine to look for a hammer.

Given the complexity of situations to which a simple act as pointing can refer it may seem as if pointing depends on a capacity for language, but as Tomasello (2008) points out (no pun intended), all that is needed for pointing to succeed is a common ground and the capacity to understand intention. The same is true of pantomime.

In order to understand how people understand intentional action, we will first need to specify what intentional action is. At the risk of oversimplifying, I will take an intentional action to refer to a goal directed movement, such as opening a box, whereby the goal can refer both to the desired result (an open box) and to the pursuit of that result (the opening of the box). An intentional action typically involves a plan to enact it. Opening the window involves getting up from one's chair, walking to the window, extending one's arm and so on. Intentional actions are usually part of a larger scheme. One may open the window to reduce the temperature in one's room, to let in some fresh air and to talk to a person outside. A movement or action can also be a goal in itself. In dance the movements do not serve any observable goal. Of course, the dancer's goal might be to please the audience, to give expression to an emotion or to expose the futility of life, but the movements do not produce any change in the environment. In many circumstances it wouldn't make much difference if the dancer were to turn anti-clockwise instead of clockwise and raise her left leg instead of her right leg.

Even though you may understand *that* another person is pointing in a certain direction and not just stretching his or her arm, you may still not understand what he or she is trying to say.

Understanding depends on countless background assumptions, which are all part of what might be called a common ground. The common ground between two or more people can be confined to the immediate presence, such as when we both stare out of the window, in which case one might speak of a joint attentional framework; it can derive from a common goal, such as when a dance company rehearses a new production and it can be based on a common cultural background. Common ground relies on reciprocal knowledge: I know that you know; you know that I know and I know that you know that I know and so on. The ability to establish a common ground enables people to use simple gestures to refer to complex situations. The trader knew that my pointing at her meant that she could execute the trade because she knew I would get a phone call from risk management some time in the afternoon. The pile driver operator understood that he could start hammering because within their joint attentional framework that was the most likely interpretation of the foreman's signal. In another situation he might have searched for a hammer.

When one doesn't understand what another person is trying to say one usually asks for a clarification, one doesn't flee the scene or attack the other person. The other person typically consents by speaking louder or slower, by using different words, by making an analogy, by drawing a diagram or by using gestures to get the message across. The philosopher Paul Grice (1975) takes this to mean that communication is essentially cooperative. One person, the communicator, will make an effort to make himself clear, while the other person, the recipient, makes an effort to understand what the other person is trying to say. Gadamer makes the same point when he argues that 'the goal of all attempts to reach an understanding is agreement concerning the subject matter' (Gadamer 2004: 292).

Tomasello (2008) conjectures that the ability to communicate cooperatively rests on a set of social, cognitive and motivational skills that can be summed up under the header of shared or collective intentionality. Shared intentionality refers to collaborative interactions in which the participants contrue of each other as ‘we’. According to Tomasello (2008) the basic cognitive skill that makes shared intentionality possible is the capacity for recursive mindreading: I know that you know and you know that I know that you know. This is what enables people to create joint goals and joint attentional frames relevant to the joint goal. When recursive mindreading is employed in a social context, such as joining hands to remove an obstacle, it contributes to the achievement of a joint goal. When recursive mindreading is employed in a communicative context it constitutes the common ground on which communication is built. It follows that, to explain the evolution of language, we would have to explain the evolution of the capacity for understanding intention and the emergence of shared intentionality.

All theories of language evolution face the same challenge: the evolution of language has left no traces in the archaeological record. Researchers therefore depend entirely on indirect evidence. An important source of evidence is the study of our genetically closest nonhuman relatives, chimpanzees and bonobos.

Depending on how one reads the evidence and which data one emphasizes and de-emphasizes the data that have been gathered so far suggest that apes are capable of understanding that others have intentions. There is also accumulating evidence that monkeys and apes possess a large stock of gestures that are used as communicative signals (e.g. Pollick and de Waal 2007; Hobaiter and Byrne 2011). Gestures in this context are defined as nonlocomotory movements of the hands, feet or limbs. Whereas various other animal species communicate by means of facial movements, body postures and locomotion patterns, free manual gestures are only found among humans and apes. Apes use gestures to initiate play, to request food, to instigate co-movement or to stop an action, among other things. Tomasello (2008) distinguishes these gestures into intention-movement gestures, which the ape employs to get another ape to do something when it is watching, and attention-getting gestures, which it uses to draw the attention of another ape either to itself or to some object with the apparent expectation that the other performs some desired action.

However, apes appear to lack a capacity for shared intentionality (Tomasello et al. 2005; Tomasello 2008). They rarely offer a hand to help a conspecific achieve a goal and they don’t engage in joint activities with a shared goal. Apes appear to lack the motives to help others by informing them of some useful fact. Communication among apes serves the goal of the communicator, not the recipient. As Tomasello (2008: 5) writes: ‘when a whimpering chimpanzee child is searching for her mother, it is almost certain that all of the other chimpanzees in the immediate area know this. But if some nearby female knows where the mother is, she will not tell the searching child, even though she is perfectly capable of extending her arm in a kind of pointing gesture.’

At some point our hominid ancestors must have acquired the cognitive capacities that allowed for the emergence of shared intentionality. Tomasello (2008) argues that shared intentionality arose as an adaptation for collaborative activity, such as gathering food and guarding offspring. But why would an organism place its own interests second to that of others? The answer would have to be that it was beneficial for the individual. Collaborative individuals may have found it easier to find partners and produce offspring and they may have survived longer to do so.

Tomasello speculates that, initially, pointing and pantomiming may have emerged as means to facilitate collaborative activities. At first pointing may have served the purpose of requesting help. As Tomasello (2008: 195-96) writes, 'as we are working toward our joint goal in mutualistic collaboration, it is to each of our advantages that we help the other – and we are also likely to understand attempts to request and offer help communicatively as we are in the common ground of the collaborative activity. In this context, the communicator's tendency to request help and the recipient's tendency to simply help might naturally arise as a way of facilitating progress toward a joint goal.' At a later stage our ancestors may have developed the gift to not just wait until they were asked for help but to proactively offer assistance by informing others of impending danger or of a good location for finding berries. Informing can be indirectly reciprocal and therefore adaptive as it offers reputational advantage to the individual who does the informing. At the following stage our ancestors may have moved beyond informing to sharing their own experiences, which may have served the added goal of increasing group cohesion.

It is a long evolutionary road from shared intentionality, pointing and pantomime to language, too long to offer more than a very basic sketch of its itinerary. Somewhere along the line frequently used gestures must have acquired the status of icons, which were learnt to refer to a particular referent. This required the capacity to imitate gestures (☞ §27.1; §4.2). Tomasello postulates that at some point early hominids acquired the ability to produce gesture combinations that partitioned a referential situation into events and participants, which represented the first steps toward grammar. Informing required syntactic constructions that make it possible to ground referents in a current joint attentional frame, to indicate the different roles played by the participants and to express motives and attitudes. Sharing one's memories, feelings and attitudes required syntactic constructions that make it possible to date past events, to relate them to one another in time and to track participants across events. At some point gestures may have lost their iconicity when they were associated with related actions, situations or events, giving rise to arbitrary signs. The final step to language as we know would then consist in a process of conventionalization whereby gestural combinations are compressed into shared constructions and new constructions emerge as shorthand for more elaborate phrases.

Of course, over the course of six million years the brain must have evolved in such a way as to facilitate the capacity for shared intentionality and ultimately the capacity for language. The discovery of mirror neurons in the macaque brain (☞ §4.4) has provided theorists with a neural mechanism that may have played a pivotal role in this respect. Arbib (2005) neatly summarizes a possible evolutionary road from a mirror system to language in seven stages. Starting from a system for the cortical control of hand movements (1) a mirror system for grasping (2) and a simple imitation system for object-directed grasping evolved (3). This system evolved into a complex imitation system for grasping supporting the ability to recognize that an unfamiliar action sequence can be approximated by combining a set of known actions (4). The capacity for complex imitiation evolved into a manual-based communication system with an open repertoire of 'proto-signs' (5), which gave rise to an expanding spiral of conventionalized manual, facial and vocal communicative gestures (6) and finally the development of syntax and compositional semantics to yield language as we know it (7). I should add that this hypothesis does not rely on the existence of mirror neurons *per se*. What is needed, in functional terms, is a system for matching movement perception and execution, which, in principle, could be distributed over a larger neural network.

As Donald (1991) has argued a number of other adaptations had to be in place for imitation to be possible. For one thing, learning in animals is mostly dependent on environmental triggers. Early hominids therefore had to evolve the capacity for the voluntary recall of stored motor memories before they could evolve the ability to imitate. Additionally, according to Donald, a supra-modal, domain-general capacity for controlling movement had to evolve, facilitating the transfer of a movement from one limb to another. What one might call first-order mime draws on the entire body to faithfully represent an action, but second-order mime uses arm movements to refer to movements of the legs or whole body movements. For example, walking can be mimicked with the index and the middle finger.

Evidently the hypothesis that language originated in gesture is highly controversial. Advocates of the gestural origin theory of language would still need to explain the evolution of speech and the transition from gesture to speech. At some point vocalizations, too, must have come under voluntary control and unless one accepts Tomasello's argument that vocal communication depends on a prior form of communication to establish the code by which sounds are understood, it is unclear why vocalization should be preceded by a stage during which communication was gestural. Tomasello (2008: 322) claims that gestural communication builds on the 'natural' tendency to follow gaze direction and the 'natural' tendency to interpret the actions of others intentionally, but this does not preclude a vocal origin of language.

Assuming that language has its origins in gesture, it is easy to see why speech gained the upperhand, once it had emerged. Vocal communication has various advantages over gestural communication: it frees the hands for other activities, it does not require looking at a person or addressing a person, it enables communication over longer distances, in the dark and around physical barriers such as trees, walls and bushes and it allows fast communication. Because it involves less elaborate motions speech is also less energy consuming than gestural communication.

The thesis that language has its roots in collaborative activity is not uncontroversial either. It might be objected that, quite the opposite, shared intentionality and collaborative activity depend on some form of communication. Dunbar (1998) similarly argues that language originated as a tool for social bonding, but in his view it first appeared in the vocal dimension. In primates grooming is an essential technique for maintaining social bonds, but early hominid groups may have been too large for grooming to serve this purpose. Dunbar proposes that synchronized humming or chanting and at a later stage some primordial form of gossiping may have fulfilled the role of binding the group together. Dunbar also views the emergence of different languages and dialects as a means by which groups establish a group identity. Obviously, this hypothesis is just as speculative and it is hard to see how one might gather evidence to either prove or disprove it.

Against gestural origin theories it is often objected that one would expect some evidence for, or remnants of, more elaborate (gestural) sign systems. Yet the first known sign language for the deaf is about 500 years old (Emmorey 2005). As Deacon (1997: 362) writes: 'If something analogous to American Sign Language long predated spoken languages and served as the bridge linking the communication processes of our relatively inarticulate early ancestors, then we should expect that a considerable period of Baldwinian evolution would have specialized both the production and the perception of manual gestures.'[108] According to Deacon the absence of such a gestural predisposition suggests that the vast majority of Baldwinian evolution for language has taken place with respect to speech. But this is not quite correct. Evidence for a Baldwinian predisposition towards gestural communication can be found in the ease and frequency with which gesture based systems emerge in noisy environments where speech doesn't work, such as the trading floor of a derivatives exchange and the gestures used by airport marshalls or where communication has to be covert as in beach volleyball. And as the example of bharata natyam illustrates (☞ §25.2), some gestural based dance systems pre-date the oldest known sign languages and may even constitute a simple, albeit not full-blown, language, capable of forming rudimentary phrases and telling stories.

We are now in a position to piece together the two stories that I have told in the preceding pages. As I argued in the previous paragraph, the performing arts rest on the capacity for joint attention. Circle dances and other forms of synchronized performance such as military marches also depend on the capacity for shared intentionality and the ability to construct a group with a common goal. The emergence of dance as a social practice and a performing art is therefore tied to the emergence of the same cognitive capacities that underlie the evolution of language.

From our current vantage point sharing a story through gestures constitutes a dance performance. However, at the hypothetical stage where sharing one's experience emerged, the actions were not yet framed as a dance performance. Following the emergence of speech our hominid ancestors would have had the choice to tell a story or to enact it. They

[108] Baldwinian evolution is the view that learning may amplify and bias natural selection.

could therefore do what they did before but now with the intention to do it. One could also imagine a primordial dance performance whereby a hominid attracts the attention of a group of conspecifics and then performs some somersaults or joins hands with another conspecific to perform a balancing act. One could imagine some hominids separating themselves from the group to watch the others play. Our hominid ancestors would thus have danced before they conceived of their actions as dance, for this requires a concept of dance. Once the concept of dance had emerged the same activities that had previously been performed as a form of physical exercise or some other form of social practice could now be intended as dance. In the twentieth century this concept would be stretched to include anything from just walking around to contorting the body in every conceivable way.

Tomasello (2008) conjectures that the skills and motives for shared intentionality evolved in the context of collaborative activities such as sharing food and hunting together. Perhaps, and I emphasize perhaps, social play and dancing may have had an instrumental role within this context as well. I don't have any evidence to support this hypothesis, but, for whatever it is worth, it is interesting to observe that one particular gene, the AVPR1a gene, has been associated both with a penchant for dancing (Bachner-Melman et al. 2005) and social bonding (Walum et al. 2008). Taken together this suggests that social dancing and social bonding may have a common genetic origin. As the historian William McNeill argues in his book *Keeping Together in Time* (1995), the capacity for shared rhythmic movement may have allowed early hominids to establish bonds of solidarity. Rhythmic dancing, marching and chanting create a sense of euphoria in the participants, which may have cemented the practice. And so perhaps there is an even more fundamental evolutionary link between dance and language than the previous hypothetical story suggests.

26.3 THE EVOLUTION OF DANCE FROM PREHISTORY TO YESTERDAY

If we take a bird's eye view of the world history of dance what is perhaps most striking is that it wasn't until the nineteenth and twentieth century that dance as an art form, or perhaps I should say choreography as an art form, began to prosper, first in Europe and later in North America. Some four centuries earlier, during the Renaissance, painting, sculpture, architecture and music had already reached great artistic heights. If we go back in time to the Old Kingdom in ancient Egypt (2686-2181 BCE) we find images of dancers, which point to a rich dance culture. If we move to India, Cambodia and Bali, we find cultures in which dance played a prominent role, but where to this day dance has failed to proliferate as an art form the way it did in twentieth century Europe and North America. Among the Aboriginal tribes of Australia, the Dogon, the Igbo and numerous other African ethnic groups dance plays a prominent role, but the movement repertoire is limited compared with the dance traditions of India, Cambodia and Bali. These observations lead to two questions: Why did it take until the twentieth century for dance to thrive as an art form? Why didn't dance proliferate in India, Asia and Africa the way it did in Europe?

Dance itself leaves no traces. The earliest archaeological records depicting dance were found at excavation sites in the Middle East and are dated between 9,000 and 5,000 BCE (Garfinkel 2003). The decorations on pottery from this period show a relative abundance of depictions of communal dancing. The prevalence of dancing scenes suggests that in these preliterate agricultural communities dance played a prominent role. To put this into perspective we have to consider the various alternatives open to the craftsmen making the pots, jars, urns and bowls. They could be left empty, which is more economical because it saves time and energy and the decoration does not affect the objects' primary storage function. If the pot is decorated the artist can choose between an abstract pattern and something figurative. He can apply some random scratches, just do as he pleases or do whatever pleases others. If the decoration is to be figurative there are again multiple options. I'm not suggesting that this is how the artists were thinking, but from an analytical point of view there has to be a reason for depicting dance scenes.

The emergence of agriculture around 15,000-10,000 BCE involved a different organization of time and a different relationship between the work invested and the final product than hunting and gathering. Land had to be cleared, seeds sowed and crops tended and harvested. Garfinkel (2003) suggests that festivals and ceremonies involving the entire community may have marked the defining moments in this process. During these ceremonies the participants may have invoked supernatural powers to ask for a good harvest or to express gratitude if it materialized. The dance motifs may thus have served as a reference to the ceremonies during which the pottery was used.

We can only speculate about the sort of dances that were performed during these ceremonies. The pottery motifs suggest that the dances were performed in a circle. This need not be surprising. Circle dances are among the most common tribal and ethnic dances. In a circle dance all participants have the same role. The dance may thus serve the purpose of strengthening the sense of community. It is interesting to observe that objects that are not round, such as walls, were only rarely decorated with dancing figures. As Garfinkel (2003: 63) argues, 'this is a clear example of how the nature of the depicted motif (dancing in circles) dictated a preference for the specific substrate shape (round objects).'

Around 5,000 BCE the first kingdoms and state bureaucracies emerged. Garfinkel (2003) suggests that this involved a replacement of the virtual authority of the deities invoked during dance ceremonies by the real authority of kings and chiefs. With that dance lost its social significance. Dance as a motif disappeared from pottery and was replaced by images of warriors and banquet scenes. Doubtless people continued to dance, but it acquired a different status and function.

From around 2,500 BCE onwards we again find an abundance of images of dancing, beginning with the Old Kingdom in ancient Egypt. Archaeological findings from Mycene from around 1,300 BCE and from ancient Greece also show numerous dance scenes. Both in Egypt and in Greece one finds numerous images of individual dancers. This suggests that dance had acquired a new social significance. In Greek and Roman antiquity dance was an integral part of theatrical performances. Professional dance troupes were hired to perform at festivals and private parties. I am aware that I am taking a lot of shortcuts here, but my purpose is to sketch an overview of the major trends.

If we confine ourselves to Europe there is a gap of more than twelve centuries between the last Roman treatises on dance, *De Saltatione* (160 CE) by Lucian, and the first early Renaissance treatise. People continued to dance, for example, at weddings and during carnival, but dance didn't develop as an art form. The first signs of change occur around the turn of the fifteenth century. Around this time the aristocracy in Italy developed an interest in dance. Moving with grace became an asset as it was believed that the movements of the body were an outward manifestation of the movements of the soul (Nevile 2004). During this period a division occurred between country-dances, in which everyone could participate, and court dances, which required training and rehearsal and which were performed so as to please the audience with geometric spatial arrangements. The rivalry between different courts gave rise to an evolution towards ever greater refinement and complexity. During this period too the first dance masters emerged, some of whom published dancing manuals in which the dances were documented, such as Domenico da Piacenza's, *De arte saltandi et choreas ducendi* (1416), Antonio Cornazano's *Libro dell'arte del danzare* (1455) and Guglielmo Ebreo da Pesaro's *De practica seu arte tripudii* (1463). It is through these records that Renaissance dances such as the pavane, the allemande, the sarabande, the gavotte and the minuet have survived.

The year 1581 was an important year in the history of dance. In that year, on Sunday 15 October to be precise, the Ballet Comique de la Reine was performed at the court of Catherine de Medici in Paris on the occasion of the marriage of her sister, Marguerite de Lorraine. It was produced and choreographed by Balthasar de Beaujoyeulx and danced by members of the royalty and the aristocracy. In dance history it is commonly referred to as the first ballet. The sixteenth century also saw the publication of several dance treatises, such as Fabritio Caroso's *Il Ballarino* (1581), Thoinot Arbeau's *Orchesographie* (1588) and Cesare Negri's *Le Gratie d'Amore* (1602).

Throughout the late sixteenth and early seventeenth century the court dances continued to flourish both in Italy and in France. In 1661 Louis XIV founded the Académie Royale de la Dance followed in 1713 by the École de danse de l'Opéra. Dance ceased to be a leisurely activity for royalty and aristocracy and became a profession for which one needed an education. At first all roles were danced by men, but from 1681 onwards women too were allowed to dance. In 1671 the French parliament passed a decree that called for the development of a system for the fixation and transmission of dance. The choreographer Pierre Beauchamp (1631-1705), one of the principal figures in seventeenth century dance, took up the challenge and devised a system for dance notation, which, much to his dismay, was published by Raoul Auger Feuillet in his *Chorégraphie, ou l'art de décrire la danse*

(1700). At around the same time in England John Weaver (1693-1753) published various treatises on dance. Shortly after its publication he translated Feuillet's *Chorégraphie* into English. In his *Anatomical and Mechanical Lectures Upon Dancing* (1721) Weaver himself sought to establish a rational foundation for dance education based on the movement of the body.

By the eighteenth century ballet had emerged as a codified system of movements, with a lexicon of movements and positions and various syntactical rules for their combination. Choreographers could now work within this system, extending the tradition and exploring its potential for expression and spatial and temporal organization. In 1760 the French dancer, choreographer and theorist Jean-Georges Noverre published his *Lettres sur la danse et sur les ballets* in which he criticized the ballet of the time, which in his opinion had become a mere display of technical virtuosity. His writings and his own choreographic work marked the emergence of the *ballet d'action* in which all elements are subordinate to a plot and theme.

During the nineteenth century ballet continued to evolve in France, Italy, Russia and Denmark. At the Mariinsky Theatre in St. Petersburg Marius Petipa (1818-1910) created some of the classics of classical ballet that are performed to this day, such as *La Bayadère* (1877), *The Sleeping Beauty* (1890), *The Nutcracker* (1892) and *Swan Lake* (1895). At the Royal Danish Ballet, one of the oldest ballet companies in Europe, August Bournonville (1805-1879), developed his own style of ballet while creating numerous ballets, of which *La Sylphide* (1836) is the best known.

At the beginning of the twentieth century dancers and choreographers such as Isadora Duncan, Ruth St. Denis, Ted Shawn, Mary Wigman, Rudolf von Laban and Martha Graham rebelled against the classical ballet system, which they considered unduly restrictive. In their view dance should be a free expression of the body. To cut a long story short, in a rapid succession new traditions emerged against which other choreographers rebelled. All throughout each tradition continued to flourish, spawning offspring in the form of dancers and choreographers going their own way, modifying the tradition, merging styles and incorporating influences from other cultures. In the process new techniques and schools of dance were established such as Limon technique, Graham technique, Cunningham technique, release technique, contact improvisation and so on. The history of dance in the twentieth century therefore parallels the history of the avant-garde in the visual arts, architecture and music. Indeed, in some instances artistic revolutions in dance and the other arts went hand in hand, as during the golden years of the Ballets Russes and the Bauhaus and the collaboration between Merce Cunningham and John Cage.

Of course, a lot more happened than I can sketch in just a few paragraphs, but I think the following factors stand out: (1) the emergence of professional dancers; (2) the establishment of dedicated performance spaces, from royal courts to public theatres; (3) the foundation of dance academies; (4) the creation of a coded system and terminology.

The same factors contribute to the ongoing evolution of dance. Indeed, in the emergence of breakdance, krumping and parkour as dance forms we can see the evolution of dance played out in an accelerated timeframe. Each style began as a group of people playing around and, in the case of parkour, exploring the movement potential of urban environments. At first people met to dance together. They might bring friends to watch or to snap some pictures and record a video. As these gatherings grew in popularity, instead of performing on the street, dancers began performing at dedicated performance spaces. Some of the most popular dancers found sponsors, which allowed them to quit their jobs and dedicate themselves to furthering their skills. If you look online you will also find lists of breakdance moves and tutorials in which practitioners demonstrate the moves. In the spirit of the sixteenth and seventeenth dance masters some parkour artists even published handbooks (e.g. Edwardes 2009), which offer jump-by-jump tutorials of basic moves such as crane steps, cat leaps and kong vaults. This, as you will understand, is my smoking gun. It shows that, as a new dance form evolves, a lexicon and a set of formation rules, derivational rules and constraints take shape (☞ §25.2).

Let us now go back to the two questions that I asked at the beginning. Why didn't bharata natyam proliferate into multiple dance forms? The reason I propose is twofold. First, bharata natyam was originally performed in temples. In the absence of alternative performance spaces the dance remained based in temples and thereby bound to a narrative form. Second, when other movements and other dancers are included it ceases to be bharata natyam. Only in the second half of the twentieth century styles began to merge, giving rise to Bollywood dance, which is a mix of different Indian dance traditions and Western styles.

The second question I asked is why dance didn't proliferate in India, Asia and Africa the way it did in Europe. Among ethnic groups in Africa dancers did (and do) have the freedom to improvise and create new dances. They are not tied to a system such as classical ballet or bharata natyam. In so far as there are established forms they are handed over from one generation to the next. Therefore dancers could not build on the work of previous generations the way eighteenth century dancers could consult a Renaissance dance manual. In the absence of a symbolical system the dance remained tied to the present. Indeed, symbolical systems were introduced by dance anthropologists eager to record the dances before they are lost forever. Even though there are dedicated performers who prepare for a ceremony there are no professional dancers as in late antiquity and Europe of the seventeenth and eighteenth century and onwards. Finally, dance was bound by events that did not lend themselves to the kind of proliferation seen in seventeenth century Europe.

I am aware that, to firmly establish the hypotheses put forth here, a lot more details will have to be filled in. Doubtless dance historians and anthropologists will point at the omissions in my account. However, any alternative account of the world history of dance would have to do without the four factors I have identified here.

26.4 CONCLUSION

This chapter has argued that the evolution of dance is tied to the evolution of the language faculty. The same capacities that had to evolve to make the emergence of language possible also had to be in place for dance to evolve, from shared intentionality to the ability to imitate movements. I am aware that, like all theories of language evolution, this hypothesis is difficult, if not impossible, to prove. And so, for the moment it has to be judged by the range of phenomena that it explains and by the predictions that it entails.

The capacity to understand other people's intentions is one of the foundations for understanding dance and indeed dance itself. The capacity to understand other people's intentions allows us to understand *that* another person is dancing. It allows us to see intentional actions in perfectly choreographed movement sequences in which the dancers just perform a series of pre-set and pre-rehearsed movements. It allows us to understand that an actor who drops to the floor does so because he was hit by another actor even though he barely even touched him.

As I have argued the difference between dance and different forms of play is the relation with the audience. Sure enough one can dance by oneself in the kitchen or the living room, but this is not much different from talking to oneself or singing under the shower. Dance did not emerge until our ancestors developed the capacity for shared intentionality. Until that time it was just a form of play.

The emergence of dance *as a performing art* required the evolution of the capacity to construct a common ground. Once this capacity was in place any existing common ground could be gradually expanded. Anything can be a work of art if an artist intends it as such and if others understand his or her intention. A fourteenth century Venetian or Aztec artist could not dub an everyday object a work of art, because the society in which he lived and worked lacked the common ground to understand his gesture. Today a composer can record the sounds of a whale and call it music. A choreographer can get dressed and undressed and call it dance. The audience at contemporary dance and music festivals accept the proposal because they share a conceptual common ground with the choreographer or composer.

Whereas the evolution of dance depends on the same cognitive capacities as the capacity for language, the emergence of *choreography* depends on the capacity for language itself. Indeed, all forms of composition, whether in music, dance or architecture, depend on the faculty for language. I am aware that this is easier to posit than to prove. Choreography involves the organization of movements and the interactions between the dancers in space and time. This organization can be more or less spontaneous and planned in advance. The movements can be organized around a theme; they can be confined to the upper half of the body; they can be selected from a narrow set of movements and they can be arranged into abstract spatiotemporal structures. Usually the organization is geared to achieve a desired effect. The organization of the choreographic material therefore involves formation rules, a lexicon and constraints (☞ §25.2). The ability to apply these kinds of rules and constraints derives from the capacity for language.

A bird's eye view of the world history of dance provides some tentative support for this hypothesis. In the evolution of dance from prehistory to yesterday four factors played a decisive role: the emergence of professional dancers, the establishment of dedicated performance spaces and dance schools and the development of a coded system of movements. Of these the emergence of a coded system of movements is tied to the capacity for language.

Additional support for the hypothesis that choreography depends on the capacity for language may be gained from neuroimaging studies. A recent neuroimaging study in which the participants, all of whom were trained pianists, were asked to improvise a piece of music while lying inside a brain scanner, showed increased activity in a number of brain regions including the dorsal premotor cortex, the inferior frontal gyrus, the ventral premotor cortex and the anterior cingulate cortex (Berkowitz and Ansari 2008). The left inferior frontal gyrus and the ventral premotor cortex are part of Broca's area, which has also been associated with various language tasks. I am aware that this study doesn't amount to much by way of experimental evidence for the present hypothesis and more research specifically targeting choreography would be needed. One would like to know whether neurological patients with language impairments are also impaired at musical improvisation tasks and tasks requiring some form of choreography. Perhaps applying transcranial magnetic stimulation (TMS) (☞ §B.4) to the ventral premotor cortex will impair a dancer improvising a movement sequence. Then again, it may also result in a surprising novel dance phrase.

KEY POINTS

☞ 'The emergence of dance as a social practice and a performing art is tied to the emergence of the same cognitive capacities that underlie the evolution of language.'

☞ 'Whereas the evolution of dance depends on the same cognitive capacities as the capacity for language, the emergence of choreography depends on the capacity for language itself.'

☞ 'The capacity for understanding intentions allows us to see intentional actions in perfectly choreographed movement sequences in which the dancers just perform a series of pre-set and pre-rehearsed movements.'

☞ 'From classifying an activity as either play or dance it is only a small step to the hypothesis that dance had an evolutionary precursor in animal play.'

☞ 'A crucial difference between animal and human play is that humans form an audience to watch others play.'

☞ 'The relationship with the audience marks a discontinuity between animal and human play, which changes the nature of both the play and the players.'

☞ 'It has been conjectured that the ability to communicate cooperatively rests on a set of social, cognitive and motivational skills that can be summed up under the header of shared intentionality.'

☞ 'As the example of bharata natyam illustrates, some gestural based dance systems pre-date the oldest known sign languages and may even constitute a simple, albeit not full-blown, language capable of forming rudimentary phrases and telling stories.'

☞ 'Our hominid ancestors danced before they conceived of their actions as dance, for this requires a concept of dance. Once the concept of dance had emerged the same activities that had previously been performed as a form of physical exercise or some other form of social practice could now be intended as dance. In the twentieth century this concept would be stretched to include anything from just walking around to contorting the body in every conceivable way.'

☞ 'Social play and dancing may have had an instrumental role in the evolution of the capacities that underlie the capacity for language.'

27

THE MEANING OF IT ALL

The Dying Swan (1907) by the Russian choreographer Michel Fokine, set to the 13th movement of *The Carnival of the Animals* by Camille Saint-Saëns, is one of the most famous solos in dance history. It is little more than three minutes long and consists mostly of a long series of *pas de bourrées*[109] and gliding motions of the hands and arms. In his biography of Anna Pavlova, for whom Fokine originally created the ballet, Keith Money writes that 'Pavlova understood precisely the mood of the piece, melancholic and resigned, yet containing the last dying fire of a spirit that had known untrammelled freedom' (Money 1982: 71). Of course, the title gives it away, but after watching the piece many spectators will similarly understand that it is about death. As the dancer trips around the stage she gently sways her arms up and down, but the beats of her wings are no longer capable of letting her take off from the lake surface and all she manages are some *arabesques*. Exhausted she sinks down on one knee. With a few more beats of her arms she gets up, but as she tiptoes toward the edge of the stage her upper body gives in. She sits down on one knee stretching her other leg forward. After a few last contractions she bends forward, stretching her arms alongside her leg, and her body relaxes.

If you didn't understand what the piece was about upon first viewing my short exegesis will enable you to recognize the symbolism in the movements and the work's dramatic arc, which provides a sense of closure (☞ §15.4). You may even be moved as Ulyana Lopatkina sits down on one knee and extends her arms toward her toes. But how do we understand the meaning of a gesture, a scene and an entire ballet? And what if a piece features multiple scenes and dancers and extends over more than three and a half hours such as *1980 – Ein Stück von Pina Bausch*?

27.1 UNDERSTANDING GESTURES AND ACTIONS

People use hand gestures to communicate that everything is fine, to indicate that they want to turn left or right and to express their disapproval. As we have seen in the previous chapter, gestural communication relies on a common ground that binds the sender and the recipient. A customer in a restaurant can seek eye contact with a waiter to hint that she would like to order, but for this signal to succeed the waiter needs to understand that the

[109] A tiny step on point with the feet held close together.

customer wants to order and is not flirting with him. Actions that lack communicative intent can still have signal value if there is a reliable link between the action and some subsequent event. A waiter who notices from a corner of his eye that a customer closes the menu and puts it down on the edge of the table next to his or her plate will assume that he or she is ready to order. A customer who notices a waiter approaching his table will understand that he should decide what he wants to order. People also generally understand the meaning of everyday actions. If you notice a colleague opening the different drawers of her desk and lifting the pieces of paper that are lying around on her desk, you may inquire whether she is looking for something. If you notice someone rushing through the corridor towards the staircase carrying a pile of papers in his hands you may understand that he is in a hurry to go to a meeting and so you may wait to keep the door open for him and let him go first. But how do we understand what these persons are up to?

One possibility is that we have learnt the relationship between different phenomena through repeated exposure to many everyday situations. Whenever somebody had lost something you may have noticed that they were looking everywhere and so if you notice someone searching every corner of his desk you may surmise that he is looking for something. An alternative explanation is that we map the actions of the other person onto our own experience. When you notice a person rushing through a corridor you are reminded of the times when you yourself rushed through a corridor and since on each of those occasions you were in a hurry to get to a meeting you assume that the other person must be in a hurry to get to a meeting as well. According to what has become known as the motor simulation theory of action understanding the latter process is mediated by the motor system.

A considerable amount of research effort has been spent on attempts to figure out what apes, dogs, crows, pigeons, infants, patients with various neurological disorders and children diagnosed with autism do and don't understand. Even though research is ongoing the minimal conclusion is that humans are unique in the degree to which they understand other people's actions and intentions and that development disorders and damage to different parts of the brain can lead to impairments in the recognition of actions and intentions. This suggests that the capacity for understanding other people's actions is a human adaptation and that it has a basis in the brain.

The discovery of mirror neurons gave new credence to the motor simulation theory of action understanding. As you may recall, mirror neurons are neurons that discharge both when a monkey executes a goal directed movement and when it observes another individual performing the same goal directed movement (di Pellegrino et al. 1992; Gallese et al. 1996). When mirror neurons were first documented the researchers already speculated that they might allow the observer to understand the goal of the actions of others. This interpretation gave way to the hypothesis that mirror neurons provide the neural missing link between the abilities of our non-human ancestors and modern human language (Rizzolatti and Arbib 1998). This hypothesis was given in by the observation that the region in the monkey brain where mirror neurons were originally discovered appeared to have its human homologue in Broca's area, an area that has been implicated in a variety of language comprehension and production tasks, including sign language. In many subsequent papers this conjecture was taken as a matter of fact, but recent findings have called it into question (Toni et al. 2008).

As I discussed at length in chapter 4, so far mirror neurons have only been directly demonstrated in monkeys. I also listed some of the weaknesses in current experimental paradigms aimed at investigating the existence of a human mirror system as well as some of the objections that have been raised against the dominant interpretation of the original findings and numerous subsequent experiments (☞ §4.4). When assessing the possible role of the (putative) mirror system in language and non-verbal communication we should therefore bear in mind that the status of many experimental findings and their conceptual foundations are as yet controversial.

To summarize once more, the essence of the mirror mechanism, in the words of Rizzolatti and Sinigaglia (2010: 264) is the following: 'each time an individual observes another individual performing an action, a set of neurons that encode that action is activated in the observer's cortical motor system.' As I argued in chapter 4 a number of conditions need to be met for this statement to hold (☞ §4.5). Obviously, the movement has to be known, that is, it should be possible to map the observed movement onto a global motor schema that one has previously acquired. I have neither a tail nor breasts and so a dog wagging its tail and a bellydancer moving her breasts won't activate any corresponding mirror neurons in my brain. Additionally, one should pay attention to the relevant movement; the movement has to be performed neither too fast nor too slowly; it should be possible to parse the movement into discrete chunks; and the movements should be observed from a canonical perspective.

Rizzolatti and Craighero (2007) concede that the mirror system only represents movements that are part of one's own motor repertoire and that other movements are recognized on a visual basis. But this raises the question of how a mirror neuron might become attuned to a novel movement. And what is meant by motor repertoire? Is it defined by action objectives or movement kinematics? Do grasping an object in front of the body and above the head define the same action? Aware of this objection Rizzolatti and Sinigaglia (2010: 269) further concede that 'in the earlier studies on the mirror mechanism, it was indeed not clearly specified that the parieto-frontal mirror mechanism in humans is involved in two kinds of sensory-motor transformation – one mapping the observed movements onto the observer's own motor representation of those movements (movement mirroring), the other mapping the goal of the observed motor act onto the observer's own motor representation of that motor act (goal mirroring).' However, they do not make clear how these two 'representations' are 'represented' in the same neuron. Or are there goal mirror neurons and movement mirror neurons? It is not clear either what would count as a goal. The primary goal of both grasping and snatching is identical: getting hold of the desired object. But the subordinate goal in snatching is to grab it without or before the other person notices. The only apparent difference in terms of observable movement parameters is the speed of execution and yet grasping and snatching are altogether different actions with potentially different consequences. A person who notices someone snatching something might interfere. Had the other person just grasped it, it might not have raised any suspicions.

One of the most popular functional interpretations of mirror neurons, or the mirror neurons in the parieto-frontal network to be precise, is that they enable individuals to understand the actions and intentions of others. The central claim is that 'mirror neurons create a direct link between the sender of a message and its receiver. (..) The observation of an individual grasping an apple is immediately understood because it evokes the same motor representation in the parieto-frontal mirror system of the observer' (Rizzolatti and Craighero 2007: 778; see also Rizzolatti et al. 2001 and Rizzolatti and Sinigaglia 2010). Except, of course, that even in this simple example it is by no means clear why the person grasping the apple is doing so and what he or she is going to do next. Weigh it? Eat it? Smell it? Peel it? Throw it away perhaps? Even if the observation of grasping activates a copy of the appropriate motor schema for grasping, it is unclear that this in itself amounts to *understanding* the action. If all that happens is that the appropriate motor schema is activated we have understood precisely nothing, because there is nothing to understand. To the contrary, observing someone grasp an apple outside of any context might raise a number of questions. Why did the experimenter grasp the apple? Understanding an action, recognizing an action and observing an action are not synonymous.

Rizzolatti and Sinigaglia (2010: 271) admit that 'understanding the reasons behind an agent's motor intention requires additional inferential processes.' However, it is not clear how and where one might place the boundary between motor intention and the reasons that guide an action. Chess grandmasters think several moves ahead, but to a novice player watching a chess match, the reason a player moves the rook from b2 to b6 may only become clear five moves later. A person unfamiliar with the game of chess will not understand the intention behind the move at all.

The direct matching hypothesis, according to which actions are understood because they map onto a motor representation of the same action in the brain of the observer, is attractive because of its simplicity, but it fails to capture what is normally meant by understanding. To understand a move in chess one has to understand chess. One does not learn chess, Go or mahjong by observing someone picking up the pieces, but by studying the rules and playing it. Moving a piece in chess and draughts may well involve the same goal directed movement of picking up a piece and moving it to another location, but the meaning of the action is entirely different and cannot be inferred from observing the movement alone.

What is more, there is no need to assume that action understanding is mediated by the motor system. Even though I have never myself prepared pizza dough and have only eaten the finished product I understand what a pizza baker is doing when I see him juggling with dough. Perhaps I should add that proponents of the direct matching hypothesis might argue that there is something lacking in my understanding in this case, the extra bit that comes from knowing how to prepare pizza dough. However, if I want to I can look up why preparing pizza dough requires juggling it around in one's hands. Indeed, I may well gain a better understanding of the whole process of making dough than the pizza parlour apprentice who merely imitates the movements of his mentor without ever questioning their purpose.

So how *do* we understand other people's actions? Perhaps the most straightforward answer is that we come to understand something by comparing it to what we already know. A person who knows that some people tend to perform seemingly nonsensical gestures when inside a church or a temple, may interpret another person's behaviour in this light when he visits a church and notices someone touching first his head, then his breast, then his left and then his right shoulder. He may not understand what the movements stand for or why the person performs them in that order, but he may guess that it probably has some religious connotation. The church thus provides a frame in which to interpret the movements.

Evidently, the same capacity that allows us to understand other people's actions in everyday situations also allows us to understand movements that resemble everyday actions in dance. However, unlike classical Marcel Marceau-like pantomime and the dance theatre of Pina Bausch contemporary dance is relatively low in movements that look like everyday actions. Legs are stretched, arms are extended, bodies are contorted and the dancers lift, carry and support each other, but most of these movements resemble… dance. Indeed, some emblematic movements are instantly recognizable as classical ballet, flamenco, tango or breakdance. And so, when you see a series of typical dances move you understand that the person is dancing and that there need not be anything to understand.

27.2 UNDERSTANDING SCENES (1)

As we grow up we learn to understand the world around us. We learn that if something is pushed it might fall and that if something falls it might break. We learn that falling might hurt, but that inanimate objects don't feel pain. We learn to understand other people's actions and we learn to assess situations. At some point we will have learnt to recognize a drunkard's walk, either from encountering a drunk on the street or from watching one on television, and so we understand that towards the end of Hans van Manen's *Black Cake* (1989) the dancers get a little tipsy. We also understand from the ballroom dances in the first section and the fact that the women wear high heels and black dresses that we are watching a party. Of course, the title may already have given it away and to remove all doubt in the third and final section a waiter serves champagne flutes. We also understand that some dancers bring out a toast by extending the arm in which they hold their glass and we understand from the animated atmosphere that they must be having a good time. As a matter of fact, our understanding runs much deeper than just recognizing the scene and the gestures. We understand that the dancers get drunk, or at least pretend to do so, and we understand that they are getting drunk from drinking alcohol. We also understand that, as the wine goes to their head, their mood and motor behaviour is affected. This may seem like an obvious point to make, but it is not. When a shaman suddenly begins to dance around in a frenzy we might conclude that the drugs are beginning to work whereas the members of his tribe might infer that the spirit has entered his soul and has taken over his body. They may acknowledge the causal role of the drugs, but they may consider them a mere conduit for allowing the spirits to enter.

The above observations can be formalized in the concept of a schema (☞§4.2; §31.1). A schema can be defined as a cognitive representation comprising a generalization over observed similarities between multiple instances of the same object or event. Schemas are mental constructions that represent generic knowledge. They only contain typical features and the relations among those features and do not include details about specific objects or events. For example, a party schema might contain people, a crowded space, music, drinks, dancing and so on. A restaurant schema might contain various objects (chairs, tables, menu), roles (waiter, customer, chef) and scripts (reading the menu, ordering food, paying the bill). A schema for getting dressed might include the objects that are typically involved (clothes, shoes) and the order in which the actions are typically performed. The most generic schemas comprise abstract (and possibly spurious ☞ §6) relations such as that between cause and effect and good and evil. Schemas constitute our background knowledge and enable us to understand a situation or event. In the case of a text the content of our schemas becomes manifest when we are required to explain the text or when the text is adapted for theatre or cinema.

At the start of Hans van Manen's *Black Cake* we notice the women in eveningwear and the waiter serving champagne and so we implicitly fit the scene into a party schema. The reason that we instantly recognize the scene as a party is that the scene itself is an abstraction of a typical party. The sparse elements are all superstimuli (☞ §7) aimed at facilitating rapid identification. Hans van Manen could also have had the waiter serve coffee, but that would have transformed the entire scene.

Once a schema is bestowed upon a scene everything else that ensues is interpreted within that schema, or at least until the scene changes. Hans van Manen's *Sarcasmen* (1981) opens with the image of a woman standing next to a grand piano. When the piano player begins to play a male dancer enters the stage. This tells us that what follows is a duet. And so from the very start the actions on stage are framed as a duet. Rather than ignoring each other the woman follows the man with her gaze and the man repeatedly glances at the woman. This suggests the beginning of a relationship. Of course, the gaze directions are all choreographed. Hans van Manen could have had the woman study her toes or look up to the ceiling, but the gaze directions create a subtle undercurrent of sexual tension.

Accordingly, we interpret the ensuing ballet as an unfolding relationship between a man and a woman, that is, as a *pas de deux* and not as a mere duet.

Schemas allow us to recognize many everyday situations from office meetings to traffic accidents and to adjust our own actions accordingly. When you notice that there is a queue in front of the box office you understand that you should go to the end of the line. However, since schemas capture the generic aspects of a scene, the same schema may cover various scenes from modern life. A butcher, a baker and a hair stylist are easy to tell apart, but even though their job descriptions are radically different, it may be hard to distinguish a comptroller from a software architect or a corporate lawyer just by looking at their actions. They just sit behind their computer. What is more, one cannot tell from looking at someone sitting behind her computer whether she is working, playing a game, filling in her tax form or checking her private email.

The reason that much classical ballet and the work of choreographers such as Pina Bausch (☞ §18.2) revolves around a small number of stereotypical themes – the most stereotypical of which is, of course, love – is that these themes are easily represented and recognized. To represent more complex forms of behaviour in dance, theatre or cinema one would first have to establish a common ground (☞ §26.3), which allows the spectator to frame the behaviour in the appropriate context. Lacking a common ground most spectators' interpretations will gravitate towards a handful of basic schemas such as conflict or the relationship between individual and group. By exercising one's imagination these basic schemas could be elaborated upon and this is what one often notices in dance and theatre reviews and other forms of art criticism (☞ §11.1).

As we are exposed to new products and experiences new schemas take shape inside our mind. Until a few years ago no one had a schema for a laptop, a mobile phone, a smartphone or a tablet computer because the products in question did not exist yet. Following a visit to a foreign country one may acquire a schema for a pagoda, an auto rickshaw and t'ai chi (or t'ai chi ch'uan). Whenever one notices some people inside a public park slowly moving their arms in synchrony, whether in New York, Sydney or Vancouver, one may then guess that they are practicing t'ai chi. This in turn means that dance, theatre and cinema also have the potential to enlarge our schema repertoire and thereby our understanding of the world, both for good and for bad.

However, film, dance and theatre can also perpetuate existing schemas. After all, schemas are at work in the mind of the spectator and the artist. Once a scene is interpreted within a relationship schema it is difficult to see it otherwise. Indeed, it is difficult *not* to see a duet for a man and a woman in terms of a relationship. However, one's schemas also determine *how* one views a relationship. This is as true of the audience as it is of the choreographer who created the work. Choreographers such as Hans van Manen and William Forsythe have contributed a lot to the emancipation of the male dancer in ballet. In much classical ballet and even in many contemporary works, such as *Salt* (1999) and *Amelia* (2002) by Edouard Lock, the main role of the male dancer is to support the female dancer. By contrast, in the *Herman Schmerman* (1992) pas de deux by William Forsythe the male and female dancer appear as equals. Both dancers can initiate *and* reject a duet and both can take the lead. In various pieces by William Forsythe the same role can be danced by both male and female dancers. For instance, I have seen *Self Meant to Govern* (1994) danced by a cast of six female dancers, four female and two male dancers and an all male cast. While I have always found this interesting (☞ §10), since each dancer brings something different to a part, one German dance critic once commented that 'the Forsythe company (..) can appear cold, for example in the unerotic equating of men and women' (Koch 1995). Which goes to show that schemas not only structure our world, they also bias our judgement.

27.3 UNDERSTANDING SCENES (2)

Before we can understand a scene we first need to identify its borders. In *Potemkins Unterschrift*, the first section of *Impressing the Czar* (1988), a production by William Forsythe, the stage is filled with dancers and stage props, including a lyre, an eagle, an oversized cherry, a giant pair of scissors, a maquette of the Venus de Milo, a devil's pitchfork, a saw, a hammer, a chair and what looks like a reproduction of a Velazquez canvas. Part of the stage is occupied by a tilted oversized chequerboard. Some dancers are dressed in historical costumes others in leotards. Two men wear black trousers, a white shirt and a black tie and two girls are dressed in a school uniform. A male dancer in a short black and white pleated skirt, who may or may not stand for the martyr Sebastian, is shooting with a bow and arrow. The dancers in leotards are performing classical ballet routines. One of the girls in school uniform is commenting on the pandemonium around her while fragments from Beethoven's *String Quartet No. 14 in C minor Opus 131* can be heard interspersed with electronic noise. Occasionally the girl in school uniform makes phone call to a certain Mr Pnut. It is, in short, a typical 1980s postmodern extravaganza. How are we to make out scenes amidst all this concurrent activity?

Normally we perceive the world around us as divided into discrete objects, scenes and events. Whereas a scene is ongoing, an event can be defined as something that is perceived as taking place at a given location and having a beginning and an end. Thus, the traffic at a busy intersection constitutes a scene, a traffic accident an event. The boundary between scenes and events is not clearly demarcated though. For example, an exhibition can be perceived both as a scene and as an event. To avoid confusion with its usage in dance and theatre, in the present context I take a scene to refer to a special kind of event that involves a series of actions by one or several people. Thus, if buttoning a shirt comprises an action, then getting dressed constitutes an event when performed at home and a scene when performed on stage or on screen.

Event segmentation appears to be an automatic, ongoing component of human perception. In chapter 14 we saw that the brain continuously generates predictions of the next likely event in a series. When watching a person get dressed one can predict what the person is going to do next. After putting one arm through a t-shirt he or she is likely to continue with the other arm and the head. It is unlikely that he or she will continue by putting on a sock and a shoe first.[110] However, when an event comes to an end, for example when the person is all dressed up, the predictive relationships break down. Zacks et al. (2007) propose that, when the number of prediction errors increases, people perceive an event boundary. They may then update their mental representation to another event based on the continuing stream of sensory input. For example, they may notice that the person has moved on to packing his or her bag. Event boundaries can be identified at various levels of granularity. A dinner has a beginning and an end, but so do the individual courses.

Experiments have shown that, when asked to describe everyday events, people tend to segment them into meaningful segments based on prior knowledge in the form of event schemas (☞ §27.2) and feature changes such as starts and stops, changes in the speed and direction of motion and changes in body configuration and orientation (Zacks et al. 2007). During your first visit to a dental hygienist as part of a preventive treatment for periodontal disease you may have failed to recognize what was being done to your teeth, why it was necessary and when it was finished. The dental hygienist most likely followed a set sequence of procedures, but since it was your first visit, to you the beginning and the end of the treatment were marked by the moment you reclined in the dental chair and opened your mouth and the moment the dental hygienist told you you could rinse your mouth. Not knowing what was going on you had to fall back on sensory cues. You may have noticed that the dental hygienist started with your lower jaw and worked from left to right and you may have seen her select a different instrument. This allowed you to monitor the progress of the treatment. You may have sensed that the first part of the treatment consisted in a lot of picking and that a second and a third part consisted in grinding and polishing. During a second visit these cues would constitute part of a schema for a visit to a dental hygienist, which would enable you to gauge how much longer the treatment might still take.

The same processes that enable us to parse a continuous stream of sensory input into discrete events in everyday situations allow us to break down a dance performance into meaningful scenes. *Duende* (1991) by the Spanish choreographer Nacho Duato opens with a short solo for a female dancer. She is joined by a second female dancer who enters the stage from the left. They dance a short duet in which their movements are nearly perfectly mirrored. Next a male dancer becomes visible at the back of the stage somewhere to the right. The three of them dance in alternating constellations and then one of the girls leaves the stage and the man and the girl dance a longer duet. The reason that it is relatively easy to identify different sections is that the piece is neatly organized in segments demarcated by entries, exits and groupings.

[110] As you may have guessed, changing the order in which one gets dressed might make for an interesting dance scene.

In dance scene boundaries can be accentuated by musical cues, costumes, stage design and lighting changes. In *Stepping Stones* (1991) by Jiří Kylián a beam of light falls through a round hole in a triangular shape hanging from the fly system. The light delineates a circular area on stage indicating that whatever happens within the borders of that area constitutes a scene. *Potemkins Unterschrift* is also less chaotic than it may seem during the first few minutes after the lights come on. As a matter of fact, by describing the characters according to their physical characteristics I had already come a long way to partitioning the piece into various scenes. For instance, there is a correlation between the style of the costumes and the style of the dance movements. It is only towards the end that all dancers engage in a synchronized group section. But what, you may ask yourself, is the point of all this? At a certain moment in *La Maison de Mezzo-Prezzo*, the third act of *Impressing the Czar* in which stage props from the first act are auctioned off, one of the girls in schooluniform asks the audience the same question. Is it a metaphor?

27.4 UNDERSTANDING METAPHORS

In the final scene of *Quintett* (1993) by William Forsythe, a piece for three male and two female dancers, set to the first half hour of Gavin Bryars' haunting score *Jesus' Blood Never Failed Me Yet*, as the music grows towards a crescendo, at the back of the stage a dancer falls backwards and just as she is about to hit the floor another dancer appears from a gap in the stage floor, catches her and pushes her up, after which he disappears into the hole again. This scene is repeated several times as the curtains slowly come down. The sense of collapse is enhanced by the fact that the dancer falls backwards, bending in her knees and raising her arms helplessly into the air. Is she falling into her grave and is she pushed back into life until, in the end, the final curtains come down?

Movements and scenes, like sentences and stories, can have a literal and a metaphorical meaning. In their book *Metaphors We Live By* Lakoff and Johnson (1980: 5) describe the essence of metaphor as 'understanding and experiencing one kind of thing in terms of another.' In cognitive linguistics metaphor refers to an underlying pattern of thought, of which individual expressions are particular instances. Throughout this book I frequently refer to experimental evidence in support of a theory and I have dismissed various hypotheses because I did not consider the evidence strong enough. Each of these expressions derives from the THEORIES ARE BUILDINGS metaphor. There are many more such metaphors, each of which give way to a number of idiomatic expressions. For instance, ideas are people that can die off or live on forever, they are products that are produced and refined, they are plants that come to fruition after the seeds have been planted, they are commodities than can be packaged and sold and they are resources that can be pooled and wasted and that one can run out of.

Traditionally, metaphor has been viewed as a matter of language, but as Lakoff and Johnson argue, metaphors are the product of a general cognitive capacity and a means of structuring the world. As they write, 'in all aspects of life (..) we define our reality in terms of metaphors and then proceed to act on the basis of the metaphors' (Lakoff and Johnson 1980: 159). They illustrate their claim with the by now classic example of the concept of ARGUMENT and the metaphor ARGUMENT IS WAR. An argument is just a type of conversation structured around a number of participants and events. But when a conversation is understood as an argument, elements from the concept of war are superimposed on the structure of the conversation. What began as a mere difference of opinion may turn into a conflict of opinion. One may view one's conversation partner as an opponent and one's own opinion as a position in need of defending. One may seek to identify the weaknesses in the other person's position and raise any number of objections that will force him or her to surrender. Even though it doesn't really change anything, when one wins an argument one may feel vindicated and when one loses an argument one may feel depressed.

To demonstrate how the ARGUMENT IS WAR metaphor structures our actions Lakoff and Johnson (1980: 6) invite the reader to 'imagine a culture where an argument is viewed as a dance, the participants are seen as performers, and the goal is to perform in a balanced and aesthetically pleasing way. In such a culture, people would view arguments differently, experience them differently, carry them out differently, and talk about them differently. But we would probably not view them as arguing at all: They would simply be doing something different. It would seem strange even to call what they were doing "arguing".' If you find it hard to believe that any culture could ever conceive of an argument as a dance, this just shows how dominant the ARGUMENT IS WAR metaphor is.

The most fundamental concept of conceptual metaphor theory is that of a mapping or projection. A metaphor is conceived of as a mapping of the elements and relations from one domain (e.g. journey) onto another domain (e.g. life). This mapping is taken to be systematic and unidirectional. We say that love is madness, but we don't say of mental delusions that they are passionate or affectionate. We refer to the foundations of a theory, but not to a building's axioms. Cognitive linguistics therefore rejects the notion that metaphors are a mere figure of speech based on some observed similarity between the source and the target domain. It also rejects the view advocated by the philosopher Donald Davidson (1978) that anything can be understood in terms of any other thing. One person might say that life is a journey, while another person might say that every journey is a mirror of life. According to Davidson the range of metaphorical expressions is limited only by the limits of the human imagination. It may be that some metaphors are more common than others, but that might just be a feature of a specific language. However, proponents of this view would need to explain why in many languages most conventional metaphors are unidirectional.

One of the central tenets of conceptual metaphor theory is that many metaphors are grounded in our physical experience and as such a reflection of certain aspects of human perception and cognition. Experiences are organized into structured wholes or what Lakoff and Johnson (1980: 71) refer to as experiential Gestalts and these form the basis for various concepts and metaphors. The reason that in English one speaks of a heated argument is that during an argument tempers can run high, meaning that people become emotionally involved as a result of which their body temperature may rise.

Our experience with physical objects, including our own body, leads us to view situations, events, states, actions, experiences and ideas as objects and substances. For example, the mind is taken as an entity; work, time and effort as a quantity; and goals and causes as objects. The organization of the body is reflected in expressions such as the foot of a mountain, the legs of a table and the arms of a chair. As Lakoff and Johnson (1980) show, many metaphors give a concept a spatial orientation such as up-down, front-back, centre-periphery and on-off. Happiness and health are 'up', while sadness and sickness are 'down'. People fall ill, their health declines and they feel down. Similarly, more and good are 'up', while less and bad are 'down'. By the same token success is conceived of as progress and forward motion while failure is conceived of as a fall back and a regression.

If metaphors in general are conceived of as a mapping from one domain to another, then metaphorical gestures can be defined as those gestures which have the potential to engage such a cross-domain mapping (Cienki and Müller 2008). For instance, pointing forward with one's index finger, the arm extended into space, indicates a direction in space, but it can also represent something situated ahead in time and thus point toward the future. Similarly, showing one's open palms to indicate that one's hands are empty can acquire the added meaning that one doesn't have any money or that one doesn't have a clue. A stopping motion of the hand may indicate a limit or the end to a process. Like ordinary metaphors, gestural metaphors can derive from our physical experience. When people get hot from working hard they take off their jacket and pull up their sleeves. Pulling up one's sleeves may then acquire the metaphorical meaning of getting down to work. When incorporated into a sequence of movements metaphorical gestures can give meaning to the sequence as a whole. For instance, by stopping in the middle of a phrase and looking into the distance the dancers can give the impression of something looming outside. This in turn can alter the mood of the piece and the audience's interpretation.

As we have seen conceptual metaphors project the structure of a source domain onto a target domain. This explains why one may recognize the human life span in the dramatic arc of *The Dying Swan*. It also explains why one might interpret the final moments of *Quintett* (1993) in a similar vein and why Lady Macbeth's sleepwalking can be interpreted as a metaphor for her restless and guilty mind.

If it is true as, Lakoff and Johnson (1980: 4) claim, that 'our ordinary conceptual system, in terms of which we both think and act, is fundamentally metaphorical in nature', then a choreographer or a director looking to express something by means of movement or the interaction between the dancers or actors will build upon the same conceptual system and thus the same metaphors. For example, when staging an argument he or she may draw on the ARGUMENT IS WAR metaphor. It follows that, from the point of view of cognitive linguistics, many artists merely create new instances of existing metaphors, rather than inventing entirely new metaphors. Instead of saying that life is a journey one might say that life is a commute with a few rest stops along the way, but the underlying conceptual structure is the same. The reason that many scenes in the work of Pina Bausch are recognizable on a metaphorical level is that they are variations on existing metaphors. This in turn may be a result of her working method, which consisted in handing the dancers rhetorical questions, tasks and metaphors, which the dancers then developed in the form of a movement or a scene.

According to conceptual metaphor theory metaphors have their basis in the way we experience the world. While this may be true for some metaphors it does not explain how metaphors such as ARGUMENT IS WAR emerge. It could be that the terms used to describe argument were at one time borrowed from the domain of war and were subsequently embedded in the domain of argument. It also fails to explain how novel metaphors are created and comprehended.

Fauconnier and Turner (1998; 2002) have proposed a theoretical framework which treats metaphors as the outcome of a more general cognitive process. In their view this process, which they have termed conceptual integration or conceptual blending, is fundamental to human cognition and also underlies the capacity for language.

Conceptual integration is a mental process that operates across mental spaces. Mental spaces can be thought of as some kind of temporary thought assemblies that are constructed as we think and speak. They can comprise anything from generic schemas and known facts to personal memories and imagined scenarios. When you think of the last time you went to Paris a mental space is activated which includes you and Paris. When you try to imagine what it would be like to be in Paris while it is snowing, a mental space is set up which includes you, your memories of Paris and images of Paris in the snow that you may have seen in a magazine or newspaper. At a neural level, mental spaces can be thought of as temporary networks of neuronal assemblies that are co-activated in working memory. In the terminology of mental spaces, a mental space that comprises a conceptual domain with a known structure is referred to as a frame. For example, a rehearsal, an audition, a holiday, a loan and a commercial transaction each define the elements contained in the underlying mental space in a different way.

Conceptual integration combines the elements from different mental spaces into a new configuration. Its basic features are illustrated in figure 27.1. In this diagram mental spaces are represented as circles, elements as points and the connections between elements in different spaces as lines. A partial cross-space mapping connects the elements in the two input spaces, represented by the solid lines. A generic mental space maps onto each of the input spaces and contains what the elements in each of the input spaces have in common. The blended space, or blend for short, contains a projection of selected elements from the two input spaces. The blended space has a structure of its own, not contained in any of the input spaces, represented by the solid square in the diagram. Within this framework metaphors are a special subclass of conceptual blends.

Constructing the blended space involves three operations: composition, completion, and elaboration. The blended space consists of elements from the two input spaces, but the relations between the elements do not necessarily exist in the separate input spaces. Composition is the process whereby a relation from one space is attributed to an element or elements from the other input spaces. Completion occurs when the structure of the blended space is combined with the conceptual structure of other organizing frames. Elaboration is the process whereby the content of the blended space is filled in with more details. For example, when politicians are said to kick the can down the road, one might retort that it won't roll very far or that, when they reach the end of the road, they can't kick the can any further. Together composition, completion and elaboration lead to emergent structure in the blended space.

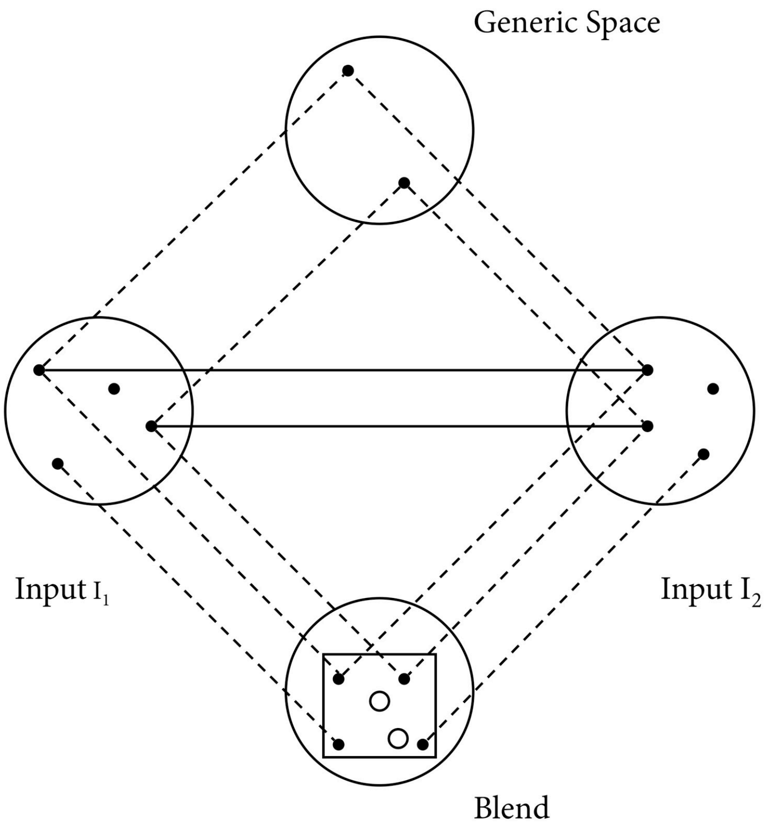

Figure 27.1 The basic diagram. Adapted from Fauconnier and Turner (2002)

Conceptual integration is governed by several principles which decribe the various conceptual relations that can obtain between different mental spaces, such as change, identity, time, space, cause-effect, part-whole, role, analogy, disanalogy, property, category and intentionality. If someone were to say that, when she was 20 she had long hair, we create an identity relation between now and then and imagine a blended space in which the person has long hair. When I say of a sweater that it is warm the fact that it keeps me warm is translated into a property of the object. If I were to surmise that Wittgenstein would no doubt disagree with the present framework I transport Wittgenstein to the present and create an imaginary space in which Wittgenstein and I engage in a debate about the merits of conceptual blending theory. In the conceptual blending framework it constructs an identity relationship between space and time.

Fauconnier and Turner (2002) distinguish four different types of conceptual integration networks. The simplest kind of network is a simplex network, which connects a frame with its values. For example, the statement 'Paris is the capital of France' invokes the frame X IS THE CAPITAL OF Y, which takes as input two elements, cities and countries, which are connected to their respective values. It is a special instance of a more general frame, which takes the form X IS THE .. OF Y.

A mirror network is a network in which the input and generic spaces share a single organizing frame. In many of Picasso's cubist portraits different views of a nose and a mouth are combined into a single presentation but the organizing frame is the shape of a face. The debate with Wittgenstein is another example of a mirror network.

A single-scope network combines two input spaces with different organizing frames, whereby one organizing frame is carried over to the blended space. Consider a newspaper headline which says that Apple outpaces Sony. If we were to analyze this statement in terms of the conceptual blending framework, we might put two competitors engaged in a race in one input space, with one competitor outpacing the other and Apple and Sony in the other input space, with Apple gaining market share over Sony. The generic space consists of a competition between competitors. In the blended space the organizing frame of the first input space, a race, is projected onto the elements from the second input space and so we obtain 'Apple outpaces Sony'.

A double-scope network integrates two input spaces with different and possibly clashing organizing frames into a new blended space with an organizing frame of its own. The trashcan on your desktop is an example of a double-scope network. It combines elements from the frame of everyday life (throwing trash away) and from the frame of computer commands (delete). The world of information technology provides us with another example of a double-scope network in the form of computer viruses. The term computer virus integrates elements from the realm of biology and the world of computers to indicate a malicious, self-replicating, unwanted computer program. As this example shows conceptual blending produces word combinations that can become engrained in lexical constructions. As they became more common the 'computer' was dropped so that 'having a virus' acquired the additional meaning that one's computer is infected.

Blending is not confined to language. It operates across all domains of cognition. Shortly after the death of Steve Jobs images appeared on the internet of the famous Apple logo with the bite replaced by a silhouetted profile of Steve Jobs. The symbolism was impossible to miss, which demonstrates the ease with which people perform double-scope blends.

Classical ballet provides us with a fascinating example of a double-scope blend in the form of Odette in *Swan Lake*. The evil sorcerer Von Rothbart has cast a spell on princess Odette, which transforms her into a swan during the day and a human during the night. The fact that she is a blend is key to the story, for when Siegfried aims his crossbow he is so mesmerized by the beauty of one of the swans, which is more that of a girl than of a swan, that he lowers his bow and instantly falls in love with her. At the level of the choreography the movements do not aim to imitate those of a swan, but try to capture their grace and their essence transposed onto a human body, thus creating a blended figure with a structure of its own. The actual performance provides yet another blend. Some people in the audience may have come to watch Ulyana Lopatkina or Aurélie Dupont, but they see Odette.

Conceptual integration is a powerful concept and once you get the point the whole world becomes a blend. Expressions such as digesting a book, the top of a building and junk food for the brain are all conceptual blends. Several years ago MTV Netherlands launched an advertising campaign with billboards reading 'If Elvis was still alive, he'd be dead by now'. At one point in David Foster Wallace's *Infinite Jest* (1996), 'Lenz overheard the veiled girl Joe L. tell Clenette Henderson and Didi Neaves the man was so cross-eyed he could stand in the middle of the week and see both Sundays' (Wallace 1996: 543).

An advantage of the conceptual integration framework over conceptual metaphor theory is that it accounts for expressions in which the metaphor does not result from a simple cross-domain mapping. For example, the expression digging one's own grave, which Fauconnier and Turner (2002) frequently invoke, is a combination of death and burial on the one hand and failure on the other. However, digging one's grave does not cause death and so the causal structure is not imported into the metaphor. Whereas conceptual metaphor theory is primarily concerned with the search for primary metaphors, conceptual integration theory also accounts for complex combinations of metaphors. Finally, conceptual blends are supposed to be created on the fly.

It is, however, as yet unclear whether the mind operates according to the analytic framework outlined by Fauconnier and Turner (2002). For one thing, it is not altogether clear what exactly mental spaces are and whether the model needs four spaces. Fauconnier and Turner (2002) provide numerous examples of conceptual integration, but no empirical evidence to support their model. They don't provide a specific methodology for analyzing blends either and even though they list a number of principles that govern conceptual integration and place constraints on the underlying processes, such as the compression principle, the topology principle, the unpacking principle and the pattern completion principle (Fauconnier and Turner 2002: 309-352), the whole procedure remains rather ad hoc and intuitive. It is also unclear how to distinguish a blend from a non-blend and a simple from a complex blend. As Gibbs (2000) argues, in the end, the theory may not be falsifiable.

Even though its merits as a scientific theory of how the mind works are contested, conceptual integration theory is a useful analytical framework for analysing dance. Merce Cunningham liked to recount in interviews how wildly the reception of *Winterbranch* (1964) varied when they first toured the piece in the late 1960s. The piece had started out as a study of different ways of falling to the floor, getting up and walking off, but depending on the country where it was performed audiences interpreted it in radically different ways. 'In Sweden they said it was about race riots; in Germany they thought of concentration camps, in London they spoke of bombed cities; in Tokyo they said it was the atom bomb. A lady with us took care of the two children who were on the trip. She was the wife of a sea captain and said it looked like a shipwreck to her. Of course, it's about all of those and not about any of them, because I didn't have any of those experiences, but everybody was drawing on his own experience, whereas I had simply made a piece which was involved with *falls*, the idea of bodies falling' (Cunningham and Lesschaeve 1985: 105).

These interpretations are not random associations but the result of a systematic mental process in which we can detect the principles of conceptual integration. When movements such as stumbling, falling, fleeing, evading, seeking support and so on are performed outside of any context and independent of any apparent goal, as they are in a dance performance, we may reconstruct their meaning by filling in the missing element using a process similar to Fauconnier and Turner's pattern completion principle. Some of the spectators who attended *Winterbranch* (1964) may have recognized the dancers' falling as fleeing and struggling to get away. However, people don't just flee, they flee *from* something. In the absence of any visible cause the spectators may have associated what they recognized as fleeing with events that might cause such behaviour. Since different people may have different associations, interpretations may vary wildly.

Since conceptual integration can be a conscious effort as well as an automatic process, it may also stand in the way of new blends and new meanings. The same strategies choreographers employ to annihilate a movement's emotional connotations can be used to deconstruct existing blends and give way to new meanings and new ways of seeing. Merce Cunningham's chance operations to determine the order of movements and the spatial organization of the dancers break the natural coherence of movements and events. In minimal dance simple movements are seemingly endlessly repeated as if someone were reciting the same words over and over again. In butoh movements are frequently performed so slowly that the beginning and endpoints blur and any goal or meaning becomes difficult to discern.

Understanding a conceptual blend can produce what is known as an *Aha*-experience, the jolt of emotion that accompanies a moment of insight (☞ §15.4). When asked what gets wetter and wetter the more it dries you may at first be puzzled until you realize that it is a towel. Depending on the nature of the elements and the relationships between them understanding a conceptual blend can also produce laughter or crying. The latter may be the result of a conceptual blend in which one creates an identity relationship between oneself and the character on-stage or on-screen. Conceptual integration theory thus provides an alternative account for the process of identification with a fictional character in cinema, literature and the performing arts (☞ §21).

Martha Graham liked to recount how, after one of the first performances of *Lamentation* (1930), she was approached by an elderly lady who had obviously been crying and who thanked her and said she would never know what she had done for her that night. When Martha Graham later inquired about her she learnt that the woman had seen her nine-year old child killed in front of her by a truck. Since the accident she had been unable to cry, but when she saw *Lamentation* she realized that grief was honourable, that it was a universal emotion and that she need not be afraid of crying for her son. The event made Graham realize that there is always one person in the audience to whom you speak. But why did *Lamentation* make the elderly lady cry?

In *Lamentation* the woman sitting on the bench is trying to hide from the world, the way a child might hide – if I don't see you, you don't see me – but in hiding she also tries to keep the world at bay. Because there is nowhere else to hide, she covers herself with her clothes, which become a protective sheet between her and the world. But her hiding place becomes a prison, from which she tries to escape, but she can't, because the fabric of the dress just stretches as she tries to break out. And so we witness someone who is at once trapped and hiding. The elderly lady who cried during a performance of *Lamentation* may have unconsciously understood the piece's symbolism and thereby her own predicament. She may have realized that she too was hiding in order to protect herself, but that her hiding had become a form of imprisonment.

27.5 CONCLUSION

Pina Bausch's *Sacre du Printemps* (1975) opens with the image of a woman lying face down on the soil-covered stage floor. Another woman runs diagonally to the edge of the stage, lifts her dress and covers her face. One by one more similarly dressed women enter the stage. While the other women run around the stage the woman who had been lying on her stomach gets up and reveals a red piece of cloth on which she had been lying. As she slowly extends her arms holding the piece of cloth all of a sudden the other women freeze and look at her as she lets the piece of cloth drop to the ground. The women gaze at the piece of cloth, retreat towards the rear end of the stage and begin to repeat a short phrase in keeping with the rhythm of the music. The group is dispersed as a group of men all dressed in black trousers and with bare torsos runs onto stage. At first the men dance amidst the women, both solo and as a group. For a brief moment both men and women dance together in unison. Then, almost imperceptibly, men and women split into two groups.

Of course, the choreography is infinitely richer than I can describe here, concurrent events are notoriously difficult to capture in a linear narrative, but the present account highlights some of the basic schemas and gestures around which the ballet revolves. When the woman extends her arms and lets it drop to the floor we understand that she wants to get rid of it. We also understand from the fact that the other women successively grab the piece of cloth that it inspires a strange fascination and that it plays a central role in the ballet. We understand that the men and women form a community and that the community is split along gender lines, a division which is visually enhanced by the costumes (☞ §5). The division becomes even clearer in the second half when the men gather upstage to the right while the women cluster together to the left. One by one a woman separates herself from the group to present the red cloth to the man who stands separated from the other men and whom we understand is their leader. At long last one woman is singled out as the Chosen one. All of this we understand effortlessly and spelling it out seems rather superfluous. However, the reason that we instantly identify the scenes and gestures and understand their meaning is that they fit into some basic schemas. If you think it's natural to see the groups of men and women as opposite sides, think again: you don't see the people on both sides of a pedestrian crossing as opponents ready to strike the moment the lights turn green.

As we have seen people segment the continuous flow of sensory input into discrete scenes and events based on prior knowledge in the form of event schemas and feature changes such as starts and stops, changes in the speed and direction of motion and changes in body configuration and orientation. We understand scenes in so far as they resemble known schemas and we understand movements in so far as they resemble familiar actions. According to the motor simulation theory of action understanding the meaning of other people's actions is understood because the action matches an identical motor representation in the brain of the observer. There is, however, little experimental evidence to support this view. As I have argued, the direct matching hypothesis also fails to capture what is normally meant by understanding. Understanding depends on context. An embrace can be a greeting, an expression of love and a gesture of consolation and support. To repeat, observing an action, recognizing an action and understanding an action are not synonymous.

Schemas allow us to understand scenes and events, but they also impart a structure on our world. Once an event has been fit into a schema it is difficult to see it otherwise. It is difficult *not* to see the men and women in the *Sacre du Printemps* as opposite sides and it is difficult *not* to see a gender relationship in a duet between a man and a woman. This has long been one of the staples of critical theory, but as I have argued, it is a result of the normal operation of the mind and brain. As I have argued before, the arts provide us with a number of generic schemas, which become part of the framework within which we interpret the world (☞ §23.3). As a result art can constrain and bias our view of the world and our own life. Novels and movies tend to have a plot and so it is tempting to search for a plot in one's own life and in world events, even though the best explanation is that it all happened by chance as a result of a host of factors that nobody expected or controlled.

However, by enlarging our schema repertoire and by inventing novel metaphors art can also enhance our understanding of the world.

While the number of *movements* that can be performed in dance is infinite, the number of *actions* that can be represented in dance is rather limited. Most actions involve an object, whether cutlery, pottery, power tools or a computer. In the absence of an object there is only so much that one can do. Accordingly, the number of scenes that can be represented in dance, compared with literature, theatre or cinema, is equally limited. There is a lot of pushing, pulling, lifting, running, wriggling and wrestling in dance, all of which is covered by a small number of generic schemas. Consequently, many dance productions give way to the same interpretation. Of course, these interpretations can be filled in and expanded upon. However, there is often little in the choreography to support more elaborate interpretations.

When in Pina Bausch's *Sacre du Printemps* the female dancers plant their elbow in the side of their body it is as if they drive a dagger into their stomach. The movement itself is simple enough, but it looks violent and aggressive, like an act of self-flagellation. According to conceptual metaphor theory a metaphor consists in the mapping of the elements and relations from a source domain to a target domain. In the phrase from the *Sacre du Printemps* one recognizes a stabbing motion and the forearm itself resembles a dagger or a sword and so the gesture acquires meaning as a metaphor. According to the conceptual integration framework developed by Fauconnier and Turner (1998; 2002) a metaphor is a special case of a conceptual blend, which combines the elements from two domains of knowledge or experience to yield a third, blended configuration. Normally stabbing oneself in one's stomach would cause the person to be mortally wounded. Since the dancers don't collapse the metaphorical gesture only retains some elements from the act of stabbing oneself.

One of the central tenets of conceptual metaphor theory is that metaphors structure our conceptual system and thereby our way of thinking and acting. In so far as artists work within a particular conceptual system the metaphors they use derive from the same conceptual system. Art is therefore far from the unconstrained realm of the imagination for which it is usually taken.

The present analysis has a corollary in that an artist can create the *illusion* of some deeper meaning by juxtaposing some disparate elements, leaving it to the audience to search for the structural similarities that would make it a metaphor. Viewers may assume that there *has* to be some deeper meaning, why else would the artist have created this particular configuration of elements? If they fail to come up with a satisfactory interpretation they may consider the artist profound and ahead of the rest of us ordinary earthlings.

As Aristotle already wrote in his *Poetics* (59a), for an artist, 'the most important thing is to be good at using metaphor. This is the one thing that cannot be learnt from someone else, and is a sign of natural talent' (Aristotle 1996: 37).

In *Véronique Doisneau* (2004) Jérôme Bel lifted a dancer, who for most of her career had been part of the corps de ballet of the Paris Opera Ballet, out of her anonymity and into the limelight. A woman stands alone on the giant, bare stage of an opera house. This in itself is enough to create a sense of solitude and one feels compassion for the solitary woman standing there. These feelings are enhanced by the story she tells. She talks about her life as a ballet dancer, about her marriage, her salary and her two children. Jérôme Bel thus literally gives a voice to a dancer whose job it has been throughout her career to be in the background. She tells how, within the hierarchy of the Paris Opera Ballet, she is a *sujet*, meaning that she can perform both corps de ballet and soloist roles. At a certain moment in the performance she dances a corps de ballet role from *Swan Lake*, a role which is normally danced by a group, but which now becomes a solo. Or rather, she strikes some poses, since the choreography requires the corps de ballet dancers to stand in line to form the background against which the principal dancers (*étoiles*) can show off their virtuosity. She tells how much she always resented just standing there. Earlier in the performance she danced an excerpt from *Giselle*, the role she always dreamt of dancing, but which, being a sujet, she of course never danced and which she now performs for the first time on stage. This constant doubling of meaning is one of the things that, in my view, makes it a brilliant piece. With *Véronique Doisneau* Jérôme Bel not only exposed a dark side of the dance world, he also erected a monument for all those who once dreamt of a successful career, but got stuck somewhere along the way.

KEY POINTS

☞ ‘Understanding an action, recognizing an action and observing an action are not synonymous.’

☞ ‘The direct matching hypothesis, according to which actions are understood because they map onto a motor representation of the same action in the brain of the observer, is attractive because of its simplicity, but it fails to capture what is normally meant by understanding.’

☞ ‘We come to understand something by comparing it to what we already know.’

☞ ‘Humans are capable of understanding the meaning and intention of both simple and elaborate actions. The same capacity allows us to understand gestures in dance.’

☞ ‘When you recognize a series of movements as dance you understand that there need not be anything to understand.’

☞ ‘The reason much classical ballet and the work of choreographers such as Pina Bausch revolves around a small number of stereotypical themes is that these themes are easily represented and recognized. To represent more complex forms of behaviour one would first have to establish a common ground, which allows the spectator to frame the behaviour in the appropriate context.’

☞ ‘Most people’s interpretations will gravitate towards a handful of basic behavioural categories.’

☞ ‘Schemas constitute our background knowledge and enable us to understand a situation or event. Once a schema is bestowed upon a scene everything else that ensues is interpreted within that schema, or at least until the scene changes.’

☞ ‘Dance, like all forms of art, has the potential to enlarge our schema repertoire and thus our understanding of the world.’

☞ ‘People segment the continuous flow of sensory input into discrete scenes and events based on prior knowledge in the form of event schemas and feature changes such as starts and stops, changes in the speed and direction of motion and changes in body configuration and orientation.’

☞ ‘If metaphors in general are conceived of as a mapping from one domain to another, then metaphorical gestures can be defined as those gestures which have the potential to engage such a cross-domain mapping.’

☞ ‘To the extent that metaphors structure our ordinary conceptual system and thereby our way of thinking and acting, a choreographer looking to express something by means of movement or the interaction between the dancers will build upon the same conceptual system and thus the same metaphors.’

☞ ‘Since conceptual integration can be a conscious effort as well as an automatic process, it may stand in the way of new blends and new meanings. The same strategies choreographers employ to annihilate a movement’s emotional connotations can be used to deconstruct existing blends and give way to new meanings and new ways of seeing.’

Part 6

Aesthetic Experience

28

INTRODUCTION

I started this inquiry with the uncontroversial observation that the perception of an artwork can produce various effects in an observer. It can produce pleasure, joy, sadness, disgust, delight, ecstacy, boredom and indifference. It can offer consolation and comfort, it can trigger one's imagination, it can inspire and give meaning to one's life and it can provoke social and political action. These effects don't just happen out of the blue: they are mediated by the brain. All human powers, such as the capacity to perceive, feel, think, believe, understand, anticipate and pay attention, are made possible by the interaction of numerous neural mechanisms. I summarized these observations in the form of a simple model:

$$X \rightarrow \blacksquare \rightarrow Y$$

With this model in the back of our minds the goal of the present study could be described as explicating the contents of the black box.

Works of art, like all cultural artefacts, are a product of the mind and therefore reflect the properties of the mind. I should add once more that, in a dual or dialectical sense, works of art that are created so as to delay or avoid the detection of certain features or the emergence of certain effects, are a negative or dual image of the mental capacities they were designed to evade. An artist who wishes to create an abstract pattern will have to push his capacity for pattern recognition to the limit in order to ensure that no figurative pattern exists. As I think the Dutch artist Theo van Doesburg once commented, before you know it a face appears (☞ §3.1). The present model therefore explicitly allows for avant-garde, Dadaist and conceptual artworks that elude other approaches in neuroaesthetics. It also allows for a much wider range of effects and experiences than traditional approaches in the psychology of art that focus on positive affect or aesthetic preference (e.g. Leder et al. 2004).

We are now in a position to provide a tentative map of the processes inside the black box, although, in many ways, the mind remains a black box (Figure 28.1). For one thing, it is as yet unknown how all of these processes interact and give rise to a conscious experience. I should emphasize once more that, as discussed in the introduction (☞ §1.8), all of the processes are to be understood as capacities in the sense of Cartwright (1989) or as invariant relationships that hold under a number of interventions in the sense of

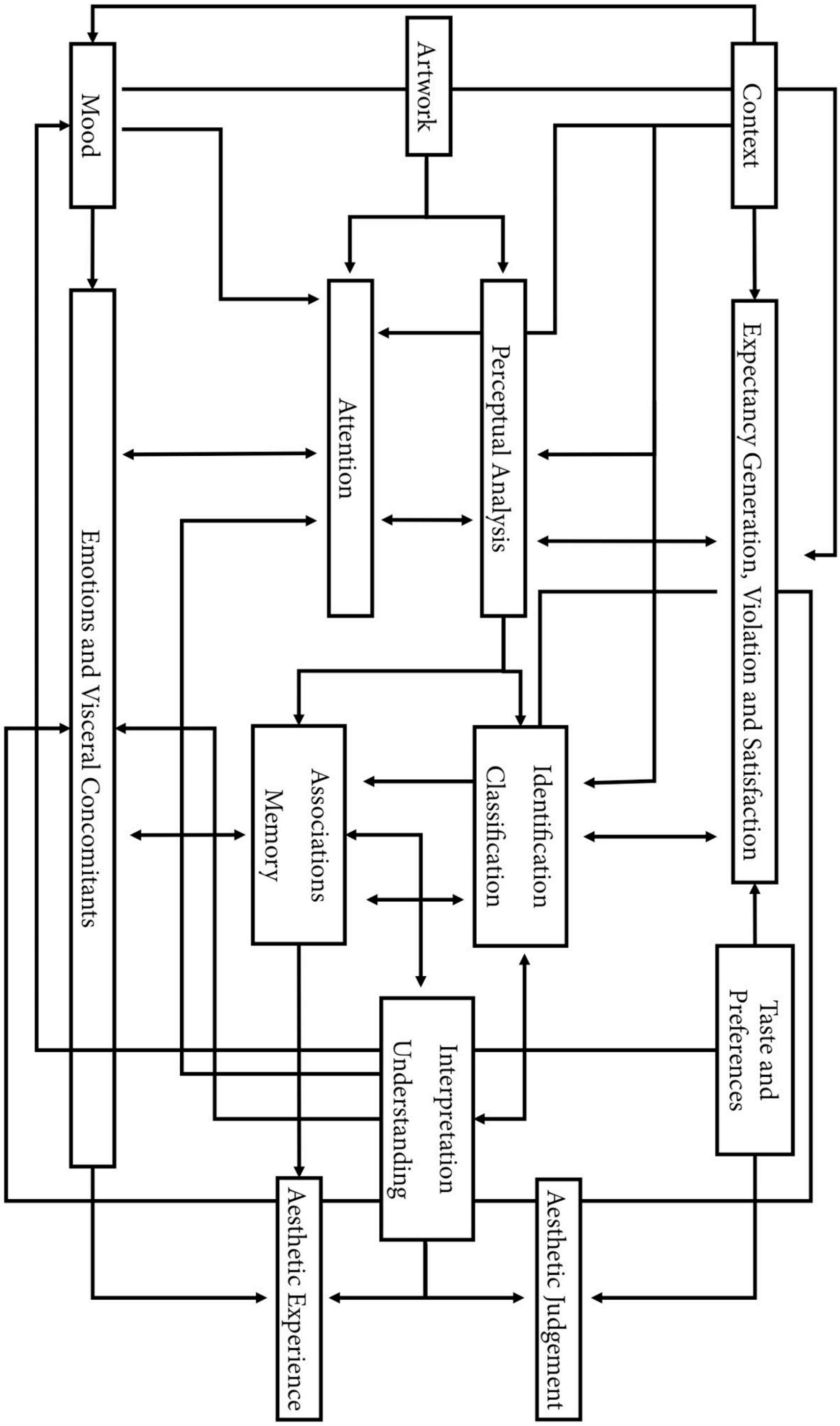

Figure 28.1 Adapted from Leder et al. (2004) and Tramo (2001)

Woodward (2003). Mental fatigue can, but need not, affect one's experience of a dance performance in an adverse way. Novelty and visual or semantic complexity can, but need not, be interesting. A performance of *La Bayadère* can be thrilling if everything is near perfect, but may lack magic if the dancers of the corps de ballet mess up the *Kingdom of the Shades* scene. A dance performance that does everything right in terms of internal differentiation and visual patterns can still be boring if it is yet another dime a dozen Forsythe or Kylián clone. As I have argued, overexposure to a class of stimuli, whether ballet, Japanese temples or contemporary art, may produce a sense of boredom. After visiting a dozen temples or watching the umpteenth supposedly cutting edge contemporary ballet you may feel you have seen it all before.

It might be objected that the present framework does not yet explain what is distinctly aesthetic about aesthetic experience. It does not distinguish between the pleasure of watching a synchronized swimming competition, a b-boy battle and a performance by the Forsythe Company. It does not distinguish between the arousal that accompanies playing a video game and watching a dance performance. It does not distinguish between an interesting novel and an interesting essay, theorem or algorithm either. So what, if anything, makes the output of the present model, the *Y*, an *aesthetic* experience? What distinguishes *aesthetic* pleasure from other forms of pleasure (☞ §22.1)?

Aesthetic pleasure is a problem, as Frijda (2007) observed. It is a problem, because an object can be repulsive, but a photo or a painting of it can be a source of pleasure. It is a problem, because people can take pleasure in something they don't enjoy, such as an art installation featuring decomposing animal corpses. It is a problem, because, as I wrote in the introduction, people on their way to work just walked by as Joshua Bell, one of the U.S.'s most celebrated violin players, played the concluding movement of Bach's *Partita No. 2 in D minor* inside a Washington D.C. metro station during the morning rush hour. This suggests that aesthetic pleasure requires a particular frame of mind and that there is no straightforward relationship between an object's sensory qualities and the aesthetic pleasure it affords.

Any explanation of aesthetic experience should account for the variety of artworks that people in different cultures around the world and across time actually take pleasure in, without committing us to any particular notion of art, if only because nature too affords experiences that can be considered aesthetic. Why else do people watch sunsets, solar eclipses and natural wonders such as waterfalls, canyons, caves and crystals? We should also allow for the fact that whereas some people are delighted by a performance of Pina Bausch's *Masurca Fogo* (1998), sitting through two and a half hours of *Tanztheater* may fill others with dread. I am aware that philosophers have grappled with these questions for centuries and the best we can hope for is to add some arguments for or against some existing perspectives. The next chapter provides a tentative account of aesthetic experience. Following that I will discuss the concept of aesthetic properties. I will end with a discussion of what many people would say art is all about: beauty (by whatever name).

29

AESTHETIC EXPERIENCE

Perhaps the simplest and most straightforward definition of aesthetic experience is in terms of its object. Reading a novel and watching a movie is an aesthetic experience – what else could it be? – for the simple reason that novels and dance performances are works of art. Defining aesthetic experience in terms of its object solves at least one problem, that of the compound nature of experience. A jogger may take pleasure in running through Central Park, in the music on her iPod, in being outside rather than inside a gym and in the admiring gaze of the men she passes by. When asked about the weather she might say that it is nice outside and looking at her stopwatch she might take pleasure in having set a new personal record. She might tell a friend that the new album she was listening to is awesome and offer to share it with her. The weather, the music and the course through the park all contribute to one's experience, but each can be singled out as an *object* of one's experience. Judging the weather has little to do with judging the music. If you don't like the music, you switch to another song or album. It would make no sense to put on more comfortable clothes in the hope that this will make you appreciate the music more.

A problem with this approach is that it is contingent on a definition of an artwork or an aesthetic object. Another problem is that it confines aesthetic experience to works of art, thus excluding nature, urban landscapes and found objects. If we don't want to get caught in an infinite regression we might stop here and simply posit that some objects or events are considered art and that, in so far as they are the objects of one's experience, the experience is thereby aesthetic. However, we can add some further considerations.

In the introduction to his *Critique of Judgement* (1790) Kant defines an object's aesthetic character as that which 'is merely subjective in the presentation of an object,' which is to be distinguished from 'whatever in it serves, or can be used, to determine the object (for cognition)' (Kant 1987: 189). But what is it that remains subjective in an object's presentation and cannot become an element of cognition? Kant says that it is 'the pleasure or displeasure connected with that presentation' (idem: 189). The pleasure or displeasure, which we feel upon encountering an object, tells us nothing about the object itself. When you walk into the permanent collection of the Museum of Modern Art in New York armed with the art historical categories you learnt in school and see a painting hanging on a wall, you may instantly recognize it as 'cubist', 'abstract expressionist' or 'pop art'. If the painting needs packaging to be transported to another location you may gauge its size in inches or centimetres with the help of a ruler. You may also judge its insurance value by consulting auction catalogues for the prices of similar works. Anyone with the same knowledge would come up with the same classification, the same measurements and the same price estimate. Upon looking at the painting you may think that it is pretty cool. You may be stopped in your tracks as you go to a higher floor and you may pause to take a closer look. For Kant this feeling is a sign of our being in the presence of beauty. Aesthetic judgement in the Kantian sense can then be defined as the judgement which seeks to connect the feeling of pleasure or displeasure to the object that gives rise to it and to establish the origins of this feeling. This aspect of Kant's *Critique of Judgement* therefore reads as a core affect theory of emotion *avant la lettre* (☞ §18.4).

Kant went on to claim, rather controversially, that it is an object's form or its composition, which constitutes the object of aesthetic experience or aesthetic judgement. Colour and the tone of an instrument, in his view, were merely sensory qualities, although he does concede that 'pure' colours can be beautiful. Kant's argument need not concern us here though, since colour can be considered a formal quality, as it is in the work of Barnett Newman and Ellsworth Kelly.

Many philosophers and theorists in one way or another subscribe to the notion that aesthetic experience consists in attention to an object's formal qualities (e.g. Beardsley 1982). Accordingly, one could say that experience is aesthetic if it takes as its object an object's form, its design, its composition or even more generally, the way it appears. Following Carroll (2002: 165) the form of an artwork may be defined as 'the perceptible embodiment of the point or purpose of the work.' However, before dismantling it, a car mechanic may contemplate how the engine of a car he isn't familiar with embodies its purpose, and so this broad definition also fails to uniquely characterize what is aesthetic about aesthetic experience.

If, instead of focusing on an aesthetic *object*, we focus on an object's aesthetic and expressive *properties* and if those properties can be objectively characterized in a non-circular fashion, that is, without recourse to a concept of aesthetic judgement or aesthetic experience, then perhaps the problem of defining an aesthetic object could be circumvented (☞ §8.2). In so far as it has aesthetic and/or expressive properties any object or event could then give rise to an aesthetic experience. Knowing that Truman Capote's *In Cold Blood* (1966) is a non-fiction novel one's reading experience could then be characterized as aesthetic. When admiring the design of a medieval Ottoman sword or the expression on an African mask one's experience would also be aesthetic, even though the objects were not intended as works of art, since in this case one contemplates the object's form or its aesthetic or expressive properties.

A further problem in defining aesthetic experience in terms of its object is that one can look at a painting to estimate its size or count the number of faces, figures or colours and one can watch a dance performance so as to learn the moves. We would therefore need to add that, in engaging with an object or event, one should merely attend to it and free oneself of any ulterior concerns. One might learn something from watching a film and reading a novel in a foreign language might enhance one's foreign language skills, but to learn about India one should read a non-fiction book, not *Midnight's Children* (1981) by Salman Rushdie and one should watch a documentary, not *Slumdog Millionaire* (2008). As Carroll (2000) has argued one should also be willing to play along according to the rules of the work or the genre. One should be willing to accept that in a horror movie a person can be chased by body parts detached from a living person and that in opera dialogues are sung instead of spoken. Aesthetic experience therefore implies a form of sympathetic attention, a willingness to surrender oneself to the work, the artist or the event and to be emotionally receptive to whatever may happen. This willingness depends on one's mood. You may feel like putting on some music, but not jazz and not that Nick Cave album you listened to over breakfast. And so, as you browse through your music collection, you try to think of what music you are in the mood for until you suddenly happen upon an album by Frank Zappa, which you hadn't listened to for ages. By the same token the people who walked by as Joshua Bell played inside a Washington D.C. metro station may have noticed the music and the musician, but they may not have been in the mood to disengage themselves from their preoccupations and to surrender to the music.

In summary, we might say that aesthetic experience consists in an inclination, a disposition and a readiness to engage with an object's or event's formal, aesthetic, symbolic or expressive properties and to disregard any other function, purpose, meaning or qualities it might have. Such a minimal, deflated view of aesthetic experience has been advocated by various contemporary authors such as Carroll (2000; 2002) and Levinson (1996). An advantage of defining aesthetic experience in terms of its object is that it does not depend on a notion of pleasure. Contrary to Frijda (1989), aesthetic experiences are not necessarily seen as affectively positive. One can look at an installation or a dance performance without thinking or feeling anything, but one's experience would still be aesthetic. One's experience of a dance performance does not cease to be an aesthetic experience if it turns out to be tedious and if one wishes to flee the theatre. Another advantage of the present definition is that it accounts for the fact that the nature of one's experience stays the same, regardless of whether one feels pleasure or displeasure. When taking a shower your experience may change from pleasant to unpleasant, if all of a sudden the water turns cold. While watching a dance performance you may not constantly experience pleasure, yet your experience remains of the same nature. Knowing that it can't be faked, viewers of *Oldboy* (2003) who, until that moment had enjoyed the movie, may experience an extreme sense of disgust the moment Oh Dae-su takes a bite from the still living octopus. Paradoxically, the intensity of this negative experience may increase people's aesthetic experience.

Although the present account helps us to define aesthetic experience, it does not tell us much about the nature of aesthetic experience. For one thing, aesthetic pleasure is 'individualizing' as Levinson (1996) puts it. It makes no sense to express a liking for music, dance, literature or art in general. A person might like the work of György Ligeti, but not György Kurtág, even though they're both called György, and he may not like Ligeti's early work or his mechanical compositions. This aspect marks an essential difference between aesthetic pleasure and other forms of pleasure.

A further difference is that sensory pleasures remain constant through time, whereas aesthetic pleasure changes with time. I love chocolate, although I should add that I have a preference for dark chocolate. If someone were to wake me up in the middle of the night and put a piece of Valrhona chocolate into my mouth, chances are I would enjoy it. Not much has changed in this respect since I was a little child. By contrast, my preferences in music have changed radically over time. I've got dozens of albums that I don't listen to anymore and I sometimes wonder why on earth I ever bought them. What is more, at times I am even annoyed by albums that I know I still like, for instance, when I need to concentrate or when I've got a headache.

Aesthetic experiences are valued in themselves or for their own sake, or so it is often claimed. A tennis player feels pleasure upon winning a major tournament, but it is the victory that he values, not the experience. The spectators who attend a performance by Meg Stuart Damaged Goods or the Forsythe Company value the experience itself: any feeling of pleasure that might accompany the experience is intrinsic to it and derives from acknowledging the aesthetic value of what is perceived.

The assertion that aesthetic experiences have an intrinsic value does not suffice to distinguish aesthetic experience from other experiences though. A choreographer visiting with friends may derive pleasure from doing so and value the experience for its own sake and not because he hopes to win them over to sponsor his next dance production.[111] However, it would make no sense to thereby qualify his visit as an aesthetic experience.

The view that aesthetic experiences are intrinsically valuable is also problematic in the light of the vast amounts of time, money and energy that individuals and societies have devoted to creating the conditions for attaining aesthetic experiences. It is hard to account for the countless paintings, madrigals and sculptures that were created for the Church, if we stick to the view that aesthetic experience is intrinsically valuable. There must be some benefit along the line somewhere. It is not necessary to assume that aesthetic experiences have an evolutionary benefit, as some authors assert (e.g. Dutton 2008). The benefits may also be social, political or personal. There may be good reasons why a person likes or dislikes a particular work at a particular moment in her life, even though she may be oblivious to those reasons herself.

The history of philosophy is full of examples of exalted qualitative accounts of aesthetic experience. In *The World as Will and Representation* (1818) Arthur Schopenhauer famously writes that aesthetic experience involves both a release and a relief from the everyday and the burdens of living.

> 'Raised up by the power of the mind, we relinquish the ordinary way of considering things, and cease to follow under the guidance of the forms of the principle of

[111] But thanks anyway.

sufficient reason merely their relations to one another, whose final goal is always the relation to our own will. Thus we no longer consider the where, the when, the why, and the whither in things, but simply and solely the *what*. Further, we do not let abstract thought, the concepts of reason, take possession of our consciousness, but, instead of all this, devote the whole power of our mind to perception, sink ourselves therein, and let our whole consciousness be filled by the calm contemplation of the natural object actually present, whether it be a landscape, a tree, a rock, a crag, a building, or anything else. We *lose* ourselves entirely in this object, to use a pregnant expression; in other words, we forget our individuality, our will, and continue to exist only as pure subject, as clear mirror of the object, so that it is as though the object alone existed without anyone to perceive it, and thus we are no longer able to separate the perceiver from the perception, but the two have become one, since the entire consciousness is filled and occupied by a single image of perception' (Schopenhauer 1966: 178-179).

What Schopenhauer here writes is not much different from what today is referred to as *flow* (Csikszentmihalyi 1990), which once more raises the question of how far we have actually advanced in our understanding of aesthetic experience beyond what was recognized two or more centuries ago.

As Carroll (2002) points out, a problem with all views that ground aesthetic experience in a form of release from everyday concerns, be they moral, political or practical, is that they derive from positive examples. However, during a tedious minimal dance performance one may become highly aware of one's practical concerns, a pain in one's left ankle, a slight tinkling behind one's right ear or the price of the ticket. What is more, some contemporary artists deliberately try to disrupt the lull of calm aesthetic contemplation by calling attention to the fact that what one watches is theatre or fiction.

Whereas Schopenhauer emphasizes the radical break between ordinary and aesthetic experience, John Dewey, in his book *Art as Experience* (1934), stresses the continuity between ordinary and aesthetic experience, but he too makes various emphatic claims. Dewey rightly observes that if we want to understand the nature of aesthetic experience we should widen our view beyond the canon of art history. Works by Raphaël, Vermeer, Mozart, Van Gogh, Balanchine, Duchamp, Cunningham, Shakespeare and so on come to us with a whole history of reception attached to them. It is impossible to deny their status as works of art. They are perfect examples of their kind and it is unclear whether listening to Beethoven's *Violin Sonata No. 9 in A major*, commonly known as the Kreutzer Sonata, or Michael Jackson's *Billy Jean* for that matter, is representative of listening to music in general and of the experience it affords. As Dewey remarked:

'In order to *understand* the aesthetic in its ultimate and approved forms, one must begin with it in the raw; in the events and scenes that hold the attentive eye and ear of man, arousing his interest and affording him enjoyment as he looks and listens: the

> sights that hold the crowd – the fire-engine rushing by; the machines excavating enormous holes in the earth; the human-fly climbing the steeple-side; the men perched high in air on girders, throwing and catching red-hot bolts. The sources of art in human experience will be learned by him who sees how the tense grace of the ball-player infects the onlooking crowd; who notes the delight of the housewife in tending her plants, and the intent interest of her goodman in tending the patch of green in front of the house; the zest of the spectator in poking wood burning on the hearth and in watching the darting flames and crumbling coals' (Dewey 2005: 3).

In Dewey's view 'even a crude experience, if authentically an experience, is more fit to give a clue to the intrinsic nature of aesthetic experience than is an object already set apart from any other mode of experience' (idem: 9). The question then becomes what, according to Dewey, counts as an authentic experience. In passing Dewey already mentioned the three moments that define aesthetic experience: attention, interest and enjoyment. In what Dewey refers to as '*an* experience' these three moments combine to form an integrated whole.

An experience has a unity, which 'is constituted by a single *quality* that pervades the entire experience' (idem: 38). In our ordinary comings and goings we do this and that, we browse the internet, make a phone call, go to the toilet, look out of the window, finish a report, drink a cup of instant soup, check the time, sit back in our ergonomic Herman Miller Embody™ chair, press the button of the elevator and buy 300 grams of crunchy vegetable stir fry, but none of this is experienced as such. In Dewey's account *an* experience is more than just a moment within the flow of consciousness. *An* experience in the pregnant sense of the word is rounded out into a single intense, coherent experience. It does not merely come to an end or go over into another experience: it is brought to a closure, it has an identity, *that* performance you saw *that* day in Paris, the sunset you saw *that* evening when you were on your way home from work when you wished you had your camera with you. Within the flow of experience emotion is both the sign of the break, the disruption of the ordinary flow of life (idem: 14) and the 'cementing force', which serves the restoration of harmony and which 'selects what is congruous and dyes what is selected with its color, thereby giving qualitative unity in and through the varied parts of an experience' (idem: 44). Aesthetic experience, according to Dewey, 'is the clarified and intensified development of traits that belong to every normally complete experience' (idem: 48) and any aesthetic theory or theory of art should build upon this notion.

But is aesthetic experience really marked off from non-aesthetic experiences by virtue of being unified? Doesn't knowledge of an artwork's historical context add to one's experience of it? Does the indifference one may feel towards a conceptual dance performance that drags on for 43 minutes on end also count as an aesthetic experience? Does art, not just any artwork, but all artworks, actually give rise to the kind of heightened, consummatory experience Dewey refers to? And what does it mean for experience to be unified and rounded off? Is there anything in-between unified experience and fragmented experience?

Phenomenological accounts of aesthetic experience, of which Dewey's is an example, make for compelling reading, as long as one does not read too much into them. The question is not whether aesthetic experience is consummatory, but why it gives the *illusion* of being so. Ironically, in developing his theory Dewey actually fails to account for the ordinary events that he sought to include. At least, it is hard to see how seeing a fire engine rushing by constitutes a rounded off experience. To gain a better understanding of aesthetic experience we should move away from viewing it as an exalted state and take seriously Dewey's starting point. A comprehensive account of aesthetic experience should allow for the pleasure of seeing a dress in a shop window and of attending a four-hour opera.

One of the appeals of Kant's *Critique of Judgement* (1790) is that it is essentially democratic. In Kant's view aesthetic judgement is part of being human. It doesn't require any special knowledge, training or taste. Furthermore, anything can become the object of aesthetic judgement. One should not be put off by the fact that Kant speaks of aesthetic judgement rather than aesthetic experience. In the ordinary sense of the word one's judgement may still hold after one's experience has ceased, but in Kantian terms the faculty of judgement enables us to have aesthetic experiences, so in a Kantian analysis both terms are interchangeable. We could thus think of aesthetic judgement as an appraisal. We should also abstract from Kant's notions of 'taste' and 'beauty', both of which may appear old-fashioned in relation to current art practices. Even though we may not find a particular performance or installation in any way 'beautiful', we may still take pleasure in it, which we may express by saying that it is 'great'. From an analytical point of view there is not much difference between these words, since they both give expression to one's aesthetic pleasure. Attaching a predicate adds nothing to the feeling that gives rise to it. I should add that Kant's analysis is notoriously difficult and opaque.[112] My purpose here is to try and make sense of Kant's arguments in order to gain an understanding of aesthetic experience, not to deconstruct his work.

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[112] Around the age of 50 Kant began to complain of headaches and various other clinical syndromes, which in the following years grew worse. He gradually lost his vision in his left eye and manifested signs of raised intracranial pressure, and later, other symptoms such as a slackening of social inhibitions, stereotypes and affective disinterest (Marchand 1997). Based on an analysis of historical documents and a comparison with contemporary medical case studies Marchand (1997) has suggested that Kant may have suffered from a slowly growing tumor in his left prefrontal cortex. As Marchand (1997) writes, 'this disorder gradually impaired his intelligence and judgement, progressing slowly toward dementia.' One of the symptoms of damage to this area is a general impairment in language and reasoning. Kant published the first edition of his *Critique of Pure Reason* in 1781, at the age of 56, followed in 1787 by a second edition, and the *Critique of Judgement* in 1790. Of course, Kant's medical history does little to diminish the insights one may glean from his work, but perhaps, and I stress *perhaps*, it does offer an explanation for the general lack of clarity and the overall knottiness of his later work.

Aesthetic judgement, according to Kant, is reflective. It is not based on an objective sensation (e.g. the sensation of colour) or a cognitive judgement (e.g. determining an object's colour, 'indigo') and does not follow from the application of a general rule or principle (e.g. postmodern dance sucks). It consists in an appraisal of an object in the light of the pleasure or displeasure that it affords. As Janaway (1997) notes, pleasure does not so much *cause* aesthetic judgement, it is the *grounds* on which the judgement of taste is made. As I observed above, its 'construction' is therefore akin to the constructionist view of emotion implicit in the core affect theory of emotion (☞ §18.4). In Kant's view aesthetic judgements are not mediated by a concept. Looking at the label of a bottle of wine, reading its description and noticing its price tag, won't tell you whether you will like it. You will have to taste it yourself. Knowing that a ballet was choreographed by Jiří Kylián or is performed by Netherlands Dance Theatre won't tell you whether it is any good. Your friends' recommendation and a negative review in a newspaper won't tell you anything either. You will have to see it and judge for yourself. In Kant's words 'there can be no objective rule of taste, no rule of taste that determines by concepts what is beautiful' (Kant 1987: 231).

Kant distinguishes three forms of pleasure: pleasure in the agreeable; pleasure in the good; and pleasure in the beautiful, which is the object of the judgement of taste. The judgement by which one declares an object to be agreeable expresses an interest in that object, which is 'obvious from the fact that, by means of sensation, the judgment arouses a desire for objects of that kind, so that my liking presupposes something other than my mere judgment about the object. (..) When I speak of the agreeable, I am not granting mere approval: the agreeable produces an inclination' (Kant 1987: 48). Aesthetic judgement proper is contemplative. It takes the object to be an end in itself and not as a means to serve a human purpose. It is independent of one's desires, moods, purposes and needs. The pleasure in perceiving an artwork or a magnificent 2,000-year-old 80-meter high Sequoia tree is not predicated on any future use to which it may be put. A carpenter might take pleasure in imagining the furniture he could make out of the tree and one might take pleasure in having one's car repaired or acquiring a discount card, which promises future savings, but these pleasures are not aesthetic in a Kantian sense.

The idea that aesthetic judgement is disinterested seems plausible. An aesthetic appraisal of architecture, let's say a bridge designed by Santiago Calatrava, only takes into consideration its design, not its structural stability. It doesn't matter whether its construction stayed within the budget, whether it meets the original program requirements or whether it had to be closed for traffic two days after being opened to the public. To the architecture students from around the world who come to admire it all that matters is its design. The men who visit a striptease club or a peepshow to watch a dancer gradually undress in a sexually seductive manner do so, not to contemplate the dance moves, but in order to be sexually aroused. By contrast, the spectators who attend a performance by Sasha Waltz and Guests don't do so in order to be sexually aroused, even when they know that in some scenes the dancers in *Körper* (2000) are partially nude: they are there to see the performance, not the dancers in various states of undress. Some individual spectators may have other reasons for attending the performance, one person may be eager to impress his date, while another person may be collecting material for his Ph.D. thesis, but none of this enters into one's experience of the performance.

Kant's distinction between the beautiful and the agreeable is conceptual: there is nothing *wrong* with the agreeable. The pleasurable is *not* inferior to the beautiful. It is, in Kant's view, a different category. It is also worth emphasizing that Kant's notion of disinterestedness only pertains to one's judgement and the pleasure one takes in something: it is the *judgement* that is disinterested, not the viewer, as Zangwill (1992) rightly points out. There is nothing *un*Kantian about wanting to own and preserve artworks one considers beautiful or about wanting to linger in one's contemplation of the beautiful. This does not alter one's judgement.

In 1994 Arlene Croce, dance critic for *The New Yorker*, wrote a long essay in which she explained her reasons for refusing to attend and review *Still/Here* (1994), a dance production by Bill T. Jones, which featured video footage of interviews with people diagnosed with AIDS or HIV, and urged her readers to do the same. Croce claimed that 'by working dying people into his art, Jones is putting himself beyond the realm of criticism' (Croce 2000: 709) and that she couldn't review someone she felt sorry for or hopeless about (idem: 710). Her essay caused a scandal, because most people are of the opinion that none of this has anything to do with one's judgement of the show. The history of art is full of paintings of battle scenes featuring dozens of dying people writhing in pain, which no one ever complained about. Indeed, the paintings can be quite beautiful. The famous Laocoön group shows the Trojan priest Laocoön and his sons Antiphantes and Thymbraeus being strangled by sea serpents, a gruesome scene if you think about it, but the sculpture is rightly famous. So basically most people would implicitly subscribe to the view that aesthetic experience is somehow or to some extent disinterested. Had public opinion been otherwise there would have been no need for Croce to write her essay and it wouldn't have caused the controversy that it did at the time of its publication.

One of the central themes in the *Critique of Judgement* is how aesthetic judgement is possible in the first place. According to Kant the pleasure in the beautiful is the result of what he terms the free harmonious play of the faculties of the imagination and the understanding.[113] The faculty of the understanding is free, because it is not required to

[113] To appreciate Kant's argument I will have to say a few more words about his philosophy. Kant's critical philosophy aims to explore the conditions and limits of human knowledge. His general approach is to analyse the faculties that make it possible for us to create and apply concepts. Kant viewed the mind as a complex set of cognitive capacities. Where Kant speaks of a faculty today we might speak of a capacity of the mind. It is not so much a psychological process or an entity, as a capacity for accomplishing something. In the introduction to the *Critique of Judgement* Kant tries to bring some system into his analysis of the different faculties. He distinguishes between faculties of the mind and cognitive faculties. The faculties of the mind can exercise their power in a 'higher'

provide concepts for determining the nature of the object. The faculty of the imagination is free, because it is unconstrained by the object or the faculty of understanding. In its productive capacity the faculty of the imagination is 'a power of original exhibition of the object and hence of an exhibition that precedes experience.' In its reproductive capacity it 'brings back to the mind an empirical intuition we have had before' (Kant 1987: 91). Normally, the faculty of the imagination is constrained by the sensed or imagined object itself and by the faculty of the understanding: the moment a sensed or imagined object is brought under a concept it is no longer possible to see it as something else. Similarly, the faculty of the understanding is constrained both by the faculty of the imagination and the sensed or imagined object: it cannot come up with just any concept. When you see an eagle you see a bird and an animal, not a computer or a coral reef. In aesthetic judgement both faculties are raised to a higher power, they are spontaneous in their productive capacity, unrestrained by each other or the object. Aesthetic judgement allows us to see an eagle as a symbol of strength and sharp sight, as an emblem of Jupiter and as a messenger of the Gods.

Kant assumed that the same object produces the same free play of the faculties of the imagination and the understanding in each and every person, and that aesthetic judgements therefore lay a claim to universal assent. To illustrate his point Kant refers to the way people actually behave in matters of taste. People speak of beauty *as if* it were a property of things. They don't just say 'I really liked *Véronique Doisneau* (2004) by Jérôme Bel' the way one might say of a glass of Chateau Margeaux (2005) or a piece of Valrhona chocolate 'I like it'. They say that it *is* great, that it *is* one of the greatest dance performances in recent years and they thereby expect everyone else to agree. What is more, people not only expect others to agree, they think that they *should* agree, that is, the claim to universality entails a claim to necessity. Aesthetic judgements are *normative*, to put it in

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or a 'lower' form. In their lower capacity they can be said to be bound by the laws of nature, for instance the laws of psychology or neurophysiology, whereas in their higher capacity they are autonomous and independent of the laws of nature. The faculties of the mind comprise the faculty of cognition, feeling and desire. One way of interpreting this triad is in terms of the different relations that can exist between a subject and an object. The subject can know or understand the object, it can desire it or act upon it and depending on whether its desires and purposes are furthered or impeded, it feels either pleasure or displeasure. Frijda's (1986) conception of emotion in terms of action readiness thus inherits its basic scheme from Kant. The question Kant addresses is whether each of these faculties is capable of a higher, autonomous form. In its 'higher' form, independent of objects, the faculty of desire equals our free will. The cognitive faculties are those capacities that make each of the faculties of the mind possible: understanding, which provides the mind with concepts; judgement, the general capacity to determine the nature of an object or event; reason, the capacity to make general inferences; and finally the faculty of sensibility, which is not linked to any of the three faculties of the mind and falls outside of the system, but which Kant had to include as a supplement to complete his system. Sensibility is the source of sensations of colour and sound. The imagination is the ability to conceive of previous sensations and to combine them into a new composite whole. The aim of the transcendental project can now be defined as determining the a priori conditions that underlie each of the faculties. Within this grand project the *Critique of Judgement* examines which a priori principles underlie the capacity for judgement.

contemporary terms. Surely, if someone were to deny the beauty of the Nevada Falls in Yosemite National Park, the temples at Angkor Wat, Balanchine's *Agon*, William Forsythe's *Quintett*, Bach's sonatas and partitas for solo violin or Velazquez' *Las Meninas*, he or she must be missing something?

A problem is that, in order to make a claim to universal assent, that is, in order to proclaim 'This is great!' rather than 'This feels good!' or 'I love it!' the subject should somehow be aware of the harmonious free play of his cognitive faculties. Kant appears to have been aware of this problem, although he dismisses it as a minor issue, for as he writes 'at present we still have to deal with a lesser question, namely, how we become conscious, in a judgement of taste, of a reciprocal subjective harmony between the cognitive powers: is it aesthetically, through mere inner sense and sensation? Or is it intellectually, through consciousness of the intentional activity by which we bring these powers into play?' (Kant 1987: 218). Kant answers that 'the only way we can become conscious of it is through a sensation of this relation's effect: the facilitated play of the two mental powers (imagination and understanding) quickened by their reciprocal harmony' (idem: 219).

It may seem out of place to dwell so long on the arguments of an eighteenth century philosopher in a book that deals primarily with contemporary psychology and cognitive neuroscience, but if instead of 'faculties of the mind' we read 'mental spaces' Kant's analysis is surprisingly contemporary and what Kant calls the free play between the cognitive faculties of imagination and understanding can be considered a distant forerunner of what Koestler (1964) termed bisociation (☞ §15.4) and what Fauconnier and Turner (2002) refer to as conceptual integration (☞ §27.4). In Koestler's view an aesthetic experience arises from the juxtaposition of two (or more) mental models, which brings out the analogies, paradoxes and frictions between both models. This is an ongoing process and would require the continuous free play of the faculties of the mind in Kantian terms.

Of course, what we would like to have is some empirical support for the quickening of the mind to which Kant alludes. I am afraid though that it will be a challenge to design an experimental protocol to test the hypothesis that there are changes in neural processing when an object triggers a host of associations. A number of EEG, ERP and neuroimaging studies have investigated the neural concomitants of insight (for a review see Dietrich and Kanso 2010). However, these studies have not yet yielded a consistent picture of what happens during moments of insight. Some studies report increased activity in the superior temporal gyrus in tasks that require the participants to generate verbal associations. Various studies also report increased activity in the anterior cingulate cortex, which is frequently found in tasks involving a form of cognitive conflict. As Dietrich and Kanso write, its role may be to 'initiate processes that lead to the breaking of the mental mindset that keeps one stuck in the wrong solution space.'

In his analysis Kant also comes closer than most other philosophers and theorists to capturing the productive aspect of aesthetic experience. I have no better way of describing what I think happens when inspiration strikes than to invoke my own experience.

I still remember how, on my first visit to Hong Kong, as I was on my way from the airport to my hotel on Hong Kong Island, I wanted to shout to the bus driver to stop right there and then, so I could get out of the bus and take some photographs. I felt the same kind of excitement as I walked through the back alleys of Old Delhi, even though many locals were puzzled why I was taking pictures of plumbing, wiring and walls. The same thing happens when I'm in the studio working on a new dance production.

What I see at moments like these is not what is there, but what lies beyond. What happens when I'm stopped in my tracks is not just that something catches my attention, something else happens as well, since whatever caught my eye also triggers my imagination. What I see is a photographic or a choreographic opportunity. It may be that other people don't see it, some people may not even see it after I have made the photo or when the piece is performed on stage, they may wonder what there is to see, but that doesn't matter. It may also happen that thousands of other people experience the same sensation and all grasp their camera at the same spot: just watch the tourists in Paris, Venice, Florence or Pisa or compare people's photos of touristic hotspots on photo sharing sites such as Flickr. It is fascinating to see the number of people who all happen to have the same idea of posing in front of the Leaning Tower of Pisa so that it seems as if they're supporting it. Some people may copy what others are doing or they may have seen a similar picture elsewhere. However, I believe that many people simply have a moment of inspiration: stand over there, hold your arms like that, that's fun! As a matter of fact, some people even have the same idea of taking a photo of people taking a photo of a person posing in front of the Leaning Tower of Pisa.

This kind of inspiration can strike at any moment and in any form. The sockets, light switches and door handles inside your house may until now have escaped your attention, but if you were to take a photograph of each single one they might make a nice collage or an interesting series. You may not consider yourself particularly photogenic, but if you were to take a self-portrait every single day for a period of one year and if you were to arrange the photos into a stop motion movie the result might be quite interesting. As a matter of fact, quite a few people had precisely this idea. An artist may simply be someone who is not only open to these moments of inspiration, but also unafraid to act upon it and determined enough to carry it through.

What I am proposing is that making a work of art and understanding and appreciating it, involve the same productive, creative process. A person who has never been to Italy and has never heard of the Leaning Tower of Pisa may instantly get the joke when he sees a picture of a person seemingly supporting the leaning tower. A person who understands a metaphor goes through the same mental process as the person who invented it. Of course, a reader or spectator may make a new connection and discover a layer of meaning the author didn't intend or foresee, but the process is the same.

To summarize, aesthetic experience consists in a free play of the powers of the mind or what, in a more contemporary terminology, has been called conceptual integration. In so far as the object of the experience is aesthetic and not, say, a mathematical theorem, the experience is aesthetic. The heightened attention and arousal that often, though not always, accompanies this state of mind and the fact that the experience is memorized, creates the illusion of a rounded off experience in Dewey's sense. When we experience such a state we are temporarily lifted out of our ordinary concerns in Schopenhauer's sense. Since this state occurs at a particular moment and is occasioned by a particular object or event, the experience is individualized. Since it usually feels good, we value the experience and since we don't get anything for it in return other than the feeling, we value the experience in itself.

KEY POINTS

☞ 'Aesthetic experience consists in an inclination, a disposition and a readiness to engage with an object's or event's formal, aesthetic, symbolic or expressive properties and to disregard any other function, purpose, meaning or qualities it might have.'

☞ 'Defining aesthetic experience in terms of its object makes it contingent on a definition of an artwork or an aesthetic object and confines it to works of art, thus excluding nature, urban landscapes and found objects.'

☞ 'One can look at a painting to estimate its size and one can watch a dance performance so as to learn the moves. In order for one's experience to count as aesthetic one should merely attend to an object or event and free oneself of any ulterior concerns.'

☞ 'Aesthetic experience implies a form of sympathetic attention, a willingness to surrender oneself to the work, the artist or the event and to be emotionally receptive to whatever may happen. This willingness depends on one's mood.'

☞ 'One can look at an installation or a dance performance without thinking or feeling anything, but one's experience would still be aesthetic.'

☞ 'An essential difference between aesthetic pleasure and other forms of pleasure is that aesthetic pleasure is 'individualizing'. It makes no sense to express a liking for music, dance, literature or art in general.'

☞ 'Sensory pleasures remain constant through time, whereas aesthetic pleasure changes with time.'

☞ 'To understand the nature of aesthetic experience we should widen our view beyond the canon of art history.'

☞ 'Aesthetic judgement, according to Kant, is reflective. It is not based on an objective sensation (e.g. the sensation of colour) or a cognitive judgement (e.g. determining an object's colour, 'indigo') and does not follow from the application of a general rule or principle (e.g. postmodern dance sucks). It consists in an appraisal of an object in the light of the pleasure or displeasure that it affords.'

☞ 'Aesthetic judgement is disinterested.'

☞ 'Aesthetic experience consists in what Kant referred to as the harmonious free play of the faculties of the mind. In contemporary terminology it consists in the conceptual integration of previously disparate mental spaces.'

☞ 'Making a work of art and understanding and appreciating it involve the same productive, creative process.'

30

AESTHETIC PROPERTIES

In his *Lectures on Fine Art*[114] the German philosopher Georg Wilhelm Friedrich Hegel (1770-1831) remarked that, while it is often argued that art is meant to evoke feelings, investigations into the nature of those feelings did not get far, 'because feeling is the indefinite dull region of the spirit; what is felt remains enveloped in the form of the most abstract individual subjectivity' (Hegel 1988: 32).

> 'Feeling as such is an entirely empty form of subjective affection. Of course this form may be manifold in itself, as hope, grief, joy, pleasure; and, again, in this variety it may encompass different contents, as there is feeling for justice, moral feeling, sublime religious feeling, and so on. But the fact that such content [e.g. justice] is present in different forms of feeling [e.g. hope or grief] is not enough to bring to light its essential and specific nature. Feeling remains a purely subjective emotional state of mind in which the concrete thing vanishes, contracted into a circle of the greatest abstraction. Consequently the investigation of the feelings which art invokes, or is supposed to evoke, does not get beyond vagueness; it is a study which precisely abstracts from the content proper and its concrete essence and concept. For reflection on feeling is satisfied with observing subjective emotional reaction in its particular character, instead of immersing itself in the thing at issue i.e. in the work of art, plumbing its depths, and in addition relinquishing mere subjectivity and its states' (idem: 33).

Hegel was right that any given person's feelings don't say much about a work of art. As we have seen emotions involve an appraisal (☞ §18.3), which is contingent on a variety of individual and contextual factors. I was overcome by nostalgia as I walked through the streets and alleys of Lisbon's Alfama district, but I am aware that long time residents may not share my feelings and had I been in a hurry to catch a flight I might have been supremely annoyed by those narrow streets and cobblestones. The room attendants at the Prado, the Hermitage, the Centre Pompidou and MoMA, who spend their days surrounded by some of the world's greatest works of art, don't appear to be in a state of

[114] I follow the convention of referring to this text as Hegel's. It was put together by one of his student's based on a sadly lost manuscript of Hegel and a series of lecture transcripts by his students.

exaltation either. They just hang around and wait until the day is over. But of course looks may deceive. Who knows they may be floating in a permanent state of aesthetic bliss.

If we ignore the feelings elicited by artworks, whether emotions or agitations (☞ §17.1), we also ignore some of their most salient properties and indeed the reason why many were made in the first place. Thrillers for example, can be defined in terms of the standard five elements of fiction: plot structure, character, theme, style and setting, but their most defining characteristic is the mood they elicit. A thriller which does not create a sense of fearful excitement fails as a thriller. Similarly, erotic art may exhibit certain formal qualities, but its defining characteristic is its intention to evoke sexual thoughts, feelings and desires in the reader or viewer.

Sensible as the above argument may sound, it does run us straight into a number of age-old philosophical problems. For how can the feeling that a work elicits in a reader or a viewer be a property of that work? What does it mean to say of a tragedy that it is tragic and of a dance performance that it is moving? The problem extends beyond the use of emotion terms. A work may be referred to as beautiful, graceful, elegant, powerful, flamboyant, sentimental, sad or serene and one may recognize harmony, unity, anguish, cheerfulness, wittiness, vehemence and Angst in it. But what is the ontological status of these properties? How do they emerge from or attach to the objects or events to which they are attributed? Do they exist in any objective way or are they contingent on the experience of an observer? And if they depend on the experience of a reader, viewer or listener is it enough for one person to consider a ballet graceful or moving for it to *be* graceful or moving?

30.1 REALIST VS. ANTI-REALISTS

The properties of an artwork can be distinguished into aesthetic and non-aesthetic properties. When looking at a painting by Piet Mondriaan one can count the colours and the number of rectangles and when watching a ballet one can count the number of male and female dancers and one can estimate the duration of the performance. These are what might be called *non-aesthetic* properties. When we say of a colour that it is vibrant or of a series of movements that they are frenetic we attribute an *aesthetic* property to the object under consideration. Aesthetic properties can be formal, such as the symmetrical configurations in the work of Balanchine; emotional, such as when a work is said to be sentimental or delicate; representational, when a work is referred to as realistic or surreal; evocative, when a work is described as powerful, hilarious, serene, vivid, dynamic or lifeless; and art-historical, when a work is referred to as original, revolutionary or postmodern (Goldman 2009). But what kind of properties are aesthetic properties? And how do they relate to the object?

As you may have guessed the nature of aesthetic properties is a hotly debated topic in philosophy. The debate is usually cast in terms of 'realists' and 'anti-realists'. Realists contend that aesthetic properties form a distinct category of attributes and that those attributes are both real and objectively true. Thus, for instance, Levinson (2006) defines properties as ways of being and ways of appearing as a subclass of ways of being. A property, according to Levinson, is real to the extent that it is possible for something to either exist or appear in a certain way. Colour would be a way of appearing, since it depends on the presence of light and the appropriate sense organ in a perceiver. Aesthetic properties would then be 'higher-order ways of appearing, dependent in systematic fashion on lower-order ways of appearing but not conceptually tied to them or deducible from them' (Levinson 2006: 342).

Realists often argue that we don't just judge something to be beautiful or elegant. We consider it beautiful or elegant *because of* certain features. We can provide reasons why we think of something as powerful or moving, we may feel passionate about our judgement and defend it against those who think otherwise. I mean, who does Clement Crisp (2008) think he is to dismiss one of the greatest ballets of the twentieth century, *Café Müller* by Pina Bausch, as tedious and unendurable? Aesthetic judgements are *normative*, as Kant already argued in his *Critique of Judgement* when he wrote that judgements of taste demand universal assent, and they are so precisely because the properties to which they refer are considered to be objective by those who use them. It may be that Clement Crisp and I disagree over the aesthetic merits of the work of William Forsythe, Pina Bausch and (sigh) Kenneth MacMillan and Frederick Ashton, but to paraphrase Kant's solution to his first antinomy of taste, our disagreement is contingent on a shared capacity for aesthetic judgement and the recognition of the aesthetic properties that underlies our judgement.

It might be argued that aesthetic properties are all appraisals and therefore subjective; that they require the harmonious free play of the faculties of the imagination and the understanding, to once more invoke Kant; or alternatively, that they depend on a form of conceptual integration (☞ §27.4). To this the realist might answer that one may appreciate a ballet *because of* its overt felicity and glee and *despite* its overt felicity and glee, which suggests that both can be independently recognized without instigating or impeding one's judgement.

Anti-realists wonder how one can be a 'realist' about properties that are abstract, evaluative, metaphorical, subjective, affective, dispositional, historical or cultural. Anti-realists mainly question the assertions and assumptions of realists and in their own accounts of aesthetics do, or claim to do, without aesthetic properties. One could argue along the lines of Scruton (1974) that to describe a piece of music as sad does not literally mean that the music is sad in the same way as when we say of a person that he is sad. It directly expresses our state of mind upon hearing the music. Aesthetic descriptions are therefore not objectively true. To this a realist might respond that to claim objectivity for aesthetic properties is not to accord them a transcendent status independent of human reactions, but to assert that 'qualified perceivers' converge in their judgement (Levinson 2006: 335). Scruton (1974: 54) further claims that, 'in aesthetics you have to see for yourself precisely because what you have to "see" is not a property.'[115] In response a realist might refer to roadmaps, which have special signs for scenic routes and to traffic signs, which point to a 'beautiful vista', the meaning of which every road user understands. As Zemach (1997) has argued, for aesthetic terms to be understandable at all, their meaning must be shared and learnt by way of ostentation: 'this ☞ is a beautiful vista'. To this the anti-realist might object that, while this may be true, it still does not demonstrate the existence of independent, common and stable aesthetic properties. An anti-realist might also argue that aesthetic properties are just shorthand for describing a particular constellation of non-aesthetic properties, but that they have no further explanatory value. In principle, what needs to be said could also be said with reference to non-aesthetic properties. The realist might reply that this may sound good in theory, but fails in practice. It would be hard to describe some dance scenes as other than chaotic. In reply an anti-realist might point out that one can feel sad about the extinction of an animal species and that, in this case, one might call the event sad, but to claim that it is a property of the event makes no sense.

The term aesthetic property originated in analytic philosophy, but it is not much different from what French philosophers Deleuze and Guattari in their book *What Is Philosophy?* (1994) refer to as percepts and affects. Percepts and affects, in the idiosyncratic terminology of Deleuze and Guattari, differ from perceptions and affections in that they are independent of the person who experiences them. Affects are what one might call the whole of all expressive or affective aesthetic properties, while percepts are the whole of all perceptual aesthetic properties.

In the jargon of analytic philosophy aesthetic properties are said to be supervenient on non-aesthetic properties, that is, they depend on or are determined by non-aesthetic properties. A piece of music depends on the choice of instruments and a conceptual work of art on a set of instructions, a title and the context in which it is installed or performed. In dance it matters a great deal whether a duet is danced by two male, two female or a male and a female dancer. If a duet is danced by a male and a female dancer it is almost inevitable to see it as an unfolding relationship between a man and a woman. The supervenience structure entails that, if two works of art are considered to be aesthetically different, there must be some difference in their non-aesthetic features to account for this difference. But what is the relationship between aesthetic and non-aesthetic properties? And does the supervenience relationship also hold across different observers? After all,

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[115] As Merce Cunningham once said in an interview, 'Dancers work with their bodies, and each body is unique. That's why you can't describe a dance without talking about the dancer. You can't describe a dance that hasn't been seen, and the way of seeing it has everything to do with the dancers, and that's the trap. Personally I find that marvelous. How could one experience dance except through the dancer himself' (Cunningham and Lesschaeve 1985: 27). What Cunningham says is that the totality of aesthetic properties does not exhaust the dance or choreography. There is something left that is not captured by its properties. This residue can be summed up as the dancer's body and personality.

different people may have different reasons for judging something elegant, moving or powerful.

Sibley (1959) is usually credited for arguing that aesthetic properties are non-condition governed: there are no non-aesthetic features that can serve as a sufficient ground for their application. It may be that some features are typically associated with a particular aesthetic property, for example sad music tends to be slow, quiet, played in minor keys and with descending intervals, but that does not mean that all music which exhibits those features is thereby 'sad', or that music that lacks some of these features cannot be sad. The same argument also applies to style properties. No single feature defines classical ballet and no feature is unique to it either and yet one can readily tell ballet from bharata natyam or old school b-boying.

Sibley (1959) claimed that the ability to distinguish aesthetic properties depends on a special capacity called taste. But if taste is the capacity to recognize aesthetic properties and if aesthetic properties depend on the capacity for taste, our reasoning becomes circular. Other authors argue that only 'qualified perceivers' (Levinson 2006) or 'ideal critics' (Goldman 1995) are capable of discerning aesthetic properties. Accordingly, only a (former) ballet dancer could lay a claim to judging ballet. Similarly, contemporary observers may not fully grasp the pictorial content of medieval paintings because they are unfamiliar with the symbolism and the biblical stories they portray, that is, they lack the common ground required to understand their meaning (☞ §26.2). It has also been argued that the observer should be 'properly positioned' (Pettit 1983) and that aesthetic properties depend on 'standard observation conditions' (Zemach 1997). Obviously, one has to be properly positioned in front of a painting, drawing, photograph or sculpture in order to perceive it. To see colour the lighting has to be right. To hear music it has to be played at the right volume and there should be no circumstantial noises that might interfere with it. In dance it matters a great deal where you are seated. A person seated on the first balcony may be able to appreciate the geometric patterns in Balanchine's *Symphony in Three Movements* (1972), while a person seated front row may lack the perspective afforded by the first and second balcony, but see nuances of expression people seated at the back may miss (please note that I have never sat front row during a Balanchine ballet and therefore cannot confirm whether such nuances of expression really exist).

30.2 NEUROAESTHETIC PROPERTIES

Against received wisdom in contemporary aesthetics I would like to propose that there is no need to assume any special capacities to account for the ability to distinguish aesthetic properties. Obviously, to discern art-historical or representational properties one needs to be in possession of the requisite knowledge, but this knowledge is related to the ability to recognize the corresponding aesthetic properties. To know what impressionist art is, is to be able to recognize an impressionist painting. The ability to distinguish fauvist art and modernist architecture therefore reflects one's knowledge of the respective art historical categories. What I would like to suggest is that the ability to distinguish emotional and sensory aesthetic properties similarly reflects the underlying mental capacities. I would therefore like to call *neuroaesthetic* properties, those properties which are a reflection of how the brain processes sensory stimuli.

These neuroaesthetic properties correspond with the invariant relationships that I have identified in the preceding chapters. Entertaining objects are objects which sustain attention through a combination of salient stimuli; interesting objects are objects which invite closer examination or contemplation because of their perceptual or semantic complexity (☞ §10.2); chaotic objects are objects which cause the principles that govern perceptual organization to falter (☞ §5); sentimental objects are objects that bring one to the verge of tears (☞ §23.1); joyful movements are movement in which one recognizes the expression of joy; playful movements are movements in which one recognizes elements of play and so on.

Neuroaesthetic properties that correspond with a highly stable invariant relationship are more easily recognized than properties that correspond with a weak relationship. These are the kind of properties that are easily labelled, such as chaotic and sad. As a matter of fact, some neuroaesthetic properties are impossible *not* to recognize. It is impossible *not* to see a smile in a smiling face (unless the face is inverted) and to consider the expression happy or cheerful, it is impossible *not* to see a menacing pose as menacing (but as welcoming) and it is impossible *not* to see a crying face as sad (but as merry). It may even be hard, if not impossible, *not* to attribute intentions and emotions to abstract animated figures as in the experiment by Heider and Simmel (1944) (☞ §6).

Sibley's (1959) claim that aesthetic properties are non-condition governed has been taken as gospel by many subsequent authors. I agree that it is not possible to derive necessary and sufficient conditions for the emergence of aesthetic properties in general. But logical conditions are not always all-important. Some configurations are more likely to give way to a particular appearance or aesthetic property than others. A raised voice is more likely to be expressive of anger than a whisper, but in a situation in which conversation is confined to whispering a person may seek to express his anger otherwise, for example, by stressing each syllable, rather than speaking in a flowing sentence. A choreographer or director who wishes to make a scene more dynamic won't do so by having his actors or dancers hang around on the floor, but by having them run around. This doesn't mean that, by definition, running around is dynamic, but it is more likely to be dynamic than standing still. And if the dancers are confined to standing still one would have to find another way of making the scene dynamic.

It is precisely *because* some movements, images, words and sounds are associated with particular aesthetic properties that artists avoid them if they want to prevent the audience from entertaining certain feelings and steer them away from certain interpretations (☞ §27.1; §27.2; §27.4). If you *don't* want a ballet to look graceful and elegant, then don't use floral summer dresses and Baroque music and be careful with long, fluid movements. If you *don't* want a ballet to look aggressive, then don't use heavy metal music, don't dress the dancers in jeans and black t-shirts, don't have them wear ankle boots and avoid running, throwing, chasing and anything that might look like mock fights. I have already referred several times to Merce Cunningham's use of chance operations to break the natural coherence of body postures and movement sequences so as to avoid the easy attribution of meaning and emotion. The American choreographer Alwin Nikolais (1910-1993) liked to emphasize objectivity and neutrality while downplaying the dancers' individual personalities. The dancers had to think of themselves as abstract bodies, not as characters or persons and avoid meaningful actions such as embraces.

30.3 CONCLUSION

And so we have finally come full circle. The sensations elicited by a work of art feed back into the structure of the work of art in the form of its aesthetic properties. As I have argued some of these properties can be retraced to the workings of the mind and their neurological substrates. Artists mould their material until it has the desired aesthetic properties. Or as Deleuze and Guattari put it, 'by means of the material, the aim of art is to wrest the percept from perceptions of objects and the states of a perceiving subject, to wrest the affect from affections as the transition from one state to another: to extract a bloc of sensations, a pure being of sensations' (Deleuze and Guattari 1994: 167). As I once formulated it myself, what is rehearsed during the rehearsals for a new dance production are not just the movements, but the perceptions and feelings they entail (Hagendoorn 2004b). Affects and percepts, in the terminology of Deleuze and Guattari, or aesthetic properties, in the terminology of analytic philosophy, can thus be interpreted as the inverse of the function that maps a work of art into an aesthetic experience, which I referred to in the introduction (☞ §1.2).

We are now also in a position to address the question of why artists actually create art. Creating a dance production costs considerable time and money. Why go through all this effort when there are so many acknowledged masterpieces in the world already? Why spend four to six weeks in a studio when you can travel to Angkor Wat or visit the National Parks of Utah? Why write a novel when there are more outstanding novels than any one person can read in a lifetime? Why do artists create art? Why indeed? Michelangelo, Titian and Rembrandt might have answered that they were commissioned to do so, but then Rembrandt also painted some astonishing self-portraits and portraits of his wife and son. From a business point of view that would have been a waste of time and material, even if it was just a way to enhance and showcase his skills.

What matters to an artist is whether he or she succeeds in realizing a particular combination of aesthetic properties of which he or she might say: 'This is it.' The moment the artist considers a work finished (or at least ready to be shown to an audience) it has the properties he or she wants it to have. They need not be perceptible to each and every viewer or listener. The following day the artist may change his mind and wish he could add something here or change something there. The artist may not be able to paraphrase in words what the work articulates, after all, if what he wanted to convey could be put into a few simple words it would not have been necessary to create the work in the first place.

Of course, recognition is a pleasure, perhaps foremost because of the opportunities it brings to create new work, but in the end what matters to the artist are the aesthetic properties that he or she put into the work, not whether the audience likes it or not. For even if the audience is enthusiastic and even if the work receives good reviews an artist may still feel that it is not quite right yet, that the second scene is too long, that the lighting should be adjusted, that the first scene should be danced more ferociously and so on. Indeed, positive reviews may just convince him or her of the stupidity of dance, film, music or art critics who believe they can judge a work on which an artist has worked for weeks or months after seeing or hearing it only once.

Appreciating a work of art may take time. It may take time to discern a work's aesthetic properties. It may take time to understand a work's meaning and its intertextual and art historical references. Analysing a work of art may enhance one's understanding and disclose a work's expressive properties. If at first you only saw a ballerina tiptoeing across the stage you may be moved when you learn that those flailing arms in Michel Fokine's *The Dying Swan* (1907) are the futile beatings of a swan's wings no longer capable of carrying it clear off the ground. When you watch the same performance again you may not only appreciate what the choreographer was trying to say, you may also admire the dancer for her skills in rendering the aesthetic properties embedded into the work. And when in the final scene the dancer bends forward and relaxes her upper body, against all odds you may suddenly find tears welling up in your eyes.

KEY POINTS

☞ 'Hegel was right that any given person's feelings don't say much about a work of art. As we have seen feelings involve an appraisal, which is contingent on a variety of individual and contextual factors. But if we ignore the feelings elicited by artworks, we also ignore some of their most salient properties and indeed the reason why many were made in the first place.'

☞ 'The properties of an artwork can be distinguished into aesthetic and non-aesthetic properties.'

☞ 'Aesthetic properties can be formal, emotional, representational, evocative and art-historical.'

☞ ‘People may disagree over the aesthetic merits of a work of art, but the disagreement is contingent on a shared capacity for aesthetic judgement and the recognition of the aesthetic properties that underlies this judgement.’

☞ ‘The term aesthetic property originated in analytic philosophy, but it is not much different from what Deleuze and Guattari refer to as percepts and affects.’

☞ ‘There is no need to assume any special capacities to account for the ability to distinguish aesthetic properties.’

☞ ‘Neuroaesthetic properties are those properties which are a reflection of how the brain processes sensory stimuli.’

☞ ‘Some neuroaesthetic properties are impossible *not* to recognize. It is impossible *not* to see a smile in a smiling face (unless the face is inverted) and to consider the expression happy or cheerful, it is impossible *not* to see a menacing pose as menacing (but as welcoming) and it is impossible *not* to see a crying face as sad (but as merry).’

☞ ‘It is not possible to derive necessary and sufficient conditions for the emergence of aesthetic properties in general, but some configurations are more likely to give way to a particular appearance or aesthetic property than others.’

☞ ‘It is precisely *because* some movements, images, words and sounds are associated with particular aesthetic properties that artists avoid them if they want to prevent the audience from entertaining certain feelings and steer them away from certain interpretations.’

☞ ‘The sensations elicited by a work of art feed back into the structure of the work of art in the form of its aesthetic properties. Artists mould their material until it has the desired aesthetic properties.’

☞ ‘What matters to an artist is whether he or she succeeds in realizing a particular combination of aesthetic properties of which he or she might say: “This is it.”’

31

BEAUTY AND THE SUBLIME

It seems appropriate to end this inquiry with a discussion of what, in the view of many people, art is all about: beauty. When I speak of beauty I don't mean beauty *per se*, which in contemporary usage has connotations of gentleness, tenderness, sweetness, loveliness and delicacy. One wouldn't call a heavy metal song beautiful, except perhaps a ballad such as Metallica's *Nothing Else Matters* (1991). What I mean by beauty and beautiful is anything we might call brilliant, wonderful, marvellous, dazzling, excellent, splendid, magnificent, epic, awesome, fabulous or simply great.

It is a truism among philosophers, art critics and contemporary artists that art no longer has to be beautiful. And yet, even though it has been repudiated many times, beauty persists. An art critic who champions conceptual art and dismisses beauty as the opium of the people may take great care in selecting a pair of Prada spectacles. An artist who in his own work celebrates the ordinariness of everyday objects may have a penchant for bespoke French shoes. A philosopher who has spent her entire career deconstructing the concept of beauty may secretly enjoy listening to Michael Nyman's *The Heart Asks Pleasure First* (1993) and wish she were a ballet dancer. As Roger Scruton argues in a recent treatise, 'beauty is a real and universal value, one anchored in our rational nature' (Scruton 2009: x).

There is beauty everywhere. We recognize beauty in landscapes, buildings, flowers, animals, movements, mathematical theorems, everyday objects and other people, although some people are more discerning than others. It is often said that beauty is in the eye of the beholder, but going by the number of people who visit the Van Gogh museum, the Louvre and the Grand Canyon every year, many beholders concur in their judgement.

As Mothersill (2009) observes, there are a number of commonplaces about beauty that need no argument. Beauty is a kind of good, it is linked with pleasure, it is something worth striving for and holding on to, it serves no external purpose and it depends on perception or at least acquaintance with the object. Someone who declares that *Bella Figura* (1995), a ballet by Jiří Kylián, is beautiful would lose his credibility if it turned out that he hadn't actually seen it himself and based his judgement on hearsay.

People go to great lengths to experience beauty. They get up early and drive for miles to watch the sun rise at Mesa Arch in Utah's Canyonlands National Park, they pay 160 euro or more to attend a performance of *Swan Lake* by the Mariinsky Ballet, they travel to Paris to see *La Bayadère* performed by the Paris Opera Ballet and they are prepared to queue for an hour or more to visit the Uffizi Gallery or the Sistine Chapel.

People also work hard to achieve beauty. They spend years practising a musical instrument, they waste several precious hours per week inside in a gym to get a beautiful body, they sit still for hours in order to have their body painted and they rehearse for weeks to give a flawless performance of Balanchine's *Agon* (1957). All over the world one can find temples, sculptures, tombs and frescoes that people must have worked on for years if not entire generations to complete. All of this would be inexplicable if beauty weren't, in Scruton's words, a real and universal value.

And yet, despite its ubiquity beauty remains elusive. The concept is hard to define and beauty itself is hard to attain. After weeks of rehearsing a choreographer may feel that, for some reason and no matter what she tries, her new production still lacks that certain something that makes it into a real ballet.

Philosophers have struggled for ages trying to define beauty and by now every permutation of thought has already been entertained. If we forget about the concept of beauty and all that it entails and think through what people actually *do* when they consider something beautiful we may learn more about the neural foundations of beauty. For one thing, people look longer and more intently at a beautiful object or event and they listen more carefully to a beautiful song. They also want to see the performance, movie or video installation another time or listen to the same piece of music again. This suggests that, first and foremost, a beautiful object or event sustains people's attention and that, like the interesting, it compels them to contemplate it, to look at it from different angles and in some cases to analyse it and learn more about its history and conception (☞ §10). In previous chapters we have seen that increased activity in dopamine related brain structures is associated with interest (Kang et al. 2009; ☞ §10.1) and amusement (Franklin and Adams 2011; ☞ §15.3). We have also seen that the 'chills' various people experience when they listen to their favourite music is associated with endogenous dopamine release in the striatum (Salimpoor et al. 2011; ☞ §15.2). Humour, interest and what we commonly refer to as beauty may thus bind us to the object or event. We call 'interesting' objects and events that engage us at a cognitive level; we call 'beautiful' (or great or awesome or mesmerizing) objects and events that engage us at a sensory level. Of course, some objects and events are both interesting and beautiful. The aurora borealis and australis are beautiful because of the swirls of colour and interesting because one would like to know what causes them. *Las Meninas* (1656) by Diego Velázquez is interesting because of the many layers of meaning and beautiful because of the way it is painted.

What we would like to know is what artists do to make something beautiful. In the following paragraph I will give an account of a *specific* instance of beauty that is central to many artistic endeavours. Irrespective of the field or the kind of work an artist engages in, he or she will have some vague idea of what should be done and how. He or she will continue adjusting the composition, the phrasing, the lighting, the order and the positioning until it is right or until, for the moment at least, it seems perfect.

31.1 BEAUTY AND PERFECTION

In the eighteenth century aesthetics was still a straightforward discipline. Its central concept and subject matter was beauty. Beauty consisted in the perception of perfection and perfection in turn consisted in harmony or unity in variety. The job of the philosopher was to discover the rules that governed the production of objects of beauty and reduce them to a few fundamental first principles (Beiser 2009: 2). The German philosopher Christian Wolff (1679-1754), one of the principal exponents of German aesthetic rationalism, argued that, since artists don't do anything whatsoever, there must be a reason why they do one thing rather than another. According to Wolff these reasons are embedded in the implicit rules artists follow when they create a work of art. In his view it is the task of the philosophy of art to uncover those rules. The view that I have defended in the present inquiry is that some of these rules can be retraced to the workings of the mind and their neurological substrates.

In the philosophy of Wolff a rule is nothing other than a method or principle, which allows us to create and understand order, which Wolff defines as the similarity in how things succeed one another in time or coexist with one another in space. Perfection, in his view, is a specific form of order: harmony in variety and plurality in unity. He illustrates this concept with the example of a clock, which consists of many parts arranged in such a way as to correctly display the time. Wolff goes on to define pleasure as the sensory or 'intuitive' cognition of perfection. In Wolff's terminology pleasure is therefore not some kind of sensation or feeling, it has a cognitive dimension and involves a specific kind of awareness. Having defined both pleasure and perfection Wolff then defines beauty as the perfection of an object in so far as it has the power to produce pleasure in us.[116] He illustrates this claim with the examples of painting and architecture: the perfection of a painting consists in its similarity with the represented object or scene; the perfection of architecture consists in the degree to which a building unites a plurality of functions and building constraints into a single whole. An architect who knows the rules of architecture will thus be better able to appreciate a work of architecture than a layperson. All subsequent authors in the pre-Kantian tradition, from Baumgarten to Lessing, retained Wolff's basic conception of beauty as the intuition or the sensory cognition of perfection. And like Wolff they sought to establish the rules that govern the creation and appreciation of art.

It is important to note that the rules Wolff speaks of are not restrictions that limit the imagination: they follow from the artist's goals. Rules only determine the means to an end; they don't specify the ends. As Beiser (2009) argues, Wolff actually liberates the artist from

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[116] 'Die Schönheit besteht in der Vollkommenheit der Sache, sofern sie in Kraft derselben geschickt ist, Lust in uns hervorzubringen.' Wolff, C. (1732). Psychologia Empirica, §544, II/5, 420. In Wolff, C. (1968), *Gesammelte Werke*. Eds. J. École, J.E. Hofmann and H.W. Arndt. Georg Olms: Hildesheim.

a strict doctrine of imitation that would limit the artist to copying the present order of nature. 'The artist should imitate nature, to be sure, but not in the sense that he copies its order and perfection, but only in the general or formal sense that, like nature, he creates order and perfection' (Beiser 2009: 68). A contemporary version of Wolff's general thesis, which acknowledges the discoveries of twentieth century science, would thus allow for the rules that generate randomness, chaos and complexity.

The kinds of formal rules that preoccupied the philosophers of the rationalist tradition are central to any art form that involves the composition of spatial patterns. The moment a choreographer arranges the dancers in geometric patterns, as countless choreographers from George Balanchine to Lin Hwai-min like to do, the laws of geometry come into effect. There are many ways to create a symmetrical pattern, but there are infinitely many ways to break the symmetry. As I argued in chapter 5 when I discussed the Gestalt laws of perception (☞ §5), the brain will automatically detect various geometric patterns. However, it will also notice the slightest deviation from an intended pattern. If in the final scene of Balanchine's *Symphony in Three Movements* (1972) the wrong dancer raises or stretches her arms it ruins the entire configuration. If in the double pas de quatre in *Agon* (1957) one of the girls jumps too late or in the wrong direction or if she raises the wrong arm or the wrong leg, again, the whole scene is ruined. In fact, I once saw a performance of *Agon* in which the dancers messed up the final configuration of the first section. Admittedly, since this particular configuration is rather complex I may have been one of the few people in the audience who noticed that the symmetry was broken. I'm glad I wasn't backstage to hear the ballet master chastise the dancers for their negligence. Mr. Balanchine would have been very sad if he had been in the audience.

The eighteenth century doctrine of beauty as the intuition of perfection explains why a painting of a landscape can be considered beautiful, but it does not yet explain why the landscape itself can be beautiful, unless we subscribe to Plato's theory of Forms, according to which a painting is a representation of reality, which itself is a representation of an Ideal Form. I will try to convince you that, in some carefully chosen examples, we can indeed conceive of an actual event as the realization of an idea, although the ideas of which I speak only exist in the mind and not in nature or some supranatural realm of existence. To this end I will once again borrow a concept from Kant, this time from his *Critique of Pure Reason*.

The question Kant, and various other philosophers before and after him, sought to address, was how we arrive at the concept of a circle from observing round objects and how we arrive at the concept of causality from observing sequences of events. As Kant wrote: 'no image of a triangle would ever be adequate to the concept of it. For it would not attain the generality of the concept, which makes this valid for all triangles, right, or acute, etc., but would always be limited to one part of this sphere. The schema of the triangle can never exist anywhere except in thought and signifies a rule of the synthesis of the imagination with regard to pure shapes in space' (Kant 1998: 273/B180). Kant believed he had found the answer to this conundrum by conceiving of what is perceived as the product of the faculty of the imagination and by positing schemas as 'a product and as it were a monogram of pure *a priori* imagination, through which and in accordance with which the images first become possible' (Kant 1998: 274/B181). As a matter of fact, the idea that some kind of preconceived knowledge structures govern how we perceive the world is not that farfetched. When you travel to a foreign country you may recognize the traffic lights even though they have two instead of three lights and are positioned horizontally instead of vertically.

In chapter 4 and again in chapter 27 we encountered a modern incarnation of Kant's schema concept when we discussed motor schemas (☞ §4.2) and event schemas (☞ §27.2). Just as a motor schema refers to an abstract representation of a movement or a skill we can conceive of a perceptual schema to refer to an abstract representation of an object or scene. Similarly, the gestures and expressions that accompany an emotion can be considered an emotion schema (☞ §20.4). The crucial difference between the Kantian concept of a schema and its present day equivalent is that contemporary cognitive psychology has done away with Kant's notion of the *a priori* and instead views schemas as the outcome of an evolutionary, developmental or learning process (Arbib et al. 1998).

As you may recall schemas can be decomposed into smaller schemas and recombined into schema assemblages. A schema is instantiated in the brain every time a corresponding object or event is encountered, remembered or imagined. Schemas only represent the blueprint or outline of a corresponding action, object or event. There are no exact representations of each and every object or action floating around in the brain. For example, the motor schema for waving one's arm describes the general outline of the movement; it does not describe the movement's speed and magnitude and whether it is the entire arm or the forearm that does the waving, although more detailed schemas for each of these movements may emerge if the movements were to be rehearsed at length. There is no limit to how elaborate a schema assemblage can be. The Japanese tea ceremony, a ritualized form of making tea in which every movement and every element is highly stylized, can be regarded as an elaborate schema assemblage. Schema assemblages are not bound by reality either, since one can construct a novel assemblage out of existing schemas to yield an object to which no object in reality corresponds, such as a unicorn or a dragon.

The notion of a schema allows us to conceive of perfection as the match between an actual object or event and its abstract mental representation in the form of a schema or internal model. For instance, in gymnastics and diving the goal is the perfect execution of a fixed set of routines. Through endless repetition gymnasts and divers try to perfect their moves. The judges who assign marks during a tournament all know what a somersault should look like and match each contestant against this motor schema. Upon entering a competition divers need to submit a list of the dives they intend to perform so that the judges know in advance which dives each diver is going to attempt. One may thus assume that, when the judges read the order of moves, for example, 'reverse one and a half somersaults with three and a half twists, in the free position', the appropriate motor schemas are conjured up in their mind (☞ §4.2; §14.2; §27.1). As the movement unfolds in front of their eyes it is matched against the prediction generated by the internal models associated with each motor schema. It is a matter of debate whether these motor schemas originate in motor areas or visual areas. In my view it suffices that the judges are *visually* familiar with each movement; it is not necessary that they are, or once were, capable of performing the movements (☞ §4.5).

The advantage of conceptualizing perfection as the match between a schema and an actual object or event, is that it does not commit us to any additional notions such as harmony or a particular choice of subjects, since in principle any schema can serve as a model. The object itself need not be perfect or noble either. We can conceive of a perfect rendition of an unmade bed (Eugene Délacroix, 1827), a bunch of asparagus (Edouard Manet, 1880) or a bouquet of sunflowers in all stages of life, from full bloom to withering (Vincent van Gogh, 1888/89). In dance, too, any movement can be perfectly executed; we do not need to confine ourselves to the ballet vocabulary. A breakdancer will recognize a particularly well-executed pike freeze and any flamenco dancer will be able to distinguish between a good and a poor flamenco performance.

It might be objected that the image of a walking person does not typically result in an aesthetic response, even though it perfectly matches a walking schema. To meet this objection we could modify our proposal by assuming that a perfect object does not match a schema, but exceeds a current schema. A perfect instance of an object or action could thus set a novel standard. But perhaps we have discarded our original hypothesis too soon. After all, beauty is all around us. If you look long enough anything can be beautiful. The reason may be that, when you contemplate something, an internal model of that specific object is formed within your brain. Closely looking at a scene or an object may thus lead to the formation of a closed loop between the visual stimulus and the internal model in the same way that repeatedly listening to a piece of music leads to the formation of an internal model of its musical structure as a result of which you may come to like music you once detested. The present hypothesis therefore shares some characteristics with the mere exposure effect according to which people have a preference for objects with which they are familiar or to which they have been frequently exposed (e.g. Zajonc 2001) as well as with the perceptual fluency hypothesis according to which 'the more fluently the perceiver can process an object, the more positive is his or her aesthetic response' (Reber et al. 2004).

The present proposal only applies to a narrow class of objects and events and it only accounts for a limited number of instances of beauty. The logic of the argument is that *if* an object matches a schema *then* it might give rise to a sense of beauty. It is not possible to reverse the argument. Despite its limitations it allows us to explain why both a simple object, such as a sculpture by Brancusi, and an extensive ritual, such as the Japanese tea ceremony, can be considered perfect. It also allows us to better capture what artists do when they create a work of art. Isaac Stern and Rudolf Nureyev spent much of their life rehearsing and so did Balanchine and Pina Bausch. Rembrandt, Monet, Cézanne and Van Gogh continued adjusting a painting until it lived up to what they were trying to achieve. When you watch a documentary of William Forsythe, Pina Bausch or Jiří Kylián at work you may wonder why they are adjusting a shoulder here or a duet there. Even though they would be unable to formulate in words what should be done and why, they do know that it can be improved or perhaps by experimenting with alternative configurations they become convinced that the original configuration was perfect after all.

When rehearsing a work they haven't performed before musicians and dancers draw on their training and their knowledge of other performances, which provide a frame of reference for how a work should or could be performed. Consequently, they may have a model to which they aspire or they may have their own ideas of how the piece should be performed relative to how others do it or have done it. They may believe that it should be performed faster or slower or with more vigour. William Forsythe's *In the Middle Somewhat Elevated* (1987) was created for the Paris Opera Ballet, but has since been acquired by many ballet companies around the world. The role originally danced by Sylvie Guillem, arguably one of the greatest dancers of her generation, has since become a reference point in contemporary ballet. Every female ballet dancer aspires to dance it and, of course, hopes to equal Sylvie Guillem.

As I argued in chapter 13, spectators and listeners too approach each performance and each concert with a set of expectations and some preconceived notions of dance or music (☞ §13.3). A person may not have seen or heard the piece before, but he or she will be familiar with other performances and other works. Spectators who have seen Sylvie Guillem dance *In the Middle Somewhat Elevated* may consider Agnès Letestu's performance too elegant and too polished and they may be outright disappointed when they see the same piece performed by Dutch National Ballet.

I am aware that, in keeping with the overall architecture of the *Critique of Judgement*, Kant himself argues against the idea that beauty can be analysed in terms of perfection, since that would entail an objective purposiveness (☞ §29), whereas aesthetic judgement is subjective (Kant 1987: 73-75). Perfection is always a perfect instance of an object or event and therefore requires a concept of that object or event. For example, a perfect *arabesque* depends on the notion of an *arabesque*. Kant does allow for perfection as a ground for beauty in the form of what he calls accessory or adherent beauty. As he writes: 'Free beauty does not presuppose a concept of what the object is [meant] to be. Accessory beauty does presuppose such a concept, as well as the object's perfection in terms of that concept' (Kant 1987: 76). In my view the concept of adherent beauty makes the whole system of the *Critique of Judgement* inconsistent, but that's another matter.

Kant himself saw in fine art the expression of what he referred to as an aesthetic idea: 'a presentation of the imagination which prompts much thought, but to which no determinate thought whatsoever, i.e., no [determinate] concept, can be adequate, so that no language can express it completely and allow us to grasp it' (Kant 1987: 182). An aesthetic idea is the counterpart of a rational idea, which Kant introduced in the *Critique of Pure Reason* and which is 'a concept to which no intuition (presentation of the imagination) can be adequate' (idem). As Kant explains:

> 'a poet ventures to give sensible expression to rational ideas of invisible beings, the realm of the blessed, the realm of hell, eternity, creation, and so on. Or, again, he takes [things] that are indeed exemplified in experience, such as death, envy, and all the other vices, as well as love, fame, and so on; but then, by means of an imagination that emulates the example of reason in reaching [for] a maximum, he ventures to give these sensible expression in a way that goes beyond the limits of experience, namely, with a completeness for which no example can be found in nature' (Kant 1987: 182).

By the backdoor perfection is thus covertly reintroduced into the critical discourse sincethe completeness of which Kant speaks belongs to the concept of perfection.

At the price of greater ambiguity the Kantian aesthetic idea allows us more leeway than the schema concept. A dance critic may consider Uliana Lopatkina's Odette 'the incarnation of grief revealed in long, eloquent phrasing' (Crisp 2009a). A spectator may see in *Café Müller* the perfect embodiment of sorrow, loneliness, longing and miscommunication. Similarly, a blue painting by Yves Klein may redefine the meaning of blue. You look at it and know that this is what blue is meant to be, but to say that it is blue doesn't quite cut it: It is beyond ordinary blueness.

At some point in his analysis Kant invokes what he terms the 'Ideal of Beauty', which he finds in the beautiful representation of the human figure. This ideal does not present itself in the form of a perfectly regular face or body, which according to Kant usually conveys nothing, since it contains nothing characteristic, but consists in the expression of the moral (Kant 1987: 83). If you excuse me the metaphysical excursion, had Kant been alive today, he might have recognized his Ideal of Beauty not in painting or sculpture, but in dance, which unites the human figure and the actions of which it is capable. Dance can be an expression of freedom, for instance, when in parkour *traceurs* take on a city and jump from one rooftop to another. Who wouldn't like to be able to do this? Dance can also be an expression of cooperation such as when a group of dancers perform an intricate choreography.

As a matter of fact Schopenhauer comes close to actually expressing this idea. Schopenhauer regarded beauty as 'the adequate and suitable manifestation of the will in general, through its merely spatial phenomenon' and grace as 'the adequate manifestation of the will through its temporal phenomenon, in other words, the perfectly correct and appropriate expression of each act of will through the movement and position that objectifies it' (Schopenhauer 1966a: 224).[117] As he wrote 'grace consists in every movement

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[117] To properly understand Schopenhauer's aesthetics one would need to understand his metaphysics. Like Kant before him Schopenhauer holds that the object-in-itself, the inner nature of

being performed and every position taken up in the easiest, most appropriate, and most convenient way, and consequently in being the purely adequate expression of its intention or of the act of will, without any superfluity that shows itself as unsuitable meaningless bustle or absurd posture; without any deficiency that shows itself as wooden stiffness' (idem). There are no references to ballet or dance in the work of Schopenhauer, and it should be noted that at the time that he wrote *The World as Will and Representation* dance as an art form did not yet have the cultural prominence it would acquire in the twentieth century. However, this passage almost reads like one of the first axioms of classical ballet. As Schopenhauer continues 'grace presupposes a correct proportion of the body, as only by means of these are perfect ease and evident appropriateness in all postures and movements possible. Therefore grace is never without a certain degree of beauty of the body' (idem). Agrippina Vaganova could not have formulated it better.

31.2 AWE AND THE SUBLIME

I remember being rendered speechless when I walked into the Vélazquez rooms at the Prado and for the first time saw how big, how majestic, how stunning, those paintings that I only knew from reproductions really are. Of course, the grandeur of the rooms, the light and the kind of solemn atmosphere you only find in museums, at least when they are not crowded by groups of visitors and rowdy school classes, added to the experience.[118] I had a similar experience when I visited the Mosteiro dos Jerónimos, a sixteenth century monastery in Belém near Lisbon. It was late in the afternoon when I got there and when I climbed up the stairs for a look at the nave from the mezzanine level, I noticed how beams of sunlight fell through a window opposite a large sculpture of a Christ on a cross, casting the tormented look on his face in a blazing light. I felt tears welling up in my eyes as I realized that this was how it had been for more than five centuries, that this was how it would be long after my own death and that this was how the architects had envisioned it when they designed the cathedral. I also remember how, every time I watched William Forsythe's *Eidos: Telos* (1995), which I must have seen more than a dozen times,

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reality, cannot be known. Our body is an object like any other. This is how it appears to a surgeon or a dentist. However, one can know one's own body and one's actions from within, since every action is an act of the will. In other words, from the point of view of the self, the body and the will are one. Schopenhauer concludes that our body is given to us (subjectively) as Will and (objectively) as Representation. Schopenhauer then extends this notion to the world and the nature of reality at large, regarding the Will, the aimless desire for self-perpetuation, as the fundamental force that grounds all being. As he writes: 'the act of the will is indeed only the nearest and clearest *phenomenon* of the thing-in-itself; yet it follows from this that, if all the other phenomena could be known by us just as immediately and intimately, we should be obliged to regard them precisely as that which the will is in us. Therefore in this sense I teach that the inner nature of every thing is will, and I call the *will* the thing-in-itself' (Schopenhauer 1966b: 197). For an excellent introduction to Schopenhauer's aesthetics I refer to Levinson (2006: 355-65).

[118] After visiting the Goya rooms I had to be carried outside to recover on a bench in the nearby Real Jardín Botánico.

somewhere during the third act I would feel shivers running down my spine and wishing that the performance would go on for another hour.

The sublime, for that's how the experiences I just described are often referred to in aesthetics, has its origins in classical philosophy. Its roots can be traced back to the first century treatise *On the Sublime*, usually attributed to the Roman scholar Longinus, but it wasn't until the eighteenth century that the notion of the sublime gained currency in philosophy and art theory following Edmund Burke's *A Philosophical Inquiry into the Origin of Our Ideas of the Sublime and Beautiful* (1756) and Kant's influential treatment in his *Critique of Judgement* (1790). Burke argued that whatever causes terror or operates in a way analogous to terror can be a source of the sublime or at least as long as the person is safe from harm. In Kant's conception, in line with the rest of his thinking, it is not the object, but the experience of it that is sublime. It consists in a mixture of pain and pleasure: the pain of not being able to form an adequate representation of what is perceived by the senses, followed by the pleasure at the recognition that we can overcome the limits of our sensory faculties with the power of reason.

In Kant's view the feeling of the sublime emerges when one encounters something larger than life. Powerful events confront us with our physical limits and the fragility of the body. On a dark and starry night we may suddenly be overwhelmed by the sheer size and age of the universe that surpasses all standards of sense. According to Kant the failure to conceive of these objects and events reminds us of our power of reason to form an idea of the infinite. In comparison with the idea of infinity everything else is small and thus we find in ourselves a sign of our superiority over nature. However, it is unlikely that standing on a mountain top, or the viewing platform of the Empire State building for that matter, we are reminded of an idea of reason and Kant himself admits that 'this principle seems farfetched and the result of some subtle reasoning' (Kant 1987: 262).

Schopenhauer provides what is perhaps the most eloquent description of the sublime. In *The World as Will and Representation* (1818) he neatly captures my experience at the Mosteiro dos Jerónimos in Lisbon when he writes how some objects give the impression of the sublime 'by virtue both of their spatial magnitude and of their great antiquity, and therefore of their duration in time' and how 'we feel ourselves reduced to nought in their presence, and yet revel in the pleasure of beholding them' (Schopenhauer 1966a: 206). He observes that for a vast space to produce the feeling of the sublime, it should be directly and fully perceptible, that is, we should be able to form a representation of it, which is why we may be overcome by vastness when we enter a cathedral or the Turbine hall at London's Tate Modern, although the space outside is much larger. According to Schopenhauer, what distinguishes the feeling of the sublime from that of the beautiful is that, in the case of the beautiful the subject, disengaged from its usual needs and desires, freely contemplates the universal Idea embodied in the object, whereas in the case of the sublime the subject has to struggle to achieve and maintain this state of pure contemplation; it has to actively suppress its natural inclination to retreat from the edge of the cliff, to hide from the storm or to look the other way.[119]

Schopenhauer (1966a: 203-5) distinguishes several degrees of the sublime, or rather, transitions from the beautiful to the sublime. With great feeling for drama he invites the reader to transport himself 'to a very lonely region of boundless horizons, under a perfectly cloudless sky, trees and plants in the perfectly motionless air, no animals, no human beings, no moving masses of water, the profoundest silence.' Such surroundings offer a hint of the sublime 'for, since it affords no objects, either favourable or unfavourable, to the will that is always in need of strife and attainment, there is left only the state of pure contemplation'. Next Schopenhauer asks us to imagine a change of scene, the landscape now denuded of plants and showing only bare rocks. The feeling of the sublime distinctly appears, since the landscape now takes on a fearful character, being deprived of all that is necessary for human subsistence. Schopenhauer then invites us to imagine that it is near dark, that black thunderclouds gather above our heads or that masses of water and the wail of the wind sweep through a ravine. 'Yet as long as personal affliction does not gain the upper hand, but we remain in aesthetic contemplation, the pure subject of knowing gazes through this struggle of nature, through this picture of the broken will, and comprehends calmly, unshaken and unconcerned, the Ideas in those very objects that are threatening and terrible to the will. In this contrast is to be found the feeling of the sublime.' The feeling becomes even stronger when storms break loose, when we can no longer hear our own voice through the roaring of a falling stream, when lightning flashes from the sky and mountainous waves rise and fall.

From a contemporary psychological point of view the descriptions offered by Kant and Schopenhauer to illustrate their notion of the sublime mix two distinct feelings: on the one hand a state of increased arousal and on the other hand a feeling of *awe*. The feeling of awe can be analysed in terms of an appraisal of vastness and accommodation (Keltner and Haidt 2003). Vastness refers to anything that exceeds a person's ordinary frame of reference: it can be physical, such as a grand vista or loud music, but also social, such as an encounter with a celebrity or a Nobel laureate, and cognitive, such as when you grasp a mathematical theorem or a novel. Accommodation refers to the process of adjustment and assimilation needed to get to grips with a novel experience. This process can either fail or succeed. Its success determines the flavour of the experience on a scale ranging from

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[119] In keeping with the architecture of his metaphysical system Schopenhauer is forced to make a peculiar twist when he writes that the recollection of the will required to maintain the state of the sublime is 'not of a single individual willing, such as fear or desire, but of human willing in general, in so far as it is expressed universally through its objectivity, the human body' (Schopenhauer 1966: 202). For if 'a single, real act of will were to enter consciousness through actual personal affliction and danger from the object, the individual will, thus actually affected, would at once gain the upper hand. The peace of contemplation would become impossible, the impression of the sublime would be lost' (idem). However, the notion of there being two forms of will, one acting against the other seems contradictory.

terrifying to enlightening. If either one of these appraisals is missing the feeling is best described by another name. Thus vastness without the need for accommodation may be associated with deference and submission, while accommodation without vastness can be associated with a sense of surprise. A feeling of awe can be accompanied by various physiological symptoms. A person may experience shivers running down his spine (☞ §15.5), which can be a sign of arousal, and he may feel tears welling up in his eyes, without the other usual concomitants of crying, which can be a sign of submission (☞ §23.1). Importantly, and in contrast with Kant and Schopenhauer, there is no need to assume that the subject grasps a transcendental idea or rises above him or herself unless the process of accommodation as a whole is viewed as such.

As Kant, Schopenhauer and others already observed, to maintain the sublime one has to get close enough to the edge, but not too close, because then fear will take over. The feeling of awe for an object or event depends crucially on a *process* of accommodation. Dance and music have such a temporal dimension by definition, but in the case of painting and architecture one has to maintain it oneself by moving closer or by changing one's perspective. When you step inside a cathedral you are overwhelmed by the immense space, but the feeling of awe sets in only later, when the process of accommodation falters and you realize how vast, how magnificent the space really is. This gradual build-up of tension can find its release in the form of shivers running down one's spine or the spontaneous discharge of tears. This process is therefore not dissimilar from the general model of crying, laughter and the feeling that accompanies a sudden insight that I outlined earlier (☞ §15.3). To experience the sublime once more after the process of accommodation has succeeded one would have to step further towards the edge, look at something at a human scale and then up towards the ceiling again or turn up the volume of the music.

There are a number of aesthetic properties one would need to highlight in order to elicit a sense of awe. Scale works. The vast stages at Frankfurt's opera house, the Bastille Opera in Paris and Amsterdam's Muziektheater were designed to deliver the sublime. To emphasize the size of the space one could fill the stage with a large crowd or, by contrast, with a single person. Loudness also works, but a crescendo and anything resembling loud cracks of thunder that break the silence or the flow of the music work even better. Masses of people inspire awe by their sheer presence, a feeling which is enhanced when the people move in unison. When elements from different registers are combined the effect becomes even stronger. The choir in opera and the orchestral music of Mahler and Brahms combines a large mass of people with a wall of sound. In Pina Bausch's *Sacre du Printemps* (1975) pulsing music is combined with large orchestrated group sections. Solemnity also works. *Whereabouts Unknown* (1993) by Jiří Kylián opens with an ensemble of female dancers moving in unisono to the slow, grave sounds of *Fratres* by Arvo Pärt. There is, however, a fine line between the sublime and the bombastic and indeed between the sublime and the ridiculous.[120] Whereas some people revel in Wagner others may think that it is over the top.

Kant and Schopenhauer and various other philosophers after them distinguished between the beautiful and the sublime. Although the examples they used to illustrate their notion of the sublime were psychologically inspired, the distinction itself derived from considerations particular to the architecture of their philosophical system. They were thus unable to account for the observation that, in psychological terms, beauty too can inspire awe.

As I mentioned above, in the realm of aesthetics every permutation of thought has already been entertained. The idea that beauty or perfection can inspire awe was first proposed by the German philosopher Moses Mendelssohn (1729-1786). As he wrote in an essay on the sublime, 'every quality of a thing is called sublime when it is capable of arousing admiration (*Bewunderung*) through its extraordinary degree of perfection.'[121] He adds that this feeling of admiration is brought about by 'a sudden intuitive knowledge of a perfection that we did not expect of the object under the circumstances and that surpasses everything that we could have thought to be perfect.' But, as Beiser (2009) notes, the problem with the sublime is that by its very nature it transcends the limits of beauty. 'The pleasure of the sublime seems to arise precisely from our *incapacity* to grasp the object as a whole; it stirs our admiration just because it is immeasurable, unfathomable, and infinite' (Beiser 2009: 220). Mendelssohn appears to have been aware of the problem, since he revised his earlier essay and devoted a series of commentaries to Burke's *A Philosophical Inquiry into the Origin of Our Ideas of the Sublime and Beautiful* (1756), but he remained faithful to the idea that the sublime is that which is immeasurable in its degree of perfection.

Implicit in the feeling of awe, in so far as manmade objects are concerned, is admiration for the act of bringing the object into being. It follows that one's feeling of awe for a painting by Vélazquez is, at least in part, contingent on knowing that it is a painting and not a photograph. A photo by Andreas Gursky may also inspire awe, but it does so

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[120] The fact that the sublime can easily collapse into the ridiculous reminds me of catastrophe theory, a branch of mathematics largely developed by the French mathematician René Thom, which combines dynamical systems theory and singularity theory and which was briefly popular in the 1970s. One of the best illustrations of catastrophe theory concerns aggressive behaviour in dogs. It had been observed by Konrad Lorenz that aggression in dogs depends on two factors: fear and rage. Fear induces a dog to retreat, rage induces it to attack. But what happens if a dog is both enraged and afraid? Will it retreat or attack? The answer is that the dog's behaviour may suddenly switch from one type to another. A growling dog may flee if its fear increases and a retreating dog may suddenly attack if its rage passes a threshold. Neuropsychology provides us with numerous examples of gradual changes that result in a sudden state transition. The most obvious example is waking up and falling asleep, but some emotional episodes, of which crying is one, also fit the description. Perhaps the fact that extreme joy can alternately express itself in laughter and tears reveals the instability of the underlying dynamical system at its peak.

[121] Mendelsohn, M. (1761/1929). *Gesammelte Schriften, Jubiläumsausgabe*. Eds. Fritz Bamberger et.al. Stuttgart-Bad Cannstatt: Frommann, vol. I, p. 193, as quoted in Beiser (2009: 220).

because of its size and its subject matter. Just playing scales on a piano is unlikely to inspire a sense of awe, it is also unlikely to be considered beautiful, no matter how well played, even though a musical scale matches a perceptual schema many people are familiar with. If, however, someone were to play scales faster and faster at some point we may be awed by the player's speed and virtuosity, though not necessarily by the beauty of the musical arrangement. One may also be awed by the intense concentration that goes into a Japanese tea ceremony or a performance of a production by Robert Wilson and by the ease and fluidity with which a dancer performs every conceivable movement. Watching the three contortionists in *Kooza* (2007), a production by the Cirque du Soleil, one is awed by the inhuman agility of the performers. The *Wheel of Death* scene, a death-defying acrobatic act in the same production, is equally awe-inspiring, because one fears the acrobats might fall at any moment. Of course, the entire scene has been thoroughly rehearsed, but by seeming to lose their balance the performers create the illusion that through great effort and skill they surmount a superhuman challenge. Watching Jiří Kylián's *Click Pause Silence* (2000) one may be awed by the inventiveness of the movements, by the speed and the effortlessness with which they are executed and by the briefly posed body configurations that verge on the humanly impossible and that dissolve into another configuration before one has fully realized what one saw.

31.3 AND YET I (DON'T) LIKE IT

You may admire Jiří Kylián for his craftsmanship as a choreographer, but except for a few productions you may not like his work. After attending two triple bills you may fail to comprehend why Merce Cunningham is held in such high esteem; as far as you're concerned he is dance history. Even though you are big fan of the work of William Forsythe you may wish you had brought a newspaper or a magazine during *N.N.N.N.* (2002), which just goes on and on and on and on but without going anywhere. You may be puzzled why the other people in the audience are so enthusiastic about a performance by Akram Khan that leaves you totally indifferent. During a performance by Anne Teresa de Keersmaeker you may even begin to wonder whether you actually like dance. And just when you thought dance couldn't get any more dreadful you attend a performance by Wayne McGregor. Its sheer monotony is so deadening that after about ten minutes you want to flee the theatre. Out of respect for the performers you decide to stay, but when you notice other people starting to leave, in the end you too give in and leave the theatre.

It may also happen that, against all odds, you like something that does not quite match your usual aesthetic standards. Even though they won't go down as highpoints in the history of dance you enjoy watching the music videos for Kylie Minogue's *Can't Get You Out of My Head* and Justin Timberlake's *My Love*. You also love the music video for Fatboy Slim's *Praise You*, which features a group of amateur dancers performing a dance routine outside a cinema entrance in Westwood, California. Yes, the dancing is beyond bad, but it is so much fun. You would much prefer watching it every night for the next two weeks than having to sit through another hour of Stephen Petronio, John Neumeier, Marie Chouinard or VA Wölfl.

If you like everything there is something seriously wrong with your critical faculties. Perhaps you have seen too much contemporary dance recently (☞ §14.4). Perhaps you need ever more intricate and more refined stimuli to give you aesthetic pleasure (☞ §10.3). Perhaps you should take a break from art and go on holiday to Mali or Peru or perhaps you should attend a flamenco performance or an urban dance competition for a change.

This is also where our analysis comes to an end. There is not much more we can say apart from reiterating some banalities. As I said before art is individualizing. Every person is unique and so every person will have his or her own aesthetic preferences. Only patterns in human behaviour lend themselves to scientific analysis. There are some perfumes that I love and some perfumes that I don't like at all. But why does the chemical composition of one perfume appeal to one person and not to another? Why can even a minor change in the balance of the ingredients make all the difference? Perfume is simple compared with dance – it's just a chemical substance – and so it is unsurprising that there are many factors that might influence your judgement of a dance performance, from the number of dance performances that you have seen to the kinds of performances that you have seen and the number of times that you have seen a performance by a particular choreographer. The theatrical performances and the movies that you have seen also matter and so do the novels that you have read and the exhibitions that you have visited. All of this is, of course, correlated with your age, education, country of residence, income, social class and so on.

As I have argued in the preceding chapters, people may like dance because the rhythm and the flow of the movements keeps them on edge (☞ §9.1; §15.1). They may be enticed by the visual patterns in dance in much the same way as they are fascinated by time-lapse videos of traffic and of the night sky (☞ §5). They may like dance because of the emotions it either expresses or elicits (☞ §17; §18; §20), because of the meaning it embodies (☞ §27) or because they are awed by the supreme agility of the dancers (☞ §31.2). Some people may like a particular dance performance because of the way it subtly deconstructs the concept of dance while others may dislike it because it lacks structure, emotion, meaning, dramaturgy or interesting movements. There are as many reasons to like a dance performance as there are reasons not to like a dance performance, but there is no reason not to like dance.

KEY POINTS

☞ 'Beauty, by whatever name, is a real and universal value. It is linked with pleasure, it is something worth striving for and holding on to, it serves no external purpose and it depends on perception or at least acquaintance with the object.'

☞ 'Irrespective of the kind of work an artist engages in, he or she will have some vague idea of what should be done and how. He or she will continue adjusting the composition, the phrasing, the lighting, the order and the positioning until it is right or until, for the moment at least, it seems perfect.'

☞ 'Since artists don't do anything whatsoever, there must be a reason why they do one thing rather than another. These reasons are embedded in the implicit rules artists follow when they create a work of art. Some of these rules can be retraced to the workings of the mind and their neurological substrates.'

☞ 'The kinds of formal rules that preoccupied the philosophers of the rationalist tradition are central to any art form that involves the composition of spatial patterns. The moment a choreographer arranges the dancers in geometric patterns the laws of geometry come into effect. The brain will automatically detect various geometric patterns, but it will also notice the slightest deviation from an intended pattern.'

☞ 'The notion of a schema allows us to conceive of perfection as the match between an actual object or event and its abstract mental representation in the form of a schema or internal model.'

☞ 'The advantage of conceptualizing perfection as the match between a schema and an actual object or event, is that it does not commit us to any additional notions such as harmony or a particular choice of subjects, since in principle any schema can serve as a model.'

☞ 'A perfect instance of an object or action could set a novel standard.'

☞ 'If you look long enough anything can become beautiful. The reason may be that, when you contemplate something, an internal model of that specific object is formed within your brain. Closely looking at a scene or an object may thus lead to the formation of a closed loop between the visual stimulus and the internal model in the brain.'

☞ 'When rehearsing a work they haven't performed before musicians and dancers draw on their training and their knowledge of other performances, which provide a frame of reference for how a work should or could be performed.'

☞ 'At the price of greater ambiguity the Kantian aesthetic idea allows us more leeway than the schema concept.'

- ☞ 'From a contemporary psychological point of view the descriptions offered by Kant and Schopenhauer to illustrate their notion of the sublime mix two distinct feelings: on the one hand a state of increased arousal and on the other hand a feeling of *awe*.'

- ☞ 'The feeling of awe can be analysed in terms of an appraisal of vastness and accommodation.'

- ☞ 'The feeling of awe for an object or event depends crucially on a *process* of accommodation.'

- ☞ 'Kant and Schopenhauer distinguished between the beautiful and the sublime. The distinction derived from considerations particular to the architecture of their philosophical system. They were thus unable to account for the observation that, in psychological terms, beauty (and perfection) too can inspire awe.'

- ☞ 'Implicit in the feeling of awe, in so far as manmade objects are concerned, is admiration for the act of bringing the object into being.'

- ☞ 'If you like everything there is something seriously wrong with your critical faculties.'

- ☞ 'Every person is unique and so every person will have his or her own aesthetic preferences. Only patterns in human behaviour lend themselves to scientific analysis.'

32

CONCLUSION

It has been a long journey, but to draw a map you need to visit, if not the entire territory, then at least a large area. Now that our journey has come to an end we may ask whether we have learnt something along our way and whether it was worth taking the long detour that led us past various remote brain regions. We may ask whether our map allows us to navigate the landscape and get to our destination and whether it contains any suggestions for scenic routes and beautiful vistas.

Our journey already reached a summit in chapter 28 but that was when we realized we still had a long way to go. Our analysis up to that point did not yet explain how the effects produced by the mental capacities analysed in the previous chapters added up to an aesthetic experience. It did not explain what is distinctly aesthetic about aesthetic experience. It did not allow us to distinguish between the pleasure one might derive from watching a ballet class and a ballet performance. And so we had to make an excursion into philosophical territory, which led us past Schopenhauer and Dewey and eventually, by way of an analysis of Kant's *Critique of Judgement*, back to cognitive science. As I argued aesthetic experience can be thought of as involving the harmonious free play of the faculties of the mind, to use Kant's formula. It allows us to recognize the beauty in the movements of a cheetah chasing its prey and to see a metaphor of life in a simple three-minute choreography. In so far as it pertains to an object or event's formal, aesthetic, symbolic or expressive properties and ignores any other function, purpose, meaning or qualities it might have, the experience can be considered aesthetic. With that out of the way we could bring our journey to a conclusion.

One of the questions we should ask ourselves at this point is whether we have been able to finish the trail set out by Lévi-Straus and show that the structures and patterns one can observe in dance and choreography are a reflection of some underlying mental structures. Unfortunately, an analysis of the brain mechanisms that facilitate and constrain all human mental capacities did not always offer the hoped for insights into dance and choreography. At present too little is known about the brain to draw inferences about many higher-level cognitive and affective processes. However, if you browse the key points at the end of every chapter you will see that we have been able to gather quite a number of ideas that add to our understanding of dance and choreography. Some of these ideas do have their roots in elementary brain processes. For instance, an analysis of the neural mechanisms that are activated whenever we hit a target or find a solution to a problem allowed us to explain why many choreographed dance performances don't just stop but end with a proper ending (☞ §15.4). An analysis of the mechanisms of human body perception allowed us to explain why we perceive a body even though there is no body to be seen (☞ §3.4). An analysis of the psychology of pleasure allowed us to explain why these ambiguous configurations are popular with choreographers and photographers (☞ §22.1). The same analysis allowed us to explain why movies and dance performances should provide for periodic episodes that make the audience yearn for more (☞ §22.3).

A central assertion of this book is that aesthetic experience and aesthetic properties are two sides of the same coin. Tinkering with the lighting conditions and altering the speed of a particular section will change a scene's aesthetic properties, but this change manifests itself in one's aesthetic experience and one's interpretation of the scene. Like all other forms of artistic creation choreography is an iterative process whereby movements are created and adjusted, dancers are arranged and rearranged and entire scenes are deleted only to be added again two days before the premiere. As a result of this back and forth process of composition and aesthetic judgement the choreography comes to reflect the neural mechanisms that mediate perception, emotion, attention and cognition.

These considerations led me to propose a special class of aesthetic properties, which I termed *neuroaesthetic* properties, which are a reflection of how the brain processes sensory stimuli (☞ §30.2). The existence of such neuroaesthetic properties is evident from the fact that some properties, such as certain facial and body expressions, are impossible *not* to recognize. It also follows from the fact that if one wishes to prevent an observer from entertaining certain thoughts or feelings one should avoid certain aesthetic properties.

If you were to ask a philosopher why people spend much of their spare time solving Sudokus, listening to music, reading novels and watching movies, YouTube videos and choreographed dance performances, he or she would answer that they must have a reason for doing so. If you were to ask the same question to a neuroscientist he or she would answer that there must be a reward somewhere. A number of recent neuroimaging studies have demonstrated that increased activity in dopamine related brain structures is associated with interest (Kang et al. 2009; ☞ §10.1) and amusement (Franklin and Adams 2011; ☞ §15.3) and that the 'chills' people experience when they listen to their favourite music is associated with endogenous dopamine release in the striatum (Salimpoor et al. 2011; ☞ §15.2). This led me to propose that what we commonly refer to as beautiful, interesting and humorous are attributes that sustain the prolonged attention to an object or event (☞ §31). Of course, art should not be equated with beauty or the pursuit of beauty, since art can also engage us at a cognitive level, for instance by offering a critical commentary on some form of social injustice. The Hungarian author Arthur Koestler (1964) proposed that art consists in the juxtaposition of different mental models, which bring out their analogies, frictions and so on. However, the effect is that the observer is compelled to contemplate the installation, the painting or the performance once more. The juxtaposition therefore sustains the observer's attention and interest; it provides for recurring blends in the framework of Fauconnier and Turner (☞ §27.4) and an ongoing free play of the faculties of the imagination and the understanding in Kantian terms. And so, perhaps what defines a great work of art is that it resists explanation and comprehension and continues to compel the reader, listener or spectator to examine it.

These considerations motivate a 'neurocritique' of contemporary dance and art. Much contemporary art consists in a single conceptual idea. Once the idea is understood there is nothing left to sustain the observer's interest. By contrast, visually arresting works or highly layered works invite the observer back. I should hasten to add that this is not an argument against neo-conceptual art, although it does explain why much neo-conceptual dance is such a bore. After a few minutes you have got the idea, but then you still have an hour or more to go. However, as we have seen even the greatest works of art can fail to arouse interest or indeed any affective response whatsoever. Looks can deceive, but I doubt whether the room attendants at the Prado and the National Gallery are in a permanent state of aesthetic bliss. When there is nothing else to look at art too can become a bore. However, boredom is not inherently negative, as it can give rise to a stream of thoughts (☞ §11.2).

Our analysis had a number of surprising corollaries. As I have argued on several occasions, we should pay attention not only to the presence of certain phenomena, but also to the absence of others. A dance performance is unlikely to bring about feelings of guilt, shame, pride, fear, hatred, resentment, contempt, hope, greed, pity and jealousy. Of course, one might construct an example in which it does, but as predicted by the appraisal theory of emotion, since one or more appraisal dimensions are missing the emotions *elicited* by dance are constrained to a few categories (☞ §18.3). Dance is also unlikely to cause disgust, because biological motion signals do not innervate the parts of the brain that elicit a disgust response (☞ §19.8).

As we have seen the number and kinds of situations that can be represented in dance is relatively limited (☞ §27.2). This is because most actions involve an object and without an object there is only so much one can do. What is more, many dance scenes are covered by a small number of generic schemas, such as the relationship between a group and an individual, struggle and defeat and a coming together and a parting of ways, which is why people's interpretations typically fall into a few basic behavioural categories. We also saw that works of art reflect the metaphors that govern the conceptual system within which artists produce their work. It follows that, contrary to what is often thought, in dance and art in general the imagination does not roam freely.

There is, of course, scope for novelty and as I have argued this novelty emerges when previously unrelated elements are brought into conjunction. For this reason, too, works of art can offer a new window onto the world. However, to the extent that they provide us with paradigms and schemas within which we interpret the world and the people around us, works of art also condition us.

My claim that the evolution of dance depends on the same cognitive capacities as the capacity for language and that the emergence of choreography depends on the capacity for language itself will no doubt be a source of some controversy (☞ §26). The capacity to understand other people's intentions allows us to understand *that* another person is dancing and not just fooling around. As I have argued the organization of the movements of a dancer or group of dancers involves formation rules, a lexicon and constraints (☞ §25.2). The ability to use these kinds of rules and constraints derives from the faculty for language.

Along our way we have also pricked through various popular delusions in cognitive neuroscience. Research into emotion is marred by conceptual confusion and flawed experimental paradigms. The view that emotions are somehow contagious is best forgotten. Indeed, one may well wonder how anyone could possibly claim that feelings of love, jealousy, guilt, sorrow, regret, despair, shame, contempt and greed are contagious. As for the popular view that empathy has its roots in basic neural mechanisms the empirical evidence is wanting in several important ways (☞ §21). The same is true for the view that action understanding derives from a mapping of the action onto a motor representation of the same action in the brain of the observer. Apart from the lack of empirical evidence this notion fails to capture some basic aspects of action understanding. A gesture can mean any number of things depending on the context. As we have seen, even a simple act as pointing can have various meanings, provided that the speakers share a common ground (☞ §26.2).

The present analysis has been largely speculative and preliminary. If the goal were to establish scientific facts each assertion would have to be experimentally verified with dance as a stimulus. We would have to test in a controlled experiment whether drinking a glass of wine during the interval of a dance performance affects people's experience; we would have to test whether exposure to hour-long conceptual or minimal dance performances in which nothing much happens does indeed cause mind wandering and does indeed activate the default network; we would have to test whether the basal ganglia and the premotor cortex are indeed involved in motion anticipation and whether it is the release of dopamine that causes a state of increased arousal when one watches an exhilarating dance performance; we would have to test whether the conditions that I listed are indeed necessary for the activation of the putative human mirror system and whether the neural mechanisms of 'wanting' and 'liking' do indeed have explanatory value within the context of dance.

As Woodward (2003) argues, the goal of explanation is not just knowledge and understanding, but control, prediction and manipulation. And so the question is not whether we have acquired new knowledge that allows us to answer a quiz question about the basal ganglia or the orbitofrontal cortex, but whether we have learnt something, whether our abilities have been enhanced and whether we have been empowered in one form or another. The ultimate test is therefore pragmatic. This is not a choreography manual nor is it a handbook for how to understand and appreciate contemporary dance. I do hope that, if you have made it to this point without skipping any chapters, you have learnt something that changed the way you look at dance and art in general. I also hope that if you are a dancer or a choreographer you have found some useful material in this book.

As I wrote earlier (☞ §8), the history of dance and choreography can be seen as a collection of answers to the question of how the movements of one or several persons can be organized so as to attract and sustain the attention of the audience. Our analysis showed, not altogether surprisingly, that to draw the audience's attention to the dance, rather than the costumes or the dancers' facial expressions, the choreography should focus on ways of creating ongoing novelty and diversity in the movement material and the displacement of the dancer(s) across space. We also saw that if the choreography provides for a constant interplay of correct and incorrect predictions the spectators will be kept on edge (☞ §15.1). Even so, some spectators may lose their interest after a few minutes. Our analysis of interest identified four factors that have the potential to arouse the interest of the audience: complexity, novelty, uncertainty and incongruity. The information gap theory furthermore suggests that, in order to sustain the reader or viewer's interest, one would have to supply a steady stream of perceptual and cognitive challenges, which, in neurological terms, yields a periodic stream of reward signals (☞ §10.2; §10.3).

A perhaps surprising corollary of our analysis was that the reason choreographers can continue adjusting a work forever can be explained by a phenomenon known as inhibition of return, which refers to a bias against attending to a previously attended location (☞ §9.1; §9.2). Whereas the audience, dance critics included, usually see a performance once or twice, choreographers see their own work almost every day. Consequently, they are familiar with even the smallest details. Over time the work of many choreographers therefore shows a tendency towards greater visual or semantic complexity and greater subtlety.

The lesson we learnt from Charles Le Brun, or rather his failure as an artist, was that emotions in dance should follow from the dance (☞ §20.5). If it is unclear why the dancers (or actors) are expressing certain emotions all the audience will feel is puzzlement. One might predispose the audience towards certain emotions by using various emotion cues. However, this backfires if the cues are too obvious. As a result a work that strives for romance may turn sentimental and a work that pulls out all the stops in its reach for the sublime may collapse into the bombastic.

Another lesson that we learnt is that the audience will seek to understand whatever it perceives, no matter what. Accordingly, simply juxtaposing two unrelated elements may be enough to create the illusion of some deeper meaning and who knows, some people in the audience may even come up with some striking interpretations.

I don't doubt that the foregoing analysis will be tested and contested and this is how it should be. For as I once heard a speaker say in *The Vile Parody of Address* (1988), a ballet by William Forsythe, 'despite what I keep saying, it doesn't have to be this way.'

APPENDIX A

AN ULTRA SHORT INTRODUCTION TO THE BRAIN

The nervous system is usually divided into the central nervous system, which consists of the brain and the spinal cord, and the peripheral nervous system, which is composed of nerve cells that lie outside the brain and the spinal cord. The peripheral nervous system connects the central nervous system to the limbs and the organs. It is divided into the somatic nervous system, which consists of the nerves controlling the muscular system and external sensory receptors, and the autonomic nervous system, which is further divided into the parasympathetic, the sympathetic and the enteric nervous system. The autonomic nervous system regulates key body functions such as heart rate, blood pressure and gland activity and plays an important role in the regulation of emotion (☞ §19.1). The enteric nervous system controls the gastrointestinal system.

The central nervous system is commonly divided into seven main regions: (1) the spinal cord; (2) the medulla; (3) the pons; (4) the cerebellum; (5) the midbrain; (6) the diencephalon and (7) the cerebral cortex.

The spinal cord runs all the way down from the head to the base of the spine. It projects the final motor signals to the muscles and relays sensory input from the skin, joints, muscles and internal organs to the brain. The spinal cord extends into the medulla, which participates in the regulation of several autonomic body functions, including respiration and blood pressure and controls reflexes of the tongue and throat involved in swallowing, coughing, sneezing and vomiting. Moving up toward the head we find the pons and the midbrain. Different sections of the pons are involved in respiration, chewing, swallowing, equilibrium, facial sensations, control of the bladder and the secretion of tears (☞ §23.1). The midbrain contains regions associated with visuomotor control, such as the superior colliculus and the oculomotor nucleus. Together the midbrain, the pons and the medulla form a continuous structure known as the brainstem.

Beneath the cortex and tucked against the brainstem lies the cerebellum, a large region with a highly regular structure and a distinct appearance compared with the cerebral cortex. Traditionally the cerebellum was thought of as a motor region. Patients with damage to the cerebellum retain the ability to move, but their movements become erratic, incorrectly timed and imprecise. Recent studies suggest that the cerebellum also participates in numerous cognitive and emotional functions.

The thalamus and the hypothalamus together make up the diencephalon. The thalamus is some sort of a central relay centre, an intermediate zone between the sense organs and the cortex and between different parts of the brain. The hypothalamus regulates the autonomic nervous system among other things (☞ §19.1).

By far the largest region of the central nervous system is the cerebral cortex. Like all other parts of the brain, the cerebral cortex is divided into two hemispheres, left and right.[122] Both hemispheres are connected by way of the corpus callosum. In addition there are a number of minor connections, such as the anterior commissure and the hippocampal commissure. Although some mental capacities are lateralized, especially those involving language and spatial cognition, the left and right side of the brain are essentially symmetrical in terms of function. Each hemisphere interacts with one half of the body: the right side of the brain interacts with the left side of the body, and vice versa. The cerebral hemispheres are commonly divided into four sections: the frontal lobe, parietal lobe, occipital lobe, and temporal lobe. A distinctive feature of the cortex is that it has many infoldings or convolutions. A fold is called sulcus (plural sulci) and a ridge between folds gyrus (plural gyri).[123]

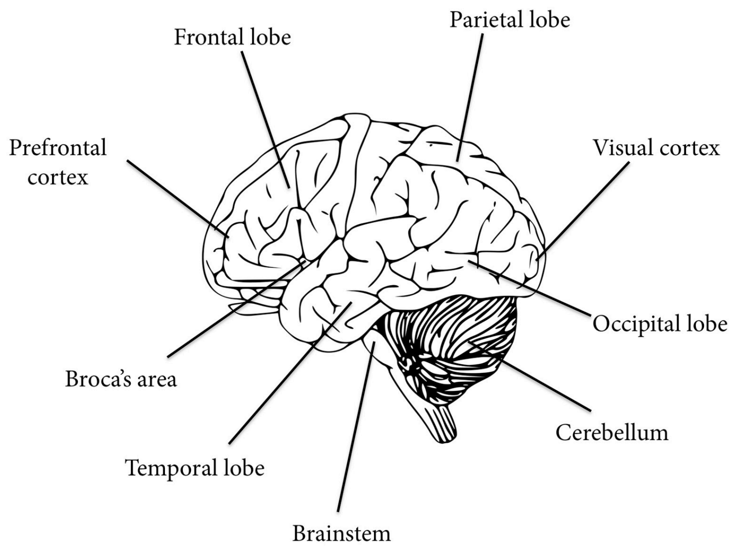

Figure A.1 Some brain regions and their approximate location

[122] A word on terminology. The front end of the brain is referred to as rostral or anterior; the opposite end is causal or posterior. The top or the back is referred to as dorsal or superior, while the bottom is referred to as ventral. Finally, the direction toward the outside and away from the midline is lateral, while the direction toward the midline and away from the periphery is medial. The same terms also apply to different parts of the brain such as the ventral premotor cortex and the anterior part of the orbitofrontal cortex.

[123] Differences in nomenclature and taxonomy are a major source of confusion in cognitive neuroscience. Different sections of the cortex can be referred to in anatomical terms, such as the fusiform gyrus and the intraparietal sulcus and in functional terms, such as the premotor cortex or the visual cortex. Some scientists use Brodmann areas (see Appendix B), such as BA44, to refer to a particular part of the brain, while others use names derived from sulcal anatomy such as the (pars opercularis of the) inferior frontal gyrus. Whenever I refer to some empirical findings I have chosen to keep the naming convention used in the original article to avoid referring to regions that were not in fact included in the original experiment.

Underneath the cortex lies a conglomerate of structures or nuclei: the basal ganglia (☞ §14.3), the hippocampus and the amygdala (☞ §19.4). The basal ganglia are a group of nuclei that act as a cohesive functional unit. Its main components are the striatum, itself composed of the caudate and the putamen, the globus pallidus, the substantia nigra and the subthalamic nucleus.

There are two main cell types in the nervous system: neurons and glial cells. Neurons are the basic signalling units of the nervous system.[124] Glial cells are nonconducting cells that provide support and protection for neurons. They produce myelin, a substance that surrounds the axons of many neurons, insulating them from other neurons. Glial cells make up about half the volume of the central nervous system. For many years neuroscientists largely ignored glial cells, focusing their research efforts on neurons, but in recent years there has been a resurgence of interest in their structure and function (Barres 2008).

There are many types of neurons, but the typical neuron consists of three parts: a cell body, which is surrounded by the neural membrane, dendrites and axons. Dendrites receive input from other cells and transmit the input to the cell body. Axons carry a neuron's output signal. Neurons differ in shape and size. For example, Purkinje cells in the cerebellum have a different size and structure than cortical pyramidal cells. The total number of neurons in the brain has been estimated at somewhere around 80 billion give or take a few billion.

A defining feature of neurons is their electrical excitability and the presence of synapses through which signals are transmitted to other neurons. A synapse is the location where the axon of one neuron (the presynaptic cell) meets the dendrite of another neuron (the postsynaptic cell), that is, it refers to the *junction* as such and not to the tip of an axon or dendrite or the space in-between.[125]

The majority of neurons transmit signals to other neurons by releasing neurotransmitters. After being released the neurotransmitters diffuse across the synaptic cleft, the gap between the presynaptic and the postsynaptic cell, and bind to receptors in the target neuron. This binding causes ion channels in the target neuron to open (or close). Ion channels are protein molecules or assemblies of several proteins that regulate the flow of ions (atoms or molecules with a net positive or negative charge) across the cell membrane. In neurons the most common ions are the chemical elements sodium, potassium and calcium. The binding of neurotransmitter molecules to the receptors of the

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[124] Another word on terminology. Properly speaking neural is the adjective for nerve and neuronal is the adjective for neuron. However, in recent years the use of neural to refer to anything to do with brain cells has become increasingly widespread. So as not to confuse the reader who may instantly forget about the distinction after reading the present footnote and with apologies to old-school neuroscientists who may cringe at my loose terminology I will use the term neural as a catch-all term.

[125] Because of the various forms that neurons may take, there are also axon-to-axon, axon-to-cell body and dendrite-to-dendrite synapses.

postsynaptic neuron causes a flow of chemicals inside the postsynaptic neuron. Since the ions are by definition charged this in turn causes a change in the neuron's local membrane potential (the membrane potential is the difference in voltage between the interior and exterior of the cell). If the flow of ions is such that the voltage increases, the membrane is depolarized and the synaptic signal is said to be *excitatory*, since the neuron is moved closer to its firing threshold. If the voltage decreases the membrane is hyperpolarized and the synaptic signal is said to be *inhibitory* (whether the synaptic response is excitatory or inhibitory is determined by the receptor, not by the neurotransmitter). In its resting state, a neuron is polarized, its resting potential ranges from -60 to -80 millivolts (mV) relative to its surroundings. The effects of a single synaptic transmission are typically small. Since a neuron may receive synaptic inputs from multiple other neurons their combined activity can cause the membrane potential to rise above the firing threshold, which sets into motion a self-reinforcing process whereby the opening of sodium ion channels causes more sodium ion channels to open thus raising the membrane potential even further. This process reaches a peak when all sodium ion channels are open. At this moment a different process is set into motion, which causes the membrane potential to suddenly decline.

The process whereby the membrane potential rapidly rises and falls is known as an *action potential*. In neurons action potentials are also known as spikes and neurons that emit an action potential are said to fire. An action potential propagates through an axon until it reaches the axon terminal where the synapse is located, causing a depolarization of the axon terminal, which in turn leads to the release of neurotransmitters. And so we're back where we started, except at a different synapse and all of this in a millisecond or less.

There is a lot more that can (and needs to) be said about the workings of the brain, but these are some of the main things you need to know about the central nervous system to appreciate the present analysis.

APPENDIX B

THE METHODS OF COGNITIVE NEUROSCIENCE

For centuries scientists have studied the brain using an ever-expanding range of tools and methodologies. First by sawing through the skull to see what's inside, once it was allowed by the Church, then by putting individual tissue under a microscope. Human patients suspected of having brain injury were examined and the correlation between their behavioural impairments and the approximate location of the brain injury was used to infer the function of the damaged site. The past 50 years have seen the development of a profusion of novel techniques and experimental paradigms that allow the measurement of the properties of individual neurons, the modelling of neural networks and the visualization of the human brain in action.

B1. NEUROANATOMY

Neuroanatomy, as the word suggests, is the study of the anatomy of the nervous system. The earliest descriptions of the anatomy of the brain go back to the Italian Renaissance. The great anatomist Andreas Vesalius (1514-1564) described various brain structures such as the thalamus and the corpus callosum in his book *De humani corporis fabrica* (On the Workings of the Human Body). Giulio Cesare Aranzio (1530-1589), an anatomist at the University of Bologna, coined the term hippocampus to refer to a structure located in the medial temporal lobe, because of its likeness to a sea horse. His contemporary Costanzo Varolio (1543-1575) was the first to dissect the brain from the base upwards and to describe a structure he referred to as the pons.

From the eighteenth century onwards ever more powerful microscopes made it possible to study the structure of individual cell tissue, a discipline commonly referred to as histology. In the late nineteenth century the German neuroscientist Franz Nissl (1860-1919) perfected a technique, first developed by the German-Austrian neuropathologist and anatomist Theodor Meynert (1833-1892), and still in use to this day, which uses chemical agents that dye the cell body to reveal the cellular composition or cytoarchitecture of the brain. Using this technique the German neuroscientist Korbinian Brodmann (1868-1918) divided the cerebral cortex into 52 distinct sections based on their cytoarchitecture. The publication of his book *Vergleichende Lokalisationslehre der Grosshirnrinde* (1909) is a landmark in the history of neuroscience (Zilles and Amunts 2010). Subsequent studies have found that the regional variation in cell distribution and morphology revealed by staining correlates well with the regional specialization of function. A century after its publication neuroscientists still use Brodmann's cytoarchitectonic map of the human brain to refer to the location of neuroimaging data obtained in the living human brain.

To identify the connections between different parts of the brain neuroscientists use a different staining procedure, whereby a chemical compound, which causes a cell to change colour, is injected into the brain of a laboratory animal. The compound will disperse through the brain along the channels with which the area of injection is connected. After a few days or hours the animal is killed and sacrificed for the sake of science and its brain is cut into thin slices, which makes it possible to identify the location of the stain.

B2. NEUROPSYCHOLOGY

Neuropsychology is an umbrella term used to refer to the study of the structure and function of the brain. I will primarily use the term in a narrow sense to refer to neuropsychological case studies of single patients who have suffered brain trauma. Studies of neuropsychological patients have provided important insights into the relationship between brain and behaviour. A classic example is the discovery by the French neurologist Paul Broca (1824-1880) of a region in the brain associated with the ability to produce language and the discovery by the German neurologist Carl Wernicke (1848-1905) of a region associated with impairments in language comprehension.

One of Broca's patients at the Bicêtre Hospital in a suburb south of Paris was unable to speak any words other than 'tan'. Following his death an autopsy revealed a lesion on the surface of the left frontal lobe of the brain. Another one of Broca's patients also suffered from severe speech impairment. After his death a lesion was found in the same region. Broca reasoned that this must therefore be the part of the brain where speech is located. The region has since been referred to as Broca's area and speech disorders that result from brain injury are known as Broca's aphasia.

At more or less the same time Wernicke found that damage to a different part of the brain resulted in disorders in the ability to understand spoken or written language. Patients with this disorder retain the ability to produce speech, but their speech is meaningless. They merely concatenate words. The area associated with the disorder was subsequently named Wernicke's area and the syndrome whereby patients have problems understanding language is now known as Wernicke's aphasia.

The findings by Broca and Wernicke suggest a *double dissociation* between language production and language comprehension. The concept of double dissociation is one of the most important concepts in neuropsychology. In the case of a double dissociation one patient or group of patients is impaired on one task, while another patient or group of patients is impaired on another task. For example, patients with damage to one part of the brain may be visually impaired but have intact hearing, while patients with damage to another part of the brain may have intact vision but hearing impairments, which demonstrates the existence of a distinct visual and auditory cortex. For a long time much of neuropsychology was devoted to finding such double dissociations as it supports the notion that mental functions can be separated into different components and related to distinct parts of the brain.

B3. FUNCTIONAL NEUROIMAGING

There are two types or uses of neuroimaging: structural imaging, which is mainly used for medical purposes, for example to identify the location of a tumour or the extent of damage of a brain lesion and functional imaging, which uses the same technology to measure the neural concomitants of mental functions. Until the mid 1990s there were two prominent neuroimaging methods: Positron Emission Tomography (PET) and functional Magnetic Resonance Imaging (fMRI). In recent years, with the widespread adoption of fMRI as the neuroimaging technology of choice, the use of PET has greatly declined. Both PET and fMRI measure changes in blood flow or metabolism related to neural activity. PET scanners measure the gamma rays emitted by radioactive elements that are injected into the bloodstream using a tracer. This is also one of the main disadvantages of the method. With fMRI there is no need to introduce foreign substances into the body.

fMRI takes advantage of the link between neural activity and haemodynamics. Neurons always fire and send out neurotransmitters, but when they get more active they consume more energy. The energy derives from glucose and oxygen. Oxygen is transported through the body by the haemoglobin in red blood cells. When a brain cell absorbs the oxygen the haemoglobin is deoxygenated. One might therefore expect regions of high activity to have less oxygen, yet the opposite is the case. The blood flow increases to more active regions of the brain, but since the neural tissue cannot absorb all of the oxygen, active regions have a higher ratio of oxygenated to deoxygenated haemoglobin. Haemoglobin contains iron and like all iron containing materials it is magnetic. The magnetic properties of haemoglobin depend on the level of oxygen.[126] And this is where fMRI comes in. By applying a strong magnetic field to the brain fMRI measures the ratio of oxygenated and deoxygenated haemoglobin, often referred to as the Blood-Oxygen-Level Dependence (BOLD) contrast or BOLD signal. The actual physics of fMRI is a bit more complicated than this, it involves the spin of the ^{1}H isotope of hydrogen, or so I read somewhere, but I won't bother you with that. The BOLD signal is thus an indirect measure of neural activity.

Magnetic resonance imaging systems are big machines that produce a lot of acoustic noise. They use a superconductive magnet that can weigh up to 5-10 ton. The strength of the magnetic field is measured in tesla (symbol T), the standard international unit of magnetic field. The first fMRI scanners that became widely operational were 1.5T. Today

[126] In case you're curious, haemoglobin is diamagnetic when oxygenated and paramagnetic when deoxygenated.

most scanners are 3T or 4T. To give a sense of how strong this is, one tesla is 10,000 gauss, and the Earth's magnetic field is around 0.5 gauss. Needless to say that before entering the scanning room one has to leave behind all metal objects – watches, glasses, belts – and remove any piercings. The strength of the magnetic field determines the maximum spatial resolution that can be obtained with a particular machine. There are currently a handful of 7T scanners in use, but increasing the magnetic field strength creates various new challenges.

It is impossible to scan the entire brain at once. It has to be done in slices. Scanning the whole brain can take up to 3 seconds. By taking less slices and thus sacrificing spatial resolution one can speed up the acquisition process. The slices have a thickness of about 3-7 millimetres and can be taken along four planes: axial, coronal, sagittal and oblique. The first three are the most common in practice. Axial slices are perpendicular to the longitudinal axis of the body and proceed from the top of the head down to the bottom. Coronal slices are parallel to the front of the body, proceeding from the face to the back of the head. Sagittal slices are obtained in parallel to the midline of the body and proceed from one side of the head to the other. Each slice is divided into a grid. Combining the grid size and slice thickness one gets voxels, the 3D equivalent of 2D pixels, which represent the minimum unit of brain tissue sampled in each image. The average voxel size is about 50 mm^3.

Scanning the brain produces a long array of data. To transform the raw data into a 3D model of the brain requires some sophisticated mathematical transformations. Even more transformations are necessary to create useful data that can be analysed. For one thing fMRI data are notoriously noisy. If you have ever used a high ISO setting on your digital compact camera you will be familiar with noise. It's the random variation in brightness and colour that you notice when you zoom in on the picture. In the case of fMRI there are basically two sources of noise: noise that can be traced back to the system, such as changes in the strength of the MRI signal over the course of the imaging session, and noise that results from head movements of the person being scanned. Even swallowing and respiration induce tiny movements of the head that can shift the next slice relative to the former. Before they can be analysed the data therefore need to be pre-processed in order to remove the effects of noise. The technology is essentially equivalent to the algorithms behind the 'reduce noise' button in photo editing software. Sometimes, if there is too much noise, the results of an imaging session have to be discarded.

By measuring the BOLD signal while a person performs a task or observes a stimulus researchers can derive the correlation between the BOLD signal and the task or the presentation of the stimulus. However, the BOLD signal itself does not tell much. Many studies use a so-called block design whereby the activity during a particular task is compared with the activity during a control task. There are different strategies for doing this. Assuming that task A engages brain regions P, Q and R and that task B engages brain regions P, Q, R and S by subtracting the activity corresponding with task A from the activity corresponding with task B one obtains the unique activity that contributes to task B (assuming there are no interactions among the cognitive components of both tasks).

Another strategy is to combine two tasks and two experimental conditions, a so-called factorial design, and to analyse the results using a statistical procedure called analysis of variance (ANOVA). An alternative methodology takes advantage of the observation that repeated exposure to the same stimulus will lead to an attenuated neural response (Krekelberg et al. 2006). For example, if you look at a moving pattern for several seconds and then at a stationary pattern, the stationary pattern will appear to move in the direction opposite to that of the moving pattern, a phenomenon known as the motion after-effect. This suggests that something must change in the brain during prolonged exposure to a stimulus. This change can be measured using single-cell recordings and fMRI.

fMRI produces large amounts of data. If a single slice contains 4096 voxels (assuming a 64 x 64 grid) and if a single image consists of 40 slices, then a single scan will consist of 163,840 voxels. A 15-minute scanning session of hundred or more trials will thus produce millions of data points. Since brains differ in size, shape and morphology, in order to compare the activation maps of different subjects, the data are usually spatially normalized into Talairach space, a coordinate system based on a detailed postmortem analysis of a single human brain. It is only after all these steps have been carried out that the data can be analysed.

B4. TRANSCRANIAL MAGNETIC STIMULATION

Transcranial Magnetic Stimulation (TMS) is a technique whereby a rapidly changing magnetic field is used to induce a weak electrical current in a relatively restricted area of the brain, which creates a temporary virtual lesion at the area of application. The neural activity caused by applying TMS is random with respect to the goal-state of the stimulated area. It therefore induces disorder rather than order into the information processing system, thereby disrupting task performance (Cowey and Walsh 2001). Whereas fMRI can only establish whether a particular part of the brain correlates with a task, TMS makes it possible to investigate whether a particular part of the brain is causally implicated in a task.

A major advantage of TMS over traditional neuropsychological studies is that, even tough it can only be applied to the surface of the cortex, the location can be systematically varied. Consequently, researchers do not depend on the whims of fate. Another advantage is that in neuropsychological studies at the time of examination the brain may already have undergone months and sometimes years of reorganization. Since TMS induces a brief disruption in cortical function it does not suffer from this limitation.

B5. SINGLE-CELL RECORDINGS

In single-cell recording a thin electrode is inserted into the brain of a living animal through a simple surgery. The electrode will detect the electrical charges generated by the neuron at the electrode tip. After the animal has recovered from the surgery the electrical probe makes it possible to record the response characteristics of individual neurons as the animal performs a task, such as lifting an arm or running through a maze, or is presented with a stimulus, such as a face or a moving patch of light. The goal of single-cell recordings is to identify the neurons that either increase or decrease their firing rate in relation to a given task or stimulus, or alternatively, to determine which task or stimulus causes a change in a particular neuron's firing rate. Single-cell recordings have provided many insights into the workings of the brain. In 1981 David Hubel and Torsten Wiesel were awarded the Nobel Prize in Physiology or Medicine for their research into the organization of the primary visual cortex, which was carried out using single-cell recordings. I should add though that the observed activity in single-cell recordings may be correlated with a certain task without actually contributing to the process and the recorded neuron may receive input from other neurons that actually perform the process of interest. The observed activity may also be part of a much larger and more complex circuit making it difficult to interpret the relationship between the activity and the task.

B6. ELECTRICAL STIMULATION

Electrical stimulation is a technique whereby individual neurons or brain structures are stimulated by sending an electrical current through a probe inserted into the brain. Since there are no pain receptors in the brain the procedure is painless. When performing brain surgery it is possible to let the patient recover from general anesthesia, while applying local anesthesia to the scalp. In the 1940s, while he operated on patients who were being treated for epilepsy, the American born Canadian neuroscientist and neurosurgeon Wilder Penfield recorded the patient’s response as he stimulated different parts of the surface of the cortex. This way he was able to create a functional map of the somatosensory and motor cortex. The American psychologist James Olds famously used electrical stimulation in rats to study the brain regions associated with pleasure (☞ §22.2).

B7. COMPUTATIONAL MODELLING

Experiments make it possible to test hypotheses and to gather data. To gain a better understanding of the relationship between the data requires a model. In general a model is an abstract, simplified representation of an underlying process in the form of a logical or quantitative relationship between a set of variables. A good example of an everyday model is a road map. Road maps are useful because they leave out a lot of detail that is unnecessary for finding your way. There are many different types of models: agent-based models, maps, flow diagrams, mathematical models and so on. Mathematical models can be further distinguished into analytical models, numerical models, probabilistic models and observational models. An example of an observational model is fitting a function to a set of data using methods such as regression and time series analysis. Models can afford insights that are not readily apparent when looking at the raw data. They also allow one to make predictions that can then be tested in an empirical study.

In neuroscience the Hodgkin–Huxley model describes how action potentials in neurons are initiated and propagated in the form of a set of nonlinear ordinary differential equations; cable theory models the flow of electric current in dendrites and Hebbian learning describes a mechanism for synaptic plasticity. In computational neuroscience a common strategy is to develop a model of a higher-level system or mental capacity based on the properties of lower-level elements in the form of an artificial neural network. In artificial neural networks neurons are represented by mathematical functions ('nodes') that approximate the characteristics of real neurons. By translating observed characteristics into a mathematical model artificial neural networks can be designed to mimic a particular function such as biological motion perception or motor control.

B8. OTHER METHODS

Neuroscientists use a number of other methods to study the nervous system. Diffusion tensor imaging (DTI) is a relatively novel application of magnetic resonance imaging technique that can be used to visualize tissue in the brain. Electroencephalography is a method that has become less popular with the rise of fMRI. By placing electrodes on the scalp it is possible to record the electrical potentials of large sections of the brain. Since EEG recordings reflect the electrical activity associated with many concurrent brain processes their use is limited. However, by recording EEG's over numerous trials and averaging the outcome it is possible to derive a pattern associated with a particular task or stimulus. These stereotyped electrophysiological responses are known as event-related potentials (ERP). EEG's record neural activity at a rate of milliseconds and thus have a much higher temporal resolution than fMRI. Because of their low spatial resolution they are mostly used to study the time course of brain activity.

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INDEX