

Sport and technology

An actor-network theory perspective

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Series editor's preface

There is now a considerable amount of expertise nationally and internationally in the social scientific and cultural analysis of sport in relation to the economy and society more generally. Contemporary research topics, such as sport and social justice, science and technology and sport, global social movements and sport, sports mega-events, sports participation and engagement and the role of sport in social development, suggest that sport and social relations need to be understood in non-Western developing economies, as well as in European, North American and other advanced capitalist societies. The current high global visibility of sport makes this an excellent time to launch a major new book series that takes sport seriously, and makes this research accessible to a wide readership.

The *Globalizing Sport Studies* series is thus in line with a massive growth of academic expertise, research output and public interest in sport worldwide. At the same time, it seeks to use the latest developments in technology and the economics of publishing to reflect the most innovative research into sport in society currently under way in the world. The series is multi-disciplinary, although primarily based on the social sciences and cultural studies approaches to sport.

The broad aims of the series are to: *act* as a knowledge hub for social scientific and cultural studies research in sport, including, but not exclusively, anthropological, economic, geographical, historical, political science and sociological studies; *contribute* to the expanding field of research on sport in society in the United Kingdom and internationally by focusing on sport at regional, national and international levels; *create* a series for both senior and more junior researchers that will become synonymous with cutting-edge research, scholarly opportunities and academic development; *promote* innovative discipline-based, multi-, inter- and trans-disciplinary theoretical and methodological approaches to researching sport in society; *provide* an English language outlet for high-quality non-English writing on sport in society; *publish* broad overviews, original empirical research studies and classic studies from non-English sources; and thus attempt to *realise* the potential for *globalizing* sport studies through open-content licensing with Creative Commons.

At the Royal Liverpool Golf Club in Hoylake in 2014 the Open Championship organiser, the Royal and Ancient (R&A), installed free Wi-Fi access at a championship course for the first time. Concerns were raised that the innovation might disturb a key aspect of golf etiquette: spectators maintaining silence whilst the players focus on their game. Partly to deal with this problem there was 'a strict ban on making or receiving calls on the course other than in "mobile device zones"'. Peter Dawson, the Chief Executive of the R&A, commented that 'technology is something golf has to embrace and people are going to feel a great benefit this year' (*Financial Times*, 17 July 2014, p. 4).

In *Sport and Technology* Roslyn Kerr does not explicitly discuss these developments in championship golf, but she does provide us with a distinctive way to think about and understand the complex relationships between technologies and a variety of sports – the Actor-Network Theory (ANT) perspective. Rather than simply introducing a sport readership to ANT, Kerr demonstrates why such an approach is significant. Specifically, ANT provides a detailed methodology as well as a theoretical basis for understanding the relationship between the human and non-human in sport.

The book begins with a discussion of critiques of ANT, how ANT defines technology and how ANT connects with the work of social theorists such as Haraway, Foucault, and Deleuze and Guattari. It then illustrates the utility of ANT through rich case studies, based on original fieldwork, of the use of technologies in sports such as kayaking, competitive swimming, Australian rules football, cricket and tennis, as well as analyses of doping, refereeing and media broadcasts of sport. *Sport and Technology* is a distinctive contribution to debates about sport in a global context, an introduction to the Actor-Network Theory way of thinking about sport and a demonstration of the insights the perspective can yield that have value for sport scientists and others involved, or those simply interested, in the development of sport.

John Horne, Preston and Edinburgh, 2015

Introduction

When, in 2013, Lance Armstrong confessed to having adopted a range of doping practices, there was no question that he had ingested banned substances in order to enhance his cycling performance. However, when asked whether he felt any guilt over his behaviour, Armstrong curiously replied that he did not. While several authors have explained Armstrong's lack of guilt by arguing that the Tour de France has been dominated by a doping culture for many years (see, for example, Brewer, [2002](#); Strulik, [2012](#)), the existence of further examination and discussion of Armstrong's actions indicates that the simple explanation that athletes' decisions to use banned technologies are based purely on enhancing performance is insufficient for understanding the use of technology in sport.

Lance Armstrong's case also concerned the immense amount of money that he obtained through sponsorship and other commercial arrangements, with fans raising questions about the continuation of those arrangements once his doping history was known. With the professionalisation of sport, athletes face increasing pressure from sponsors not only to perform but also to use particular technologies or equipment produced by their sponsors. The use of some technologies can therefore be explained by athletes' experiencing pressure from sponsors or other commercial bodies; and, by extension, athletes' desire to win can be explained by their wish to benefit commercially.

At the same time, athletes also make deliberate decisions not to use particular technologies or not to dope because of their desire for purity, to keep their bodies and sport clean and untainted. For example, US 5000m athletics champion Lauren Fleshman publicly criticised Lance Armstrong on the grounds that he undermined fair play, which she believed defined sporting practice (see Fleshman, [2013](#)). Fleshman's stance assumes an amateur ethos that places fair play ahead of winning, and harks back to a romanticised view of sport as historically free from overly competitive practices.

There is no doubt that the explanations of performance enhancement, commercial pressure and a desire for purity are valid in terms of athletes' own individual motivations for using or not using particular technologies in sport. But one of the most controversial aspects of Armstrong's case was the revelation of just how widespread his doping network was, and how many individuals and technological implements, such as syringes and other equipment necessary for performing blood transfusions, were involved in facilitating his doping. This revelation demonstrated that individual motives are only one aspect of understanding the use of technology in sport, with athletes also utilising a variety of other processes and enrolling many other actors to facilitate their use of technology.

In this book, I argue that singular explanations such as quest for performance, commercialisation or quest for purity are insufficient explanations in themselves for understanding the use or non-use of technology in sport. I do not argue that these explanations are not valid, and indeed I use cases where these explanations come into play. But this book argues that these explanations do not encapsulate the myriad of processes that contribute to the use of technology in sport. Instead, I argue that in order to understand which technologies become enrolled in sport, we must examine the processes of enrolment, and seek out the various actors that affect the enrolling or non-enrolling, and acknowledge that there are multiple issues and decisions at play. This involves a shift in focus from much other work that has been done on technology in sport. It involves attending to enactment, and to process, rather than to regulations, philosophies or cultural meanings. Yet these latter aspects can also be important, since the enrolling process can include deploying the philosophies or cultural meanings held by those involved in the enrolment processes.

Indeed, enrolment processes can be highly complex, although their complexity is often obscured by the dominant narratives used by influential sporting bodies (Goldsher-Diamond, [2014](#)). Once a technology is enrolled and its use becomes normalised, the process that produced the stability becomes concealed from view and can therefore be difficult to ascertain (Law, [1992](#)). For example, all sports have rules that outline which technologies are permitted or not permitted to be used, but this is the extent of the information that appears in the rules and regulations. The controversies or decisions that

resulted in those rules are not recorded in the same public manner and therefore become erased. Thus, in attending to how technologies come to be enrolled or not-enrolled, I also aim to bring to light the complex processes that produce particular rules or decisions.

Attending to complexity is particularly important in the light of the rapid increase in technological change that we are currently experiencing. Where, in the past, many technologies were reasonably simple and it was possible for many laypeople to understand their workings, the complexity and number of technologies have now increased exponentially, and only experts can fully comprehend them. Within such an environment, it is necessary to develop and adopt approaches that acknowledge complexity and are designed to examine multiple strands. While philosophers such as Deleuze and Guattari (2004) have argued for the need to see the world as consisting of assemblages in order to examine the current fluid and unstable environment, they did not extend their ideas to encompass methodology. By contrast, the approach adopted in this book, Actor-Network Theory (ANT), was designed as a methodology to examine scientific practices and technological change while acknowledging the complex and multiple strands that affect change, including human and non-human actors.

The earliest uses of ANT involved the examination of the processes of producing scientific knowledge, with detailed ethnographic practices revealing a complex network of factors that produce science (see, for example, Latour, 1987, 1993b; Latour and Woolgar, 1979). In this book, it is the network of sport that I am interested in following in order to trace similarly the factors that lead to the enrolment or non-enrolment of technology in sport. To date, there has been no other extensive study of sport using an ANT approach.

ANT is not the only approach well designed to trace the enrolment of technologies in sport. The social construction of technology (SCOT), as developed and adopted by Pinch and Bijker (1984), has similarly been utilised for the same goal and is more commonly used for examining sport (see, for example, Goldsher-Diamond, 2014; Pinch and Henry, 1999; Rosen, 1993; Varney, 2002). In examining how technologies come to be used, SCOT's focus is on identifying the relevant social groups that contribute to the use of the technology. For example, in their

analysis of the bicycle in the nineteenth century, Pinch and Bijker (1984) determined that the so-called 'ordinary' bicycle was deemed too risky and unsafe for use by women, whereas it was highly attractive to young men precisely because of that same riskiness. Thus, different social groups interpreted the ordinary bicycle differently (in an example of the concept of interpretive flexibility), which affected whether each group chose to use the bicycle.

ANT's focus differs from SCOT's through its emphasis on the technologies, and other non-humans, as actors that affect and influence enrolment processes. In SCOT, as in most sociological approaches, the focus remains purely on the human actors: in particular, on social groups. In ANT, humans and non-humans are understood as equally important, and this is reflected in the preference for the term 'actant' over 'actor' to refer to anyone or anything that affects the enrolment process. Other scholars interested in 'things' have similarly argued that non-human artefacts can hold agency and act as significantly as people (Harvey and Knox, 2014).

Determining how 'things', and particularly technologies, act is particularly important in sport, where international sporting bodies are constantly in the position of having to regulate the use of technology based on the ability of the technology to affect sporting performance. Sporting bodies must determine a technology's level of agency in order to decide how to regulate it. This was illustrated particularly well in the case of Oscar Pistorius, where it took several years for the International Association of Athletic Federations to determine whether his prosthetic legs had greater running capacity than human legs. The crucial point was whether the actions available to the prosthetic legs were greater than those available to human legs. It was decided that they did not have greater capacity, but it took a substantial amount of time to determine this was the case.

In claiming that non-humans can hold agency, ANT has attracted critics who argue that agency can only exist through deliberate intent and therefore agency can only be the domain of humans, as non-humans do not possess the consciousness to decide to act. In emphasising the ability of non-humans to act, ANT has been criticised for anthropomorphising non-humans (see, for example, Elder-Vass, 2008; Hearn, 2012). While this point will be discussed in more detail in [Chapter 1](#), it is a point

that has been recently considered by a range of researchers interested in what Fox and Alldred ([2015](#)) term 'new materialism'.

Essentially, discussions around agency revolve around conceptions of power. Rather than viewing power as incorporating deliberate intent, ANT views power as an effect. Utilising such a definition, anyone or anything that affects action can potentially hold power. The form this action may take varies depending on the individual study, but a simple example of the way that technology in sport can affect the action comes from my own ethnographic work in the sport of gymnastics, which utilised an ANT approach. In this excerpt from an interview with a gymnast, Malcolm, he discusses how the equipment holds power through directly affecting his gymnastics performance:

Malcolm: The high bar is always different, bouncier or harder. And the rings, sometimes they shake more.

Researcher: Is that the same here? When you compete at [another club] is it different?

Malcolm: At [another club] the high bar is a bit bouncier than I like it, and the rings, the rings are pretty good actually. The floor's a bit harder than here, so you can get a bit more bounce if you put more into it.

Researcher: So you know what to expect? If you got sent to the US or something, I guess you'd be thinking, 'I wonder what I'll get here?'

Malcolm: Yeah, because you get used to the floor you train on every day. If you have a soft floor at home and go to a hard floor somewhere else, you end up going 'Oh no!' And some floors are really bad, they're soft on the top and hard underneath and you end up tearing your achilles and stuff.

This excerpt from Malcolm's interview reveals how he has learnt how to 'be affected' (Latour, [2004](#), p. 210) by the apparatus, and therefore the apparatus holds the power to affect his gymnastics performance. His comment about the bounciness of the high bar makes it clear that he realises a certain amount of manipulation of the equipment is required to produce optimum results, but that the type of equipment directly affects what he must do. He is aware that his gymnastic routine will occur only if he manages to work as an *assemblage* with the equipment and describes how he 'puts more into' the floor to make a harder floor work more effectively.

The notion of the 'assemblage' is central to ANT. Essentially, ANT encapsulates the notion that 'the whole is greater than the sum of its parts' through arguing that combining humans and/or non-humans can create assemblages that have vastly different qualities and capacities from singular parts. This is easily understood in the case of sport, where athletes can be understood as possessing particular and often impressive qualities owing to the athlete-assemblage, consisting of a human plus a variety of technologies and training that transform the human into something surpassing normal human ability. For example, neither a human nor a pole is capable of independently jumping five metres into the air, but once a human with training uses a pole, they are transformed into an athlete-assemblage called a pole-vaulter, who can accomplish this task.

Viewing athletes as assemblages of humans and technologies creates a significant shift in thinking for the sports policy-maker. For example, at times, policies in sport attempt to ban or limit the use of particular technologies, seeing them as entirely separate from individuals. As previously discussed, seeing the two as separate was shown to be problematic in the case of Oscar Pistorius, whose legs are so interconnected with his ability to run at all that he epitomises Donna Haraway's (2004) notion of the cyborg, with no discernible differentiation between human and technology. It is also problematic with regard to doping, where vast sums of money are spent in attempting to determine whether an athlete has ingested banned substances. Doping policy-makers could instead, if they adopted the ANT notion of the athlete as assemblage, simply have an upper limit of the amount of whatever substance they are testing for and disregard whether it arrived in the body by natural or artificial means. This has occurred at times. For example, in order to test for the presence of the banned artificial substance Erythropoietin (EPO), some sports organisations used the method of testing hematocrit levels in order to ensure that no athletes went beyond the limit of 50 per cent. Their reasoning for choosing a level of 50 per cent was related to the health issue of blood thickening that occurs beyond this level (Böning, Maassen and Pries, 2011). This testing method ensured that athletes were safe and healthy, but was unable to determine whether athletes reached hematocrit levels below 50 per cent by human or artificial means. This policy assumed that athletes were assemblages made up of a range of hormones and chemicals. In the language of policy-

makers, such a stance ensured safety and produced a level playing field. However, this method has now been replaced by a definitive test for the use of artificial EPO, along with a range of other mechanisms as detailed in [Chapter 4](#), which consider the human as needing to remain separate from any technological interventions.

The concept of the 'assemblage' also reflects the use of the word 'network' within ANT. To remain with the example of the pole-vaulter, implying that a pole-vaulter is simply an assemblage of a human plus training and a pole is oversimplifying the network that produced the performance. If we were particularly intent on determining how the pole-vaulter achieves this outcome, we would need to identify the myriad of other components that contribute to the pole-vaulter's success. We would expect that the pole-vaulter would use an expert coach and other sports science experts, along with possibly specialised shoes and maybe particular mats for training. The pole-vaulter would also need funding, and competition experience. The pole-vaulter's ability to jump high is thus made up of the assemblage of all these aspects, and it is this assemblage that ANT refers to as 'the network'.

It may seem that listing these components in this way is simply repeating the components that make up elite sporting success, as identified in studies such as that by De Bosscher et al. ([2006](#)), who produced a model of factors that determine elite sporting success. The ANT approach differs from these kinds of studies in assuming that networks are individualised, rather than universal, and highly unstable. This assumption stems from the ANT view of the world as existing as a network of assemblages that changes over time. For example, at the moment I am involved in a project examining the experiences of older elite gymnasts. One of the findings from this project is that, as gymnasts reach adulthood, their coaching and training requirements change considerably from when they were younger. Some gymnasts question whether they even need a coach as an adult, given that they have already acquired the necessary knowledge to train themselves. In this study, it is apparent that the assemblage of fifteen-year-old gymnast + hands-on coaching + heavy training can produce the same level of success as a twenty-five-year-old gymnast + occasional coaching + light training. Therefore, I argue that examining the exact networks that make up elite sporting success can be valuable in understanding the myriad of processes that may

contribute to success, but it does not acknowledge that they are also always changing. While the above example referred to the change in age of the gymnast that resulted in a different network being effective, change is also important when discussing technology because of the constant production of new technologies and improvements to current technologies. As Harvey and Knox (2014) note, viewing non-humans as parts of assemblages involves acknowledging that the range of actants involved is bound to cause instability, and that therefore constant care is required to obtain stability. Attending to how stability is achieved, or not achieved, is at the core of the ANT approach (Law, 1992).

In attempting to capture the range of processes that produce stability, a criticism that has been levelled at ANT is that the concept of the network is problematic owing to its nature as 'never-ending' (see, for example, Lee and Stenner, 1999; Strathern, 1996). For example, to return to the pole-vaulter, if we were truly examining every aspect of the pole-vaulter's network, then we would also need to examine the network of each pole-vaulting coach, each sport scientist and each technological implement, which would lead to yet more strands, leading to more networks that would indeed be impossible ever to examine properly in a single researcher's lifetime. ANT's response to this critique is a pragmatic one. ANT theorists acknowledge that no research account can ever be complete and so do not suggest that researchers should continue to examine a network indefinitely (Law, 1992). Instead, Latour (2005) suggests that researchers should simply stop examining the network either where the participants in the study determine that the network ends, or when the requirements of their particular article, book or thesis are met. For example, in my own ANT study of gymnastics in New Zealand, I stopped examining the network at the point where the participants in my study were adamant that I was no longer examining gymnastics, such as when I came across competitive aerobics. In this scenario, one type of aerobics was deemed to be 'gymnastics' as participants explained that it was regulated by the International Gymnastics Federation, but another type of aerobics was not, as it was instead regulated by an international dance federation that was not associated with gymnastics.

A note about method

ANT is somewhat unusual in that it is both a method and a theory. Theoretically, ANT makes use of a number of concepts, such as enrolment, translation, mediators, intermediaries and others, which will be introduced throughout this book. Methodologically, ANT espouses an ethnographic approach that is closer in nature to ethnomethodology both in emphasising a high level of detail and in attending to processes. ANT assumes that data is wide-ranging and 'messy' (Law, [2004](#)), and argues that ethnography is best placed to encompass the mess that a researcher is likely to find upon entering the field. In order to trace the mess, Latour ([2005](#)) describes the methodology of ANT as 'following the network', where the researcher does not have a clear path planned at the outset but follows particular strands as they are revealed. Farnsworth and Autrin ([2005](#)) describe the ANT following process as being akin to the work of the detective, where the researcher follows up on clues dropped by participants and occurrences in order to determine the workings of the particular situation of their interest.

In line with ANT's theoretical position, which emphasises non-humans as actants, the ANT ethnography also pays attention to the role that non-humans play within the field of study. This can be difficult, given that things do not speak (Penley, Ross and Haraway, [1990](#)) and so cannot be interviewed, but Latour ([2005](#)) suggests that this can be accomplished in a number of ways. First, he states that the creation or innovation of new innovations or knowledge within a laboratory can be examined, as they were by him in *Laboratory Life* (Latour and Woolgar, [1979](#)) and *Pandora's Hope* (Latour, [1999b](#)). Second, they can be studied at a distance: for example, historically. Throughout this book there is some element of historical analysis, as the history of some sports and technologies are traced in order to demonstrate the socio-technical nature of sport. Third, Latour argues that they can be studied when they break down or become controversial. This final option is the approach primarily adopted in this book, which examines cases where technologies have caused controversy in a range of scenarios and contexts.

While ideally it would be most effective if all the cases discussed in this book used the ethnographic method of 'following the network', as espoused by Latour, there is

unfortunately very little ethnographic work in sport that uses an ANT approach. My own ethnographic work on gymnastics, which used an ANT approach, is drawn upon for two cases: the use of sports scientists by gymnasts and the implementation of a video replay system at the Artistic Gymnastics World Championships. These two cases use ANT's ethnographic method directly, as I obtained my data through 'following the network' of elite gymnastics in New Zealand.

Other cases are chosen because they illustrate a particular theoretical point and because, like this book, their focus is on how technologies came to be enrolled or not enrolled within particular sports environments. These include Patrick Trabal's study of the attempted implementation of new kayak technology in France, Elizabeth Pike's examination of rowers' use of sports doctors and Limin Liang's analysis of the role of new production technology in the broadcasting of the 2008 Olympic Games. The remainder of the cases use a combination of historical analysis and Latour's (2005) entry point of the controversy, where I follow the history and debate around the use of that particular technology through previous research, policy documents, media releases, newspaper reports and personal communications.

The method of following the network has been advocated by ANT theorists as being significant for bridging the gap between the 'micro' and the 'macro'. There are several ANT studies that demonstrate the way that ANT allows the connections between these two levels to be made apparent (see, for example, Callon, 1986; Latour, 1988, 1995, 1996; Law, 1992). Critics have suggested that ANT's ethnographic methods mean that ANT studies are too strongly focused on the micro and ignore social structures (Elder-Vass, 2008), but ANT theorists explain that the point of the following process is to identify and examine the connections between wider societal aspects and micro-level occurrences. For example, in my ANT study of gymnastics, previous studies had determined that there were a range of macro-level bodies, such as the International Gymnastics Federation and the New Zealand Olympic Committee, which determined selection for the New Zealand national team (see, for example, D'Amico, 2000); however, I found that selection was also affected by other aspects of a gymnast's network, such as the views of the parents and coaches, or finance to pay for elite training. Thus,

my ANT analysis determined that, although the New Zealand Olympic Committee has the final say in the make-up of gymnastics teams, there were other processes (which would normally be termed micro-level) that influenced the final selection, demonstrating the significant links between the micro and macro levels of action.

Kellner ([2002](#)) calls for the use of approaches, such as ANT, that incorporate both the micro and macro, or local and global, within the globalisation literature. Indeed, most of the globalisation-of-sport literature is understandably focused on the global, and while connections with the local are noted, they remain primarily at the national or regional level and not at the level of individual action. By contrast, ANT's following process allows connections to be made from global occurrences to the micro level of individual interaction. The book is structured in order to highlight the movement in scale that is possible with ANT.

The structure of the book

Following this chapter, I begin with a discussion of the ANT understanding of technology. The most significant point is the view of technology as a heterogeneous assemblage rather than a singular, complete object. It is made up of a variety of components, plus it works within a particular actor-network. The understanding of technology as made up of multiple strands and as sitting within multiple strands is significant for examining how and why technologies are used in sport. Later chapters of the book include several examples of technologies being only partially implemented or utilised as a result of sporting bodies focusing on enrolling one strand of the technology and not realising at the outset the multiple connections that must be in place in order for the technology to be fully utilised. [Chapter 1](#) also recognises that technologies can work as stabilising devices to ensure a particular outcome, and argues that technologies have agency.

[Chapter 2](#) begins with the assumption that technology is constituent for sport, with all sports utilising a range of technologies, such as bats and balls, in order for the sports to exist. Within this context, the technologies used within sports are frequently improved or enhanced, either by individual athletes or by international sporting federations. This chapter essentially questions the role of an enhancement's functionality

in the enrolment process. Through case studies on kayaks and swimsuits, the multiple strands of an athlete or sport's network are found to heavily complicate what might seem at the outset to be a simple case of using an enhanced form of technology.

While [Chapter 2](#) remains within the network of sport through examining enhancements of technologies already used in sport, [Chapter 3](#) moves outwards to examine technologies that are not traditionally part of sporting practice but which have been introduced into the actor-network in sport. The first case, GPS units in Australian-rules football, introduces the notion that technologies frequently produce unexpected outcomes, and shows how following technologies can reveal the power relations between different parts of the network. This case is particularly focused on the National League, with the network of a team sport being understood as very different from an individual sport. The second case examines the use and regulation of technologically constructed hypoxic environments (TCHEs), commonly known as altitude chambers. This case reveals the connections between global understandings of sport and race, and how understandings are incorporated into the network of a technology and influence its use.

[Chapter 4](#) continues to acknowledge global connections through examining doping. This chapter chronicles a variety of groups that have attempted to maintain control of doping, including the International Olympic Committee (IOC), the World Anti-Doping Agency (WADA) and the East German government. In all cases, I unpack the extensive actor-networks that each organisation has put in place in order to regulate and attempt to minimise or eradicate doping. This chapter draws attention to the role of inscriptions within power relations and demonstrates how Latour's (2005) concept of the oligopticon is valuable for understanding the way that institutions retain power through a networked arrangement of humans and non-humans that is quite different from the institutional arrangements described by Foucault (1977).

In [Chapter 5](#) the book moves to examine a somewhat peripheral yet very important part of competitive sporting practice: the use of sports science and sports medicine. This chapter investigates the processes used by athletes and coaches to integrate sport scientists into the sporting context. While it would be easy to assume that enrolment would easily take

place owing to athletes, coaches and scientists all having the common goal of improving performance, the two cases in this study demonstrate that the integration process is more complex and encompasses a range of perspectives and understandings, as well as specific actants, that contribute to enrolment or non-enrolment.

[Chapter 6](#) moves to the competition arena and the workings of officiating technologies. This chapter considers the actor-network of various sports that have enrolled technological devices for assisting with umpiring or judging. The cases of cricket, tennis and artistic gymnastics are drawn upon to examine how the actor-network of each sport is affected by the new technology. The focus in this chapter is on following the actor-network beyond the initial implementation. Each sport is followed beyond the point at which the governing bodies introduce the new technology, to examine how the new assemblage affects other, often unexpected, parts of the actor-network.

[Chapter 7](#) considers one of the most important relationships within sport: the sport media connection. However, this chapter is different from much of the other literature written on the topic as it focuses not on media representations but on the processes by which these representations are produced. It considers how humans and technologies work together to produce what we view to be a seamless television broadcast. In this chapter, the global nature of sporting coverage is considered through Collier and Ong's ([2005](#)) concept of a global assemblage, an ANT concept created to examine the creation of stable global forms.

Chapter 8 concludes by reflecting on sport as a socio-technical actor-network. I emphasise the way that the concept of the actor-network moves beyond singular explanations such as functionality for understanding how technologies come to be integrated into sport. I also reiterate how ANT considers technologies to hold agency, and consequently as being able to cause unexpected occurrences in other parts of the actor-network, a point which is particularly important for sports bodies when considering adopting new technologies. This chapter also refers to the cases and examples in the book to respond to some of the critiques of ANT.

As sport evolves to include an ever-increasing number of technologies as part of its actor-network, it is important that those studying sport adopt approaches that encompass multiplicity and provide ways to grapple with the potentially far-reaching effects that technology can produce. In this book, I show how ANT is well up to this challenge through examining a range of cases and examples that have caused controversy within sport. In line with ANT methodology, controversies provide an effective point of entry to allow the examination of the myriad of actors that assemble to produce sport.

1

What is technology?

Some of the most famous ANT cases have investigated the role of a range of technologies, including aeroplanes, ships, microscopes and a personal rapid-transport system. Technologies are frequently forefronted in ANT work in a reflection of the equal emphasis ANT places on humans and non-humans, with technologies often taking the form of significant non-human actants. In this book I am similarly interested in the non-human actants in sport and take these as my starting-point when investigating technologies. I am particularly interested in the way that the physical properties of the technology, and its precise material forms, can facilitate or produce particular effects and actions. At the same time, in line with the ANT approach, it is impossible to confine any discussion of technology to purely material forms. Instead, I consider the network that produced and utilises the technology to be of equal interest.

This chapter investigates three ways that technology can be understood through ANT, all of which are drawn upon at various times in the book. First, technology is considered as a multiple, heterogeneous assemblage; second, it is seen as a stabilising device; and third, it appears as an actant. This chapter considers how these three views of technology are highly relevant to understanding the role of technologies within sporting practice.

Technology as a heterogeneous assemblage

One of the most famous philosophers to write about technology, Martin Heidegger (1977, p. 1), argued that it is both a 'means to an end' and a 'human activity'. These combined definitions suggest that technology is something that humans utilise in order to achieve particular goals. Heidegger (1977) emphasised that human use of technology entailed mastery and that mastery was particularly important in order to avoid humans losing control of it.

Heidegger's position has been adopted by several authors writing on sport and technology. For example, Van

Hilvoorde, Vos and de Wert ([2007](#), p. 175) echoed this position when describing technology in sport, arguing that technology is part of the artificiality that defines sport, including 'mastery of technological equipment or the body [in order] to achieve the particular goals of a specific contest'. Similarly, Loland ([2002](#), p. 3) claimed that the view of technology as 'human-made means to reach human interests and goals' is the definition used most frequently within writings on technology in sport. Both these definitions acknowledge that in sport there are particular goals that must be met, and that technologies act as artificially created ways by which these goals can be realised.

Latour ([1999b](#)) derives his own definition of technology through framing it in opposition to Heidegger. Latour disagrees with Heidegger's definition of technology as incorporating mastery, even though he notes that technology is both something that can master nature and humans and something that can be mastered by humans. Latour rejects Heidegger's view of technology, instead arguing that, when humans and technology assemble together, a third actor is created that has different properties from the separate components. He emphasises that it is the combined potential of disparate parts that produces a working piece of technology. Riis ([2008](#)) argues that Latour's and Heidegger's views are not that different, with Latour misinterpreting Heidegger. She argues that Heidegger, far from arguing for the existence of total mastery by either humans or technology, acknowledges that the acts of humans are influenced by technology and vice versa. Her interpretation suggests that both Heidegger and Latour emphasise the heterogeneous nature of technology and see technology as working with multiple actors in order to be effective.

In taking this argument further, Latour and Venn ([2002](#), p. 248) use the term 'fold' to describe how they see the various heterogeneous actors that make up technology combining within it. Using the example of the hammer, they describe how the hammer exists as an accumulation of various histories, including the 'antiquity of the planet' through the mineral form of the aged oak in the handle, along with 'the forests of the Ardennes, the mines of the Ruhr, the German factory, the tool van which offers discounts every Wednesday on Bourbonnais streets, and finally the workshop of a particularly clumsy Sunday bricoleur' (Latour and Venn, [2002](#), p. 249). The

example of the hammer demonstrates the notion of technology as an assemblage, or actor-network, of heterogeneous histories, both human and non-human. The ANT approach emphasises the relationships between things, acknowledging that technologies can work to connect actants together (Harvey and Knox, [2014](#), p. 6). For example, the quotation above describes a range of different actants that are brought together through the hammer, with the hammer existing as a network encompassing all these disparate components that make it into a distinct object.

In order to emphasise the view of technologies as networks, Latour ([1999b](#), p. 191) posits that this position is easier to understand through the use of the word 'technical' rather than either of 'technology' or 'technique'. He gives four reasons for this argument. First, he suggests that 'technical' implies that numerous programmes are in action. For example, when we say 'this is a technical point', the phrase is used to denote a deviation from, or a section of, a larger project. Therefore the word 'technical' acknowledges the existence of multiple programmes, or sections of the network. Second, Latour notes how 'technical' highlights the existence of non-humans as actors, in influencing and affecting the social world and therefore connected to and part of it. Third, he argues that 'technical' can also refer to a hitch in the programme, implying that technology can act to inhibit action, but that the technology is also part of the programme. This definition mirrors the concept of the mediator, which will be discussed below. Finally, 'technical skill' can refer to a specialised skill which produces action when combined with particular technologies in a network arrangement, therefore again encompassing the notion of technology existing as a network.

In defining technologies as networks, further discussion of the term 'network' is necessary. Latour ([1999a](#)) argues that the term 'Actor-Network Theory' is a misnomer, since these three words, and the hyphen, suggest an alternative meaning to what Latour and other ANT theorists originally envisaged. In terms of the word 'network', Latour ([1999a](#)) describes how this word came into use in ANT studies prior to the invention of the internet, yet with the ubiquity of the internet the word has come to be understood as the creation of instantaneous ties and connections. Latour ([1999a](#)) argues that this is the exact opposite of the original intention. He argues that the use of the word was intended to refer to a concept similar to Deleuze's

'rhizome', which refers to 'a series of transformations' (Latour, [1999a](#), p. 15), meaning that the connections between the disparate parts connect the network together and transform its use and its meaning.

There are strong connections between the work of Deleuze and Guattari and some of the central concepts in ANT. As per above, Latour prefers the concept of the rhizome to the word 'network', as this concept acknowledges that every point can potentially connect with any other point and that these connections can result in transformations. Throughout this book, several examples demonstrate how the rhizome, or network, operates. In several cases, sporting bodies of all kinds introduce new technologies with a particular goal in mind, but in all cases, unexpected consequences are generated owing to the technology connecting, interacting and transforming an unanticipated part of the sporting network.

Like Latour, Deleuze and Guattari opposed the notion of singularity, instead emphasising that all things exist as multiple through their use of the term 'assemblage' (Deleuze and Guattari, [2004](#)), a word also used at times by Latour. Like Latour, they argued against stability, claiming that assemblages are not made up of discrete, bounded bodies, but rather that things are made of disparate parts while also making up parts of other things (Currier, [2003](#); Deleuze and Guattari, [2004](#)). This is akin to Latour's example of the hammer, which, as described earlier, has a number of historical and geographical components folded within it in order for it to be stabilised and be recognised as a hammer. At the same time, the hammer is also part of a variety of other networks, which include human builders, businesses selling tools and other larger manufacturing organisations.

In sport, any piece of technology can be similarly examined. For example, at the material level, a basketball is made up of the disparate components of rubber or leather, air and an inner bladder. When combined with the flesh of a human, who is also composed of particular chemicals, hormones, bones and muscles as well as training and knowledge, the basketball is transformed into something that can bounce on the ground or pass through the air. The need for a ball made of rubber that can bounce with ease while a player is walking or running came about owing to the particular circumstances of the invention of the game of basketball. The

inventor of the game, James Naismith, was limited to using a flat indoor space to create a game to be played during the cold Massachusetts winter. He used the indoor gymnasium, peach baskets and a soccer ball (Rust, [2003](#)), which were all easily available. Naismith found that versions of soccer or rugby were impossible in the indoor environment because kicking the ball smashed windows while tackling caused bruises on the athletes' bodies because of the hard wooden floor. He recalled a game from his childhood called 'Duck on a Rock', which involved 'lobbing small stones up at a softball-sized rock on a boulder about 20 feet away' (Cantwell, [2004](#), p. 1076) and altered it to become a game playable in the flat indoor gymnasium. The peach baskets were nailed to the walls at each end and a soccer ball used for play, as these were the only items to be found that would work for his idea. To get the ball out of the peach baskets, someone had to climb a stepladder or use a pole. Naismith quickly wrote a set of thirteen rules, which involved no carrying of the ball, integrating bouncing instead, and these rules formed the basis of what became known as basketball (Cantwell, [2004](#); Rust, [2003](#)).

This popular story of the creation of basketball is an excellent example of how sport works as a heterogeneous network where humans and non-human technologies are equally important. While it is agreed the idea for basketball and the rules were Naismith's (Cantwell, [2004](#); Rust, [2003](#)), the game was created through the assembling of humans and non-humans. First, one non-human actant, the weather, created the circumstance where a new indoor game was required. If Naismith had been living in the tropics, this would not have been necessary. Second, the availability of the peach baskets, the round soccer ball and the indoor gymnasium with a flat floor were all crucial in being able to play the game. But at the same time the network included human input. Naismith's own knowledge of a game he enjoyed as a child was an important part of the creation of the game. Following the network further, the sports commonly played in North America at the time – football, track and baseball – left a gap in the calendar which had to be filled. Therefore the network included aspects that may be considered by some theorists as micro actors, such as the individual school situation, together with what may be termed macro actors, such as the yearly sports calendar. All these heterogeneous components are folded within the network of the technology that we refer to as basketball.

Currently, to consider the modern basketball network, the humble game of basketball is now the centre of a large, commercialised league that consists of a huge number of courts, hoops, players, teams and sponsors, all of whom are also assemblages of various disparate components and combine together in a multitude of ways. The word 'basketball' refers to every aspect of this network, including human components such as players, coaches and managers, and non-human components such as balls, wooden floors, shoes, backboards and hoops.

While the above demonstrates how non-humans play a role in sport, their importance can be understood further through paying attention to the way the human body works with non-humans in order to create sport. As the philosopher of sport Loland (2002) describes, technologies are not merely instruments utilised in sport; they are also constituent in producing sport. Or, as Thorpe and Rinehart (2010, p. 1273) argue, objects such as surfboards and skateboards, as used in alternative sports, 'are not merely objects that participants throw, kick, swing or push; these are objects that define the very activity itself'. They describe how alternative sports participants do not see themselves as separate from the objects they use but, in participating in the activity, become one with it. For example, using the examples of surfing and skateboarding, Thorpe and Rinehart (2010, p. 1273) write:

Acknowledging the significant role of equipment in surfing, Ford and Brown refer to the board as a 'hybrid extension of the body', while Borden describes the skateboard as 'a prosthetic device, an extension of the body as a kind of fifth limb, absorbed into and diffused inside the body-terrain encounter'.

In describing the surfboard in this way, the surfer resembles a form of cyborg, with the material form of the surfboard feeling to the surfer like part of their body. Introna (2009, p. 26) notes how the use of a theory acknowledging the interconnection between humans and technologies is particularly relevant as the world moves to becoming more technologically mediated and 'cyborgian'. In sociology of sport, a growing number of authors are examining the way athletes negotiate the connections between the natural and the artificial (see, for example, Butryn, 2003; Butryn and Masucci, 2003; Butryn and Masucci, 2009; Chapman, 1997; Cole, 1993, 1998; Miah, 2004; Shogan, 1999; Wesley, 2001). As Butryn and Masucci (2009, p. 287) note, there is a debate over whether twenty-first-century

sport is transgressing the natural/artificial boundary, and there is a wish revealed by some sporting participants to keep sport 'pure' or solely human, and untarnished by the introduction of artificial technologies.

One of the unique and somewhat controversial points of ANT is the argument that boundaries such as the natural/artificial divide have never existed. In one of his most famous works, *We Have Never Been Modern*, Latour ([1993a](#)) confronts this divide. He notes that, while many theorists argue that modernity marks a shift towards a focus on humanity which was seen as separate from the natural, this view is a particular interpretation that does not stand up to detailed analysis. As Venn and Featherstone ([2006](#)) explain, if one were to start making a list of all the features of a modern society and then try to identify whether individual societies match the list, it would quickly become evident that very few societies, if any, would definitely do so. Instead, they argue that most societies have a range of features that may be argued to be modern and some that are not. They use the example of the USA, which may be argued to be a quintessential modern society, with its emphasis on capitalist progress, and argue that it does not fit the categorisation of a modern society entirely, owing to the dominance of religious views within it, which is argued to be the hallmark of a traditional society. Societies are instead a mix of ideas that may be termed either modern or traditional depending on interpretation, with no definitive boundary existing between the two.

Sport is no exception. As Jonasson ([2014](#)) argues, sport has both modern and traditional components. On the one hand, as Guttmann ([1978](#)) argues, sport includes a list of features that would generally be considered to indicate modernity, including rationalisation, secularisation, specialisation and others. From this viewpoint, technologies are acknowledged as a necessary component in the enactment of sport (Jonasson, [2014](#)). On the other hand, some sporting regulations seem interested in retaining a level of purity that harks back to the traditional amateur understanding of sport. This is particularly the case with doping regulations, which (as discussed in more detail in [Chapter 4](#)) have banned doping and therefore aim to retain the separation between the natural and the artificial.

Within the study of sport, the use of the natural/artificial binary has meant that, at times, examinations of sport and technology have revolved around the question of whether the natural creates the artificial or the artificial creates the natural. In terms of sporting performance, this includes the question of whether a human performance inspires the creation of new technological devices or whether new technologies create the human performance. With technological determinism at one extreme end, it has been argued that technology develops separately from the social context where it is used, but that, once used, it then determines social practice (Roe Smith and Marx, [1994](#)). At the other extreme end, it is theorised that technology and its resulting consequences are initiated entirely by social actors, a theory that falls under the vague category of the social shaping of technology, or SST (Bijker and Law, [1992](#); Mackenzie and Wajcman, [1999](#); Rosen, [1993](#); Varney, [2002](#)). For example, Rosen ([1993](#)) argued that the specific design of the mountain bike resulted from the environment around where the bikes were being made. He described how one bike design, the clunker, became popular in Marin County, California, both because it was suited to the terrain and because the users had positive cultural associations with the Schwinn Excelsior bike frame that the clunker was made from. Similarly, Varney ([2002](#)) described how the creation of women's artistic gymnastics equipment was a result of the social position of women. She argues that each apparatus was designed to require less strength and more grace and flexibility than the previously existing men's apparatus. She theorised that this was a response to the predominant male/female binary that assumes females to be less physically capable. Further, Eichberg ([1982](#)) argued that the stopwatch developed as a result of behaviour. He describes how it came about because of a change in thinking about physical exercise, from purely exercise or 'exercitia' to that of a quantified competition in the form of 'sports' (p. 47).

Eichberg ([1982](#), p. 44) opens up the question of whether 'behaviour is derived from objects or from behaviour' by concluding that answering this question is unnecessary for understanding the relationship between technology and sport. Instead, he argues that the natural/artificial binary has never been clear.

The overall argument that the natural/artificial binary is overcome through a concept encompassing multiplicity has been raised by several authors. Deleuze and Guattari ([2004](#))

preferred the term 'assemblage' but referred to the same phenomenon. Haraway (2004) similarly adopted this idea through her work on the cyborg, while ANT theorists Latour (2005) and Law (1994) used the term 'network' and Mol (2002) 'multiple'. For all these authors, the common thread is the argument that the make-up of the world makes it impossible to separate the natural from the artificial or the human from the non-human because they are intertwined in our everyday lives.

Similarly, writing on sport, Tangen (2004, p. 16) uses the word 'system' to describe the network that makes up sport. While most researchers who examine technology investigate specific improvements or implements, Tangen argues that facilities are an equally important part of the sporting network. He notes that the facility forms a significant role in determining how the sport will be played, and in allowing sport to be played:

The facility is not only a sufficient structure of sport. It is a necessary structure; a structure of embedded expectations. Without a facility there will be no sport. The sport and the facility are two sides of the same coin.

In acknowledging the equal importance of the structures of sport and the facilities, Tangen approaches the perspective adopted in ANT in arguing that the social and the technological should be treated symmetrically.

Also within the study of sport, Butryn and Masucci (2009), following Ihde's (2010) perspective, move towards understanding athletes as actor-networks through their use of the concept of a cyborg. They identify three forms the relationship between human athletes and technologies can take: first, technology as mediator; second, technology as embodied or an extension of the body (which most closely resembles Haraway's concept of the cyborg); and third, technology as providing an alternative or other-world experience (Butryn and Masucci, 2009). The distinction between humans and technologies remains, and the focus is on understanding the relationships that humans have with technologies (Verbeek, 2005). By contrast, this book, in line with the aims of ANT, is interested in tracing the workings of sport as an assemblage of human and non-human (technological) actants and in unravelling the networks that produce sport. What the two approaches share is an acknowledgement of the central position of non-humans in the

production of sport; however, ANT argues against any concept of the purely human existing as distinct from the non-human. Instead, ANT argues that social relations are always socio-technical and that humans and non-humans should be treated as equally able to produce action (Latour, [2005](#)).

Technology as society made durable

Latour argues that technology 'is society made durable' (Latour, [1991](#), p. 103). This obscure statement refers to his argument that nothing in the world is able to stabilise without the presence of non-humans. He argues that no purely 'social' world can ever exist, but the world works through the heterogeneous network of humans and non-humans, and that it is the way that the two are assembled together that produces stability.

In order to illustrate his argument that the world is always socio-technical but stabilises through the combining of human and technological entities, Latour ([1992](#)) uses the very simple example of a door. He argues that one way of understanding the equal importance of the social and the technical in society is to imagine the work that must be done by a human if the non-human were to be removed. In the case of the door, he describes how a hole would have to be made in a wall and then bricked back up in order to fulfil the same purpose as a door. If the door were removed and the hole left open, outdoor weather such as rain and wind would be able to enter indoors, making it pointless to be inside at all. With the door present, it is through the combined efforts of a human and non-human that one is able to walk through. The human has been involved in the creation of the door, in walking through and pushing or pulling the door open and closed. But this is only possible through the physical properties of the door being combined in a particular way. The door is hinged, allowing it to move freely, and made of a robust, hard material that means it will prevent weather such as wind and rain getting through.

With the door in place, the method of entering and exiting the building without allowing rain or wind inside becomes stabilised. Humans and the physical components of the door are disciplined to work together to allow entering and exiting to occur, and this behaviour is now stabilised as the dominant way in which actors enter buildings.

In sport, we can similarly see the same stabilisation of behaviour through technology as sports become stabilised networks that utilise particular pieces of technology. Many sports are now stabilised as including particular balls, bats, boats and many other technologies as part of their normalised form of operation. For example, van Hilvoorde, Vos and de Wert (2007) note the stabilisation of the high jump as including a bar, mats and the technique of the 'Fosbury Flop'. They discuss how it has been assumed that in the sport of high-jumping the now common technique of the 'Fosbury Flop' developed as a result of the creation of foam mats for high-jumpers to land in. However, Dick Fosbury actually created the 'Flop' prior to the introduction of mats. Rather, the mats allowed the 'Flop' to become the norm for high-jumpers after Fosbury first performed it with great success. Therefore it was the assemblage of the mats together with Fosbury's success that produced the current norm of the Fosbury Flop being the normal way to high-jump. The behaviour of the high-jumpers, in utilising the Fosbury Flop technique, has become stabilised as a result of the high-jump network, including landing mats and the exact technology used to hold the bar to the side supports. With regard to the latter, Dick Fosbury described how he experimented with working out which parts of his body were causing the bar to fall and created the 'Flop' as a way to avoid those body parts knocking against the bar (van Hilvoorde, Vos and de Wert, 2007). Fosbury's experimentation suggests that the particular technology of the bar itself, and how it was attached to the stand and falls off, were also significant in determining what would cause it to fall. If the bar had been attached through different means, it is possible that the Fosbury Flop would not have been as effective, and a different method of jumping might have stabilised as the norm.

The example above demonstrates how the heterogeneous or multiple aspects of a particular technique or technology can become concealed from view once it stabilises. The way that multiplicities become understood as singular and stabilised has been of particular interest to the ANT researcher Annemarie Mol, whose work on atherosclerosis demonstrated the way that the disease existed in multiple forms and incorporated multiple meanings despite being assumed to be singular (Mol, 2002). In sport, a similar example can be found through the example of doping, where the very different acts of finding banned substances in a person's blood, taking a pill or injecting oneself are singularly considered to be doping,

even though these practices are very different and are undertaken by different groups in different contexts.

Once a network has stabilised, Latour ([1991](#)) uses the term 'black boxed' and Law ([1992](#)) 'punctualised' to refer to the way that the network becomes understood as referring to that particular concept and therefore the network that created it becomes lost from view. The best example of 'black boxing' (Latour, [1991](#)) in sport occurs through rules and regulations. All sports now have countless rules and regulations in place that exist in written form as inscriptions. These have been produced in order to ensure that the sport runs effectively and that a winner can be determined fairly and appropriately, but they were not created arbitrarily. Many rules have come into effect because of occurrences of inappropriate behaviour or similar circumstances that required sanctions against particular behaviour to be included in the rules to prevent it happening again. However, the actual behaviour behind the decision to change the rules is now concealed from view. The sport stabilises, or becomes black-boxed, with particular rules in place that remain an unquestionable part of the sport. For example, in sprinting, the International Association of Athletics Federations (IAAF) introduced the rule that the winning athlete is the one whose chest moves over the finish line first because of the problem of determining which athlete was the winner (Inizan, [1994](#)). I consider a more detailed case in swimming, where particular regulations were introduced to counter problematic behaviour, in [Chapter 2](#).

Technology as actant

The above discussion of the high jump highlights the way that technologies can 'act' to alter or influence sport. One of the most extensive and controversial debates within both ANT and wider literature is about how it is that non-humans such as technologies, incapable of conscious decision-making, are able to act (Sayes, [2014](#)). Arguably ANT's most extreme critics, Collins and Yearley ([1992](#)), claim that ANT overstates the importance of non-humans in the social world and suggest that the study of technologies is better left to the physical sciences than the social sciences. Given this controversy, it is to the question of how technologies can act that I now turn my attention.

In sport, there can be no doubt that technologies have had a significant impact. At the simplest level, we know that improvements in technology can contribute to enhanced athletic performances. For example, in attempting to determine the effects that technology can have on sport, Haake (2009) used statistical analysis specifically to examine the effect of new technology on the sports of sprinting, pole vault, javelin and cycling. He historically tracked the performances of athletes together with changes in technology. He found that in pole vault and cycling there were clear historical 'jumps' in performance as a result of improved pole or bike technology. Conversely, in javelin, he found that in 1984 the rules for the technology permitted in the javelin itself were restricted, and as a result performance levels actually declined in the years following. His 2009 study is interesting as it acknowledged that rules can have the same power as new technologies. In making this acknowledgement, he called attention to the heterogeneous nature of sport and the way that sporting performances are affected by a variety of different facets. He argued that both the technology and the rules acted to influence performance.

Haake (2009) was particularly interested in the way that technologies had a causal effect on sporting performance. In the sports he chose to examine he found a very direct relationship. This kind of work is important in understanding technologies, and a statistical methodology allows the numerical identification of direct effects in sports where measurements are key. The ANT methodology allows the investigation of a wider range of complexities, including cases where it can be difficult to identify numerical effects. Indeed, Latour notes that in terms of causality, there are:

many physical shades between full causality and sheer inexistence. In addition to 'determining' and serving as a 'backdrop for human action', things might authorise, allow, afford, encourage, permit, suggest, influence, block, render possible, forbid and so on. (2005, p. 72)

In this passage Latour highlights the many different roles that technology can hold beyond direct causality as identified by studies such as Haake's (2009).

In order to determine the role that a particular technology has played, Latour (1999b) argues that in many cases we become aware that a technology has acted through

the existence of controversies. If technologies were simply instruments, as he accuses Heidegger of suggesting, then there would be little controversy about them. Instead, the use of technologies is constantly debated. As Matthewman (2011) chronicles, technologies as diverse as bridges, baby bottles and computers have all caused immense controversy in terms of their design, use and placement. They still hold value through the functions they can perform, but functional value is only one aspect of their existence.

There have been a range of controversies with regard to the use of technology in sport. While this book examines some of them in detail, such as doping and the use of the polyurethane swimsuit, there have been other landmark cases, including the case of Oscar Pistorius. Pistorius became caught in a controversy because his artificial legs were accused of acting too strongly and thus providing him with an advantage. To Pistorius himself, his artificial legs were his only means of locomotion and, given the choice, he would have preferred to be able to use flesh and bone. But to others, his artificial legs were seen as providing him with an advantage over other athletes. Pistorius's case highlights how, in comparison with Haake's (2009) study above, it can be extremely difficult to determine the effects that a new technology may have on sport. It took years for a verdict to be reached, which determined that Pistorius's artificial legs did not provide him with any unfair advantage.

One of the arguments for why technologies can create controversies is their transformative potential. The addition of a new technology, or object, to any environment can create extensive new possibilities, particularly when assembled with a human (Harvey and Knox, 2014). When a hammer is combined with a human, the human becomes capable of action that could not previously be performed. The human is transformed into a new assemblage, or a new network is created (Latour and Venn, 2002).

In the sporting context, it is precisely this notion that makes sport so appealing. The ability for an athlete to perform feats that might normally be seen as super-human can be very attractive to both observers and practitioners. It is the athlete combined with numerous different types of technology that allows them to transform from a 'normal' human into one capable of performing impressive physical achievements. As

described earlier, a human in possession of a pole vault is suddenly transformed into a person capable of jumping several metres up into the air. A swimmer wearing a specially designed swimsuit swimming in a carefully designed pool having been trained by a scientific process is transformed into a person capable of moving through the water at astonishing speeds. It is these transformations that make sport enjoyable to watch.

The difficulty for the researcher is in determining the exact way that the technology has acted to create such a transformation. Haraway, in an interview with Penley and Ross (1990), frames this as a problem of language, where scholarship has developed a vocabulary for describing and explaining the actions of humans, who can use language to describe their actions, but no such vocabulary is available to non-humans, who are unable to speak.

As discussed in the introduction, much of this book is designed to follow sport and technologies that have been particularly controversial in the last decade. Latour (2005) uses a particular term to designate those technologies that behave in a controversial or unexpected manner: mediators. He defines mediators as objects whose outcome cannot be assured by their input. By contrast, he describes the opposite as 'intermediaries': non-controversial things which behave in a particular, predictable way (Bencherki, 2012; Latour, 2005). For example, in the context of sport, a stopwatch which accurately recorded the time an athlete takes to do a particular thing would be a common intermediary. The stopwatch would obediently begin recording when a certain button was pressed, and would stop when the button was pressed again. However, many things do not behave so obediently, including some stopwatches which may refuse to display any numbers at all, or refuse to acknowledge that the stop button has been pressed. Stopwatches that behave like this would be described by Latour (2005) as mediators: unpredictable objects where the outcome is not assured. These distinctions are significant, as mediators demonstrate how it is that non-humans can act to prevent, change or inhibit action, while intermediaries act to facilitate action. Latour argues that in all contexts humans work together with non-humans in order to function, and that therefore *both* the human and non-human can cause action. In the use of the stopwatch, a human pressing the wrong button and the plastic button not working have the same effect, of not

causing the correct number to be displayed. Agency is shared between the human and the stopwatch in creating this outcome through the assemblage of the two (Bencherki, [2012](#); Latour, [2005](#)).

Such a view reverses the standard sociological conception of agency. For ANT theorists, agency is produced through a heterogeneous network rather than individually. In the stopwatch example above, agency is produced through the combination of plastic and electronics that is the stopwatch working together with a human and their knowledge of which button should be pressed. Latour emphasises that it is the size, shape and scope of the network that determines what is produced. Different kinds of actor-networks produce different kinds of effects (Edwards and Nicoll, [2004](#)).

One particular effect that Latour ([1992](#)) argued technologies can have is a moralising effect. He argues that technologies are increasingly utilised in order to discipline humans into behaving in a moral manner. This argument relates strongly to Foucault's work, which acknowledged the way that physical technologies and architecture, such as cameras or prison structures, are part of the process of disciplining individual humans to behave in particular ways (Foucault, [1977](#); Kerr, [2014](#)). The example that Latour uses to demonstrate his argument is the network of the car. He describes how the law decrees that, when humans are in a car, they should wear a seatbelt in order to ensure their own safety and points out that modern cars have disciplining mechanisms to ensure drivers and passengers do so. He notes how cars commonly make a beeping sound, or flash a light, if a seatbelt is not worn. The beeping sound or the flashing light then acts as a device to discipline the driver to behave according to the law and wear a seatbelt.

In sport there are countless examples of sporting bodies and regulations using technologies to ensure that athletes behave according to the rules. For example, at the beginning of skiing and snowboarding races, the racer must wait for a barrier to open before they can begin the race, to discipline athletes to begin at the correct time. Similarly, in sprinting, the starting blocks contain sensors to ensure that the athletes do not begin racing (in a 'false' start) before the official start of the race. In both these cases, the technologies act to discipline athletes into behaving according to the rules.

Technologies can also act to discipline spectators. All major sporting events include a range of infrastructure that disciplines those attending the games. For example, the lack of parking provided at the Olympic stadium disciplines visitors into travelling by train to arrive at the venue. Similarly, stadiums for many major sports are constructed to ensure that different groups of people are restricted to different areas. For example, in his examination of facilities, Tangen (2004) describes how a Premier League football stadium is demarcated to allow only certain individuals into particular areas. Players, managers and coaches are permitted in some areas, fans with tickets in another, and fans without tickets are not allowed in at all. In this example, it is clear that 'tickets' and other credentials transform the individuals into assemblages who can enter particular spaces. It is not the individual who is permitted into the area, but rather a credential that allows access. The credential acts as an inscription, containing the information about who the individual is that transforms them into someone who can enter that area or not, and works as a disciplinary mechanism to ensure that only particular people can enter particular areas.

Conclusion

This chapter has introduced the notion of technology and sport as consisting of actor-networks made up of heterogeneous components. This book does not view technology as having any particular, clearly defined roles in sport; instead I adopt the position that each technology exists as its own unique actor-network within a broader actor-network that constitutes sporting practice. There are no particular qualities held by any technology that makes it definable as a technology; rather, it is the network of the sport, and what is brought into the network as part of the sport and recognised by the network as a technology, that makes a technology definable as such. This is in line with the ANT view that researchers should be learning from the actors about their world (Latour, 1991). As Latour (2005) describes, any societal group spends a great deal of time defending its status as a particular group and policing the boundaries of the group. Sport is no exception. Those involved in sport are greatly concerned with what constitutes sport, and certain objects are accepted as technologies which are embraced within sport while others are banned. One of the goals of this book is to track the trajectories of these

technologies, some of which allow new technologies to be easily integrated into sport and some of which do not.

The [following chapter](#) takes up the notion that technologies are not always easily enrolled in sport. Through specifically examining technological enhancements, the book now moves to consider how functionality is an insufficient reason for the adoption of new enhancements in sport.

2

Enhancement: which technologies are improved, and how?

When watching sport on a regular basis, it can feel as though the many pieces of technology used in sporting competitions are constantly improving. Commentators draw attention to athletes using the newest type of aerodynamic helmet or carbon fibre bicycle. Sometimes, the technological changes can be so enormous that the sport may barely be recognisable, such as when the America's Cup sailing competition altered their rules to allow catamarans rather than only single hulls. At other times, it is the contrast between the technologies used by different teams that we notice, perhaps owing to personal preference or perhaps highlighting economic differences between various nations. Richer nations and sports are more likely to have the most up-to-date technologies than those with fewer resources.

The technologies that this chapter focuses on are those that are constituent for sport. They are not technologies that are external to the sport but utilised by athletes or coaches for training or other purposes; they are technologies that are used by athletes every time they train or compete. These kinds of technologies include balls in football, boats in rowing or yachting, bicycles in cycling and shoes in running. As these form necessary parts of each sport, it is understandable that improving these technologies has become another avenue for athletes to attempt to achieve an advantage over their competitors. At times, we have seen athletes adopt some unusual technologies, such as Australian Cathy Freeman's choice to wear a full-body suit including head cover in the 2000 Olympic Games, which contrasted markedly with the very brief attire worn by many of her competitors.

This chapter examines how constituent technologies come to be enhanced or improved. It may seem obvious that all athletes would be constantly seeking the best technological options, but, as this chapter notes, determining the best option for an individual athlete can be very difficult. Further, the cases in this chapter show that the actor-network of sport includes

many other actants that can influence athletes' and/or coaches' choices to enrol a newly enhanced technology. Overall, the central question explored throughout the chapter is why some technological enhancements are easily integrated, or enrolled, into sport while others are resisted.

The goal of improvement

As Guttmann (1978) described, there is an undisputed link between the goal of sport and that of scientists, with both groups searching for greater human achievement. In sport, this is often achieved through improving and enhancing already existing equipment and technology. As Trabal (2008) notes, following this logic would assume that any new technological advances that have been shown to improve sporting performance would be enthusiastically adopted by athletes and coaches. However, as I argue throughout this book, this is far from the case. Through cases studies in kayaking and swimming and a range of other examples, this chapter examines how enhancements to already existing sporting technologies are both adopted and rejected.

Brohm (1978) argued that the quest for improvement caused competitive sports training to become 'Taylorised'. He described how the body came to be treated as a machine and training was structured to produce maximum efficiency. Interestingly, Frederick Taylor, the originator of scientific management in the workplace, was also one of the first to introduce efficiency into sports training and sport technologies. While Taylor is best known for his work in conserving resources and producing maximum efficiency throughout the workplace (Taylor and Bedeian, 2007; Tenner, 1995), what is less well known about him is the way he applied these same principles to sport. Through applying his principles to the sports of tennis and golf, he invented and patented a number of new technological innovations (Taylor and Bedeian, 2007). Taylor was ahead of his time in determining that the design of the equipment utilised in sport could strongly influence one's ability in the game. He believed that 'there is a best way of doing everything' (Taylor, 1912, cited in Taylor and Bedeian, 2007, p. 196) and applied this principle to sport in exactly the same way that athletes, coaches and scientists approach competitive sport today. Taylor patented two different tennis rackets, one with a spoon-shaped handle to allow very low or high shots to be returned more

easily and one with double thickness in the middle of the strings to prevent fraying (Taylor and Bedeian, [2007](#)). In golf, Taylor has been credited with inventing a number of features that have become commonplace in clubs today. He crafted himself an 'extra-long, large-headed driver' (Taylor and Bedeian, [2007](#) p. 199) and invented the concept of placing ridges on the face of clubs, allowing the golfer to produce backspin.

Taylorist methods became popular in sport during the early twentieth century, with coaches and athletes quickly seeing the potential for improved performance through adopting Taylor's efficiency-focused practices (Tenner, [1995](#)). Accordingly, the related concept of enhancing the technological implements and equipment used to play sport in order to improve results has now become commonplace. However, what this chapter addresses is the way that many of these new innovations are not seamlessly introduced into sporting practice. Instead, many new enhancements are either rejected outright by athletes or organisations, or create immense discussion and controversy between sports participants. Even as early as 1909 Taylor had one of his inventions, the Y-shaped putter, banned from golf on the grounds that it went against the rules of the sport, which had to be upheld in order to keep it pure (Taylor and Bedeian, [2007](#)).

Butryn ([2003](#)) provides an excellent summary of literature examining resistance to technology. First, he describes how some theorists have raised concerns over the impact of new technologies on athlete autonomy (see Sage, [1998](#)). The argument here is that if sport becomes dominated by technology, then athletes will have fewer opportunities for personal expression, and the workings of sport will be determined by the limits of the technologies rather than by the athletes themselves. Similarly, he notes how one unintended consequence of some new technologies has been an increase in injuries (see also Tenner, [1995](#)). There is also an understanding of technologies adding to the 'dehumanisation' of sport (see Rintala, [1995](#); Simon [1994](#)). In terms of dehumanisation, it is argued that athletes and spectators desire sport to be a contest of human endeavour, not a competition about who has the most effective technology.

Butryn himself argues against the technological determinist stance adopted by the above authors. Instead, he takes the cyborg-athlete as a given. Butryn ([2003](#), p. 18) describes:

Viewing elite athletes as cyborgs who are inextricably tied to a range of sport technologies helps to alleviate the tension between 'natural' and 'artificial' athletes and performances, because it carries with it the recognition that elite athletes do not simply enter into competitions as technological tabulae rasae. Rather, athletes have interacted with and been shaped by various technologies since birth.

This quote is similar to the ANT stance on the technologisation of athletes. From an ANT perspective, the notion of a human body that is non-cyborgified does not exist. ANT emphasises that in all sports the human body is assembled with various equipment in order for the sport to take place. The runner assembles with shoes and a running track, and the basketballer with a basketball, backboards and a wooden court. These items form as much a part of each sport as the players. Butryn ([2003](#)), in his study of elite athletes and their attitudes towards athletic equipment, found that, although the above fears of having their bodies corrupted exist in relation to doping and medical equipment, their attitudes to what he terms implement technologies (those technologies used in the act of playing the sport) ranged from embracing innovations in line with the goal of improvement, to discarding them, to complete indifference. Butryn expresses surprise that athletes chose not to adhere to the 'win at all costs' philosophy in not utilising all the implements or rehabilitative technologies at their disposal, despite these athletes competing at the very highest level. This is one of the questions examined in this chapter, with the case study of kayaking offering a possible explanation for why athletes are not always immediately keen to utilise new technological improvements.

Other studies of technology in sport have emphasised the influence of the human or social in determining whether new technological enhancements are adopted. For example, Pinch and Henry ([1999](#)) use an SSK (sociology of scientific knowledge) approach to examine the process of technological innovation in motor sport. They describe how the difference between SSK and ANT approaches is the weighting given to non-humans in the innovation process. ANT emphasises the importance of treating humans and non-humans in a symmetrical manner. While SSK acknowledges the importance

of non-humans, those working from this approach accuse ANT of tending too far towards technological determinism. Regardless of this difference in the approach, Pinch and Henry's (1999) work provides an excellent example of how technological decisions are not always made to enhance performance, but rather are subject to ideas from a huge number of groups with a variety of agendas.

Pinch and Henry describe a large number of groups who have shaped the technological innovations utilised in motor sport, including 'the teams, their sponsors, the television companies, and the regulators of motor sport'. For example, they describe how the sponsors are torn by the desire to make the sport more exciting while also keeping it safe. The pressure to keep sponsors happy results in those involved directly in the sport feeling that it is external bodies without any technical knowledge of motor sport who end up directing the trajectory of innovations. For example, it is surprising how the design of the cars can be altered for a reason completely external to the racing, such as the 'wings' in the car being made larger in order to accommodate a larger area to place advertising (Pinch and Henry, 1999, p. 667). However, in order to resist pressure from external groups, the racing teams were revealed to be unexpectedly collaborative:

The majority of teams will group together to block a radical solution from one manufacturer if it threatens to produce cars that are much faster than all the other designs. Hence, there have been certain approaches (such as active suspension systems or turbo charging) that have been killed off, either in their infancy or at some later stage, through the regulative processes surrounding motor sport. (Pinch and Henry, 1999, p. 668)

This statement reveals how the teams are aware of the importance of retaining a close competitive race in order for their sport to continue to be viable and attractive to spectators. Like Butryn's (2003) study, it shows how teams do not deliberately enhance their cars in order to gain an advantage, even though it is commonly assumed that gaining an advantage in performance is the ultimate goal of every athlete.

A central theme in Latour's (1987) work is how innovations are not created as inventions by a single individual but instead come into practice through a number of iterations involving large numbers of humans and non-humans. This idea is shared by SSK and discussed by Pinch and Henry (1999), who describe how, although there are individual

designers who are respected for their design abilities, the designer's role is more about being part of a team than acting individually.

Similarly, ANT and SSK share an interest in the trajectory of innovation, in how technology comes into existence through an unpredictable pathway in which some avenues are closed down and others followed through (Pinch and Henry, [1999](#)). Both approaches acknowledge that the trajectory that an invention follows is not necessarily the result of technical input but may depend on a variety of social and economic factors. In being interested in trajectories, the central question then becomes why are some technological enhancements easily adopted and become part of a sport, while others are never used. To examine this question, ANT theorists have generally deployed the concept of enrolment.

Enrolment

The central question tackled in this chapter, and discussed in other chapters of this book, is the question of why certain pieces of technology are enrolled or not enrolled within the sports environment. This question is one that ANT is particularly well designed to answer, as the notion of enrolment is one of its central concepts.

Callon ([1986](#)) developed the concept of enrolment to examine precisely the mobilisation process that involves actors being integrated into a network working towards a common goal. In his heavily cited article examining the domestication of the scallops of Saint-Brieuc Bay, Callon describes the enrolment process as occurring in three phases: problematisation, *intéressement* and finally enrolment. The first step, problematisation, involves defining the problem and identifying potential actors to be introduced to create a solution (Callon, [1986](#); Tatnall and Davey, [2005](#)). For the solution to be reached, an 'obligatory passage point' must be negotiated, which involves the alignment of the viewpoints of those involved, also known as '*intéressement*' (Callon, [1986](#); Tatnall and Davey, [2005](#)). '*Intéressement*' consists of individual actants reinterpreting the problem in the context of their own concerns thereby motivating them to assist with a solution (Star and Griesemer, [1999](#)). Latour ([1991](#)) describes this process as the alignment of points of view through using the example of a hotel manager and hotel guests aligning their goals to ensure a

hotel key is returned. In this example, Latour describes how the addition of a heavy weight to the hotel key ensures the keys are returned to the hotel desk to the manager's satisfaction and removed from the pockets of the guests to their immense relief, leading to a solution which satisfies both parties. Although in his landmark article Callon (1986) describes the process of *intéressement* as the researchers or scientists attempting to impose their point of view on the scallops and fishermen, Star and Griesemer (1999) argue that *intéressement* is wider than the imposition of one point of view on the other: that it is the alignment of goals from multiple viewpoints which cannot be understood from a single viewpoint. The third phase, enrolment, involves the stabilisation of the roles of the parties involved where all are working effectively towards a common goal (Callon, 1986; Tatnall and Davey, 2005).

A central component of the enrolment process is the concept of translation. Latour (1991) argues that the only way for *intéressement* to be achieved (or for points of view to be aligned) is for each actant to translate, or reinterpret, the situation into one which they were prepared to be part of the solution of. In order for enrolment to occur, it is not necessary for all actors to agree, but they must agree that a particular outcome is desirable. They agree on this by translating and understanding the situation in different ways. For example, the hotel manager's desire that the hotel keys are returned to the hotel is translated by the hotel guests as them wanting to rid themselves of the heavy weight attached to the keys (Latour, 1991). Both result in the desired outcome of the keys being returned to the hotel, but for very different reasons. Callon and Law (1982, p. 618) describe the necessity of actors pursuing the 'imputed interests' of others to enrol them successfully. Actors make their case through translating their own interests into the perceived interests of others. The goal is for the others to be successfully enrolled into the project and thereby fall into line in assisting with the project's success. In translating their interests into their perceived notions of the interests of others and therefore attempting to enrol them, actors are essentially attempting to impose their version of order on the world.

A discussion of how new technologies may be rejected despite their effectiveness is provided by Trabal (2008), who, through adopting some ideas from Latour, describes how new kayak designs failed to be used by the top kayakers in France.

Case study: kayaking in France, Patrick Trabal

Trabal ([2008](#)) examined the introduction of a new flatwater single-seater kayak (K1) designed to offer the athlete greater stability in the water and therefore potentially faster times. A technician involved in the creation of the boat questioned whether the boat would actually be used by identifying two potential areas of resistance. First, the organisational body, the French National Canoe and Kayak Federation, was argued to be slow to change. Second, the top athletes were identified as being in opposition to change. Overall, the policy seemed to be that the preferred course of action was to use what had worked elsewhere rather than developing innovations. The results of this policy, as described by one technician, were that the French team was 'one Olympiad too late' (Trabal, [2008](#), p. 314).

While the above paragraph identifies certain groups as resistant or in opposition to new developments, Trabal ([2008](#), p. 317) describes how, just like Latour, he wishes to be 'symmetrical'. He aims to avoid judging groups as for or against, instead acknowledging that a range of actors can affect the adoption of new technological developments. In order to understand why a new design of boat could not easily be adopted by the kayaking community, Trabal used three methods. First, he conducted a questionnaire of all the top kayaking athletes at the time. He then conducted thirteen interviews with coaches and technical staff. Finally, he visited training sites and talked informally with athletes, coaches and technicians.

Overall, Trabal describes how the questionnaire found that the athletes' attitudes to new technologies were generally positive. The majority expressed an interest in technical improvements in their sport, as well as being comfortable with and happy using common technologies such as computers. However, as Trabal ([2008](#), p. 322) points out, these are 'only words'. By contrast, in one of the interviews, the complexity of the situation beyond these positive words begins to be revealed:

Researcher: To come back to the latest K1, if it was suggested that you use it here on this site, would you agree or not?

Coach 1: Well, yes! If we are told: OK, you've got this boat to test, here's the construction protocol, here's the means to do it, and here are two or three extras, well yes!

Researcher: And you think that the athletes would agree?

Coach 1: Yes, but, well ... in the end ...

Coach 2: They have to realise that it's an opportunity!

Coach 1: But how are we going to sell it to them? What is clear is that it should have been sold to us before. But even if it's been sold to us, we will need the means to be able to sell it to others.

This extract is a good example of Latour (1991) and Callon's (1986) notion of enrolment or, as is often the more common case, lack of enrolment. Three groups are identified here: the Federation, the coaches and the athletes, and all three groups come to the boat issue with different attitudes. The difficulty of groups working together who come to an issue with different points of view is one that has been investigated extensively by ANT theorists, as in the example of Callon's (1986) study of the domestication of scallops. In this case, Trabal explains that the different views on the boat come about through each group focusing on a different way of testing its effectiveness, and their belief in the boat. Some use an artificial testing tank, others argue for races, but the other ingredient is always the belief. Trabal (2008, p. 326) explains:

Scientific justifications based on curves and readings, a metrology spanning over the number of medals, sensations of the athletes in the grips of dealing with the boat, cannot separately suffice. Belief or non-belief in the project is a matter of adjusting to all these arguments. 'It needs to be sold' said the coach. Just like a sales representative in the throes of trying to convince his client must mobilize all the resources at his disposal (a 'product brochure' containing the measurements, understanding of the psychology of the person opposite, subjective descriptions of its uses, etc.), it is through a range of approaches that the conviction can be fostered.

This description clearly outlines why enrolment and adoption of the boat, have not occurred. The arguments for the improvements the boat offers had not been explained to the athletes and coaches in a way that allowed these two groups to see the benefits offered to them. Instead, the athletes and coaches trusted their own knowledge and understanding of what would improve their performance over that of the technicians who developed the boat. For example, some of the athletes tested the boat by sitting at the front, despite the advice of the technicians that improved results would be obtained by sitting further back. The athletes did not heed the advice of the technicians because their own experience led them to believe

they knew best about where in the boat one should sit for maximum effect. The technicians may have had the knowledge of the boat and its physics, but the athletes' understanding came from their own experiences and feeling of being in boats, and the two groups had difficulty reconciling their different views.

The survey performed by Trabal (2008, p. 322) also reveals the different understandings of what was the best boat.

Table 1 demonstrates the very wide range of views held by athletes and a lack of agreement about what the most effective boat would be. This was even before discussions around the technical qualities of the boat. It also illustrates the breadth of the network involving in boat-building. The athlete, coach, laboratory and current world champion are all raised as potential influences in the creation of a new boat.

Table 1

Participant responses regarding the best boat

	Line racing (n = 29)	Slalom (n = 31)	Descent (n = 27)
The best boat ... is the current world champion's boat	3.96	2.93	2.59
The best boat ... is mine!	4.86	6.12	6.31
The best boat is the one I will have built in collaboration with a constructor	5.37	6.61	5.11
The best boat is the one studied in the laboratory	4.30	2.97	4.00
The best boat is the one my coach will recommend	4.19	3.47	4.30
I am not very informed of the latest technological developments in boat-building	4.25	3.29	3.37
There is no such thing as the right boat; it is the right athlete that counts	6.22	6.90	5.58
All competitors should have the same boat	3.61	0.77	2.80

Source: Trabal, 2008, p. 322

The high result achieved by 'There is no such thing as the right boat, it is the right athlete that counts' also suggests that athletes do not rate the boat as highly significant for success, which could be another contributing factor to why a new boat was not enrolled easily. This indicates the relative importance of the boat in the minds of the athletes, with it appearing that athletes ranked the boat as not as important as their own

training. While, at times, other authors have been surprised at athletes' lack of knowledge or interest in new technology (see, for example, Butryn, [2003](#)), Trabal comes to the realisation that whether an athlete or coach is interested in technology is almost the wrong question. Instead, he reveals how the network of elite sport contains a huge number of components and it is impossible for athletes/coaches to spend all the time they would like on every one of these. For athletes, time is a commodity, and they must be careful how they use this important resource (Woodward, [2013](#)). Lack of time means they must choose to focus on those components they feel will result in the most success. For some athletes and coaches, technology is one of these components; others might see other factors, such as strength training or psychology training, as a higher priority. Either way, athletes and coaches make deliberate choices about how to spend their limited time and so do not adopt technological enhancements easily simply because a technician or scientist says they work. Many other options also work effectively, but athletes have limited time, so must choose the combination of options that works best for them within the time they have. Consequently, their particular actor-network may or may not include enhanced technology.

Emphasising elite sport as existing as a socio-technical network demonstrates how it is inaccurate to frame athletes and coaches as for or against new technological developments. Rather, elite sport training is a constant process of weighing up which aspects can create the most effective performance, and new enhancements or technologies are merely one variable that athletes must consider. Viewing athletic performance as a network ensures that the enrolment or non-enrolment of a piece of technology can be understood in relation to the other aspects of the sport. This is an important point for elite sport programmes and for technology manufacturers to be aware of. Managers or manufacturers often focus purely on the effectiveness of a piece of technology and thus make the assumption that athletes and coaches will enrol the technology because scientific tests reveal it to be effective. But as Trabal's ([2008](#)) study shows, athletes may already have their own network that they believe to be effective for themselves, and lack the time or inclination to investigate alternatives, and it is only through understanding the athletes' actor-networks that this can become apparent.

The case of the kayak highlighted two particularly important aspects for understanding how and why technological enhancements are not necessarily seamlessly adopted by athletes and coaches. First, viewing the athlete as a network emphasises how each athlete has their own very particular actor-network and their own individual views on what will be most effective for enhancing their own network. Therefore, an athlete is not likely to enrol any new technological enhancements without careful consideration of how it may affect their network as well as their performance. Second, determining whether a new enhancement will improve performance can be surprisingly difficult. There may be several ways that technologies can be tested in order to test their value, and different groups see different methods as valuable. Nevertheless, the final decision comes down to how athletes assemble with the new enhancements. I will now explore these aspects and others through examining the prominent case of the competitive swimsuit.

Case study: the competitive swimsuit, 1992–2010

One of the roles of international sporting federations is to set the rules for their sport. Rules perform a number of roles, including determining that the winner of the event is the participant(s) who performed most effectively at the particular activity deemed necessary in that sport. But in many cases technologies can perform sporting activities more effectively than humans can. For example, a boat can travel much faster through water than a human. Therefore, it is up to sporting bodies to ensure that each sport remains a contest of human abilities, with technologies generally regulated to limit the effect they have on the human body. In this sense, sporting federations and ANT theorists are interested in the same thing: how do you determine whether technology has acted? The following case study examines the International Swimming Federation's (FINA) efforts to answer this question in relation to setting swimsuit regulations for World and Olympic competition.

FINA's swimsuit regulations

In 2009 FINA rewrote the competitive swimming regulations, to take effect from 1 January 2010. The new rules required that swimsuits met double the number of criteria that they had in 2009 in order to gain FINA approval, which included passing

fourteen distinct tests. These tests were developed with the aim of determining whether the swimsuit had the capacity to 'affect' swimmers' performances in a way that was illegal based on the rules of the sport. They include multiple tests for buoyancy, body compression, body coverage, roughness and thickness. Undertaking the tests requires the use of a variety of equipment, including scanners, measuring tools and an underwater camera (Manson, [2010](#)), demonstrating that the addition of the new rules included the expansion of the swimming network to include a variety of test mechanisms that were not previously required. This expansion of the swimming network was deemed necessary owing to FINA's determination that a particular type of popular swimsuit – the full-body, polyurethane suit – had impacted on swimming results in a significant way for several years, culminating in the World Championships in 2009.

A brief history of controversial swimsuit designs

Several authors, including Magdalinski ([2009](#)) and Craik ([2011](#)), have chronicled the development of what are sometimes referred to as 'plastic' suits from their beginnings in the 1990s. Both Magdalinski and Craik agree that the first swimsuit that created any controversy was Speedo's Aquablade, worn by 77 per cent of the winners at the 1996 Atlanta Olympic Games. This was the first time that suspicions were raised that a swimsuit might be having too much 'effect' by providing athletes who wore the suit with an unfair advantage, owing to the high percentage of gold medal winners who wore the suits (Magdalinski, [2009](#)). The next suit to cause controversy was the Speedo Fastskin, developed in 1999. This suit differed from all other previous swimsuits, owing to the way it covered the whole body. Prior to this, suits had consisted of relatively brief attire, and Craik ([2011](#)) argues that the appearance of swimmers now swathed in black, was shocking to many spectators and contributed to suspicions about the suit. The suit was also different in deviating from the traditional nylon-based fabrics used to make swimsuits, with its surface designed to resemble sharkskin.

The next revolution in swimsuit technology has been identified as occurring in 2008, with the launch of the Speedo LZR Racer (Berthelot et al., [2010](#); Magdalinski, [2009](#)). In contrast to the Fastskin of 2000, the Speedo LZR Racer included quite a different global network. At the production level,

Speedo boasted of the use of NASA's wind tunnels, Ansys fluid flow analysis software, the water flume at Otago University, New Zealand, and scientists from NASA, Otago University, the University of Nottingham and Iowa State University (Barak, [2012](#); Craik, [2011](#); Matthews, [2008](#)). The suit was produced through first identifying that a particular blend of elastane nylon significantly reduced friction in comparison with shaved human skin. Next, it was established that certain parts of the human body produced large amounts of drag, and that these were reduced if polyurethane panels were placed over those body sections. Finally, in order to minimise both friction and drag, the suit was not sewn together, but rather 'bonded by acoustic vibrations', resulting in a seamless suit (Matthews, [2008](#), p. 32).

Following the Speedo LZR Racer in 2008, a range of suits using similar technology appeared in 2009, the most popular being the Jaked J01 and the Arena Powerskin X-Glide (Neiva et al., [2011](#)). The major difference between the new suits and the LZR Racer was that the new models were 100 per cent polyurethane, rather than only 50 per cent.

At the beginning of 2009, FINA's ruling was that suits could only be a maximum of 50 per cent non-permeable material, using the argument that the material traps air, thereby increasing a swimmer's buoyancy. However, swimsuit manufacturers Arena, BlueSeventy and Jaked argued that there was no proof that buoyancy was increased and threatened to sue FINA if they banned the suits. Consequently, at the World Championships in Rome, 2009, all types of suits were legal, and an unprecedented forty-three world records were broken (Harvey, [2009](#); Neiva et al., [2011](#)). The 2009 World Championships have now become notorious in swimming history, owing to the allowance of the wide range of swimsuits and the high number of records broken.

In 2009 FINA finally voted against the use of fully body suits, with the new rule introduced on 1 January 2010. As previously noted, the new rules expanded the swimming network to include fourteen new tests and their respective testing equipment in order for swimsuits to be approved for world and Olympic competition (Mason, 2011).

The enrolment of swimsuits by swimmers

From 1999 onward many swimmers enthusiastically enrolled the full-body swimsuits, in the belief that wearing them would produce faster performances. This argument is consistent with the 'classic' argument discussed earlier in the chapter that technology is primarily enrolled in sport in order to enhance performance. For example, multi-Olympic gold medallist from Australia Grant Hackett described how 'You feel so streamlined through the water. It's like you're cutting through the water like a hot knife through butter' (cited in Craik, [2011](#), p. 72). This quote demonstrates Hackett's belief in the improvement in his performance that resulted from wearing the Speedo Fastskin.

Hackett's quote suggests that the Fastskin was easily enrolled into the sport because *intéressement* was easily achieved. The goals of the swimmers, in wanting to achieve faster times, were met. The goals of the manufacturers, in wanting the most successful swimmers to wear their swimsuits, merged perfectly. The goal of the international swimming regulatory body FINA to raise the profile of swimming was also met through the possibility of more world records being broken as a result of the suits, making the sport more exciting for spectators to watch. These suits were available from a range of manufacturers. While prior to the Sydney Olympic Games there were some issues regarding availability, which almost led to the suits being banned from the USA Olympic trials owing to the unfairness of not all athletes being able to access them (Magdalinski, [2009](#); Newberry, [2000](#)), by the time the games took place there were a range of manufacturers offering this style of suit, all keen for the top athletes to wear their suits. The suits also acted as a perfect intermediary (see [Chapter 1](#)) through ensuring that they improved athletes' speed every time they were worn. These points of view were all in agreement, and thus this style of suit was adopted and soon became the norm.

Nonetheless, consistent with the kayakers in Trabal's ([2008](#)) study, not all swimmers immediately adopted the wearing of what were understood to be the 'best' suits at the time. Instead, the networks of many swimmers included sponsors who acted to complicate what may appear on the surface to be a simple case of performance enhancement. The connections between individual swimmers, swimming teams

and their sponsors all strongly affected the enrolment of various swimsuits.

Leading into the 2008 Olympic Games, the Speedo LZR Racer was believed by swimmers to be the most effective suit on the market. The media, who followed this controversy closely, reported that teams who were sponsored by Speedo, such as the already strong USA and Australian teams, were believed to be at an advantage by having easy access to the Speedo LZR Racer. Other national teams were felt to be at a disadvantage, which led to some swimmers and teams switching allegiances. Japan dropped its contracts with Mizuno 8022 and other firms in order to wear the LZR Racer. Italy, sponsored by Arena, agreed to allow its athletes to wear the LZR Racer as long as they paid a fine. But German swimmers were required to retain their links with Adidas and therefore were not allowed to wear the LZR Racer. Arena also accused Speedo of producing a culture of uncertainty and confusion through pressuring athletes over the need to wear their swimsuits (Matheson, [2008](#)). These arrangements therefore strongly affected which swimmers were able to wear the LZR Racer, with sponsorship deals both facilitating and preventing enrolment. These examples demonstrate how the networks of the swimmers, in holding particular sponsorship arrangements, was of much greater significance in determining the enrolment of swimsuits. The belief in their performance enhancement value may have contributed strongly to swimmers' desire to wear the suits, but the reality of the network of swimming, by including very particular sponsorship arrangements, did not make enrolment possible.

At the same time there was an actant with the power to disrupt this arrangement: FINA. In 2008, in an attempt to level the playing field, FINA responded to the concerns by insisting that all swimwear manufacturers must make their suits available to all Olympic competitors. On the one hand, this allowed the enrolment of the LZR Racer by all swimming competitors. On the other, it severely disrupted the swimming network by providing Speedo with an advantage. One journalist (Matheson, [2008](#)) argued that the ruling only benefited Speedo, with the belief in the superior nature of their suits being so strong that 90 per cent of swimmers opted to wear the LZR Racer at the 2008 Olympic Games – albeit many of them with the Speedo logo blacked out, to avoid breaking sponsorship agreements.

In following the swimming network further through the extensive media coverage, to encompass the position of swimming manufacturers, we find that there is no doubt that Speedo benefited financially from FINA's ruling. One news report claimed that after 2008, Speedo's market share of men's swimwear rose from 64 per cent to 76 per cent (Lloyd, [2008](#)). A different journalist argued that this was due not just to the suits, but partly to Speedo's actor-network, including the sponsorship of swimming phenomenon Michael Phelps. The same journalist estimated that Phelps's airtime produced US \$3.6 million for Speedo (Matheson, [2008](#)).

At the 2009 World Championships a year later, the situation had changed. With other manufacturers following in Speedo's lead and creating their own high-technology suits, swimmers had a range of options available to them. The suits believed to be the most effective in 2009 were not those produced by Speedo; they were instead the 100 per cent polyurethane suits such as the Jaked J01 and the Arena Powerskin X-Glide. However, not all athletes chose to wear these suits. Journalists noted how Michael Phelps opted to stick with the LZR Racer despite its being only 50 per cent polyurethane (Diaz, [2009](#)), as did British 2008 Olympic gold medallist Rebecca Adlington (Hart, [2009](#)).

The decisions made by Phelps and Adlington to stick with Speedo rather than moving to a 100 per cent polyurethane suit demonstrate that the decisions of athletes to work with particular technologies are based on a wide network rather than simply being based on which is the superior product. In the case of both these athletes, their network included a long-standing close association with Speedo, which meant that media reports such as the one by Hart ([2009](#)) interpreted their stance as demonstrating loyalty to the brand. It is understandable that swimmers who are earning significant amounts of money from their sponsors may wish to remain loyal to them because of that financial incentive. It could therefore be argued that there are two conflicting understandings of professional swimmers making such decisions: on the one hand, that of the swimmer as a competitor who wishes to win the race at all costs; on the other, that of the swimmer as a member of a sport not renowned for large potential earnings wanting to continue to benefit financially. Most of the time these two understandings align, but not always. In the case of swimming, this conflict appears through

the non-human entity of the swimsuit. The swimsuit acts as the publicly visible proof of the swimmer's network. The brand and style of the swimsuit are easily identifiable and clearly demonstrate the swimmer's choice. There were a range of choices that swimmers made based on national or financial loyalties.

For example, while Phelps and Adlington remained loyal to Speedo, the American Dara Torres switched suits from the LZR Racer to a Jaked with the logo blacked out because she did not qualify for the semi-finals in her first event wearing the Speedo suit. In a media interview she described blacking out the logo to avoid causing any difficulties with her Speedo sponsor, but said she believed wearing the Jaked would make her more competitive:

I don't want to get myself in trouble ... Obviously I'm sponsored by Speedo. But everyone here is wearing these suits and they seem to be going fast. The times are kind of outrageous, what's going on here. I feel like if you want to be on par with everyone, you have to do what they're doing. (Torres, cited in Newberry, [2009](#), para. 8)

Torres here articulates the conflict between the desire to succeed and the pressure of sponsorship. Ironically, sports journalist Karen Crouse ([2009](#)) argues that, far from the suits providing an unfair advantage, the rules that required manufacturers to make all their suits available to all competitors created a more level playing field. Crouse ([2009](#), p. B11) claimed:

The suits had a democratizing effect on the results, levelling the playing field for countries that have long been playing catch-up to the United States and Australia. At the 2007 World Championships, those two countries accounted for 30 of the 40 victories. In Rome [the 2009 World Championships], they finished with 13 as swimmers from 17 countries won gold medals.

While Crouse does not provide any evidence that it was the swimsuits alone that accounted for these results, it is an interesting explanation in the light of the usual assumption that new technologies can make sport unfair by giving those with access to them an unfair advantage. This is quite different from the more common situation where new technological advancements are only available to those with the economic power to access them, such as the case of altitude chambers, which will be discussed in the [following chapter](#).

The enrolment and non-enrolment of swimsuits as facilitated by FINA

Like all international sports federations, FINA's role in its sport takes multiple forms. FINA is required to promote swimming and ensure the financial viability of the sport, which, as with the swimmers, includes negotiations with sponsors on a constant basis. But FINA is also responsible for setting the rules, and for ensuring that the rules are followed. With regard to this second point, FINA's primary role was to determine whether the swimsuits had *acted* to improve performances in an illegal way. As discussed in [Chapter 1](#), determining whether non-humans have acted can be extremely difficult, and the case of the swimsuits proved to be particularly challenging for FINA.

The discussion of the potential banning of full-length swimsuits began as early as 2000, with questions being raised about the full-body suits. At the time the regulations set by FINA stated:

FINA rule SW 10.8: 'No swimmer shall be permitted to use or wear any device that may aid his speed, buoyancy or endurance during a competition (such as webbed gloves, fins, etc). Goggles may be worn.' (FINA, cited in Craik, [2011](#), p. 73)

Following the 2000 Olympic Games there was considerable debate about whether the Fastskin suit was a 'device' that aided 'speed, buoyancy or endurance'. Given that FINA was unable to produce any definitive evidence that the suit did aid speed, buoyancy or endurance, the argument in this area centred on whether this suit was a device or a costume. As fashion theorist Jennifer Craik ([2011](#)) argues, the swimsuit was unsettling because it contrasted so strongly with the swimwear as worn over the last century. While swimsuit debates had historically centred on the accusation of swimwear being too brief, this suit instead covered the entire body. As such, the swimmer was transformed into a completely different figure from what the public was used to seeing. This example demonstrates Latour's and Venn's notion of how ideas can be folded into new technologies and how their effect can vary as a result of what is folded within (Latour and Venn, [2002](#)). In this case, the idea of a swimmer having a very visible body was so strongly folded into the idea of competitive swimming that the appearance of a swimmer swathed in a black suit from wrist to ankle was alien and shocking. Therefore it is

understandable that it would be easy for the audience to see the suit as a device rather than a normal swimming costume, even though FINA did not see any grounds to ban the suit at the time.

Craik's (2011) argument is a good example of the way ANT can draw attention to what is elsewhere termed 'affect theory'. Thrift (2008) argues that a weakness of ANT is that it does not allow for the consideration of human emotions, since emotions are a purely human phenomenon and ANT argues against the existence of a 'pure' human. By contrast, I argue that the above example demonstrates how emotional affect can potentially be 'folded' into a technology as part of the network that makes up that particular technology. In this case, Craik (2011) argues that the reaction to the appearance of swimmers swathed in black full-body suits was one of shock, which suggests that that shock then becomes part of the network of this style of suit.

Nonetheless, despite the reactions of shock that spectators experienced, at this point FINA did not see any grounds to ban the suit. They could not find any evidence that the suit broke any particular swimming regulation. As a result, swimmers very quickly adopted it as their preferred style of suit, and it soon became the norm for the competitive swimming body to be seen covered in a full-body black suit.

In 2008, with the invention of the 100 per cent Speedo LZR Racer, the question of whether full-body suits should be banned was raised again. The large number of world records broken in 2008 and 2009 created a belief that the suits must produce some sort of unnatural assistance, and should therefore be banned. Yet the effects of the suits were not equal for everyone. Some swimmers benefited more from the new suits than others. Some swimmers posted spectacular times while wearing the full-body suits and far slower times without, while others posted similar times in both scenarios. For example, in the 200m breaststroke, Rebecca Soni is one of the few swimmers whose times have improved since 2010 despite the suits being banned. Journalist Karen Crouse (2010) described her as being renowned for having a very unusual breaststroke technique, including possessing a very strong core, meaning the suit would not be of as much benefit to her. Similarly, in an interview with Crouse (2009, p. D1) Soni's coach, Dave Salo, explains that the suits give all swimmers an

ideal physique, rather than one created by hard work and athleticism: 'A lot of kids who aren't in very good shape can put on one of these suits and be streamlined like seals.' In a different media interview, retired Olympic gold medallist Duncan Armstrong argued that the suits compress the body and therefore allow it to sit higher in the water: 'That's why you do thousands of hours in the pool, working on your hand pitch and your strength, to be able to sit higher in the water. Once you sit higher, you swim across the water – not through it. Once you swim across it, you're faster' (Harvey, [2009](#), p. 61). Kainuma et al. ([2009](#), p. 69) agreed with Salo and Armstrong by arguing:

the corset-like grip of the suit supports and holds the swimmer so they can maintain the best body position in the water without losing flexibility of movement. Furthermore, this high-speed swimsuit makes the surface of the swimmer's body very flat and smooth, thus reducing water resistance.

The second point made by Kainuma et al. ([2009](#)) describes the suit's ability to compress the body. Similarly, multi-Olympic gold medallist Grant Hackett reported in an interview that he was surprised to see some swimmers wearing more than one suit in order to maximise the effect of the compression (Millar, 2008). Kainuma et al. ([2009](#)) additionally propose that the tightness of the suit, in restricting blood circulation, could be a significant factor in improving performance, observing that the LZR Racer was particularly effective in short course events but not in events longer than 400m, where greater blood circulation is required.

These explanations reveal how the swimsuit technology cannot be considered separately from the athletes' bodies, and that therefore swimming must be viewed as an assemblage of body and suit. The different bodies of the athletes have as much to do with the effectiveness of the suit as the suit's design. According to Salo, bodies that are less strong and toned can reap greater benefit from the suits. This argument is confirmed by the popularity of the suits at the Masters swimming level, where media reports claim that athletes in their forties or fifties have been found to swim faster than they did in their twenties by wearing the suits (see, for example, Sataline, [2009](#)). The use at Masters level demonstrates how the swimsuit and the body acts together as a network assemblage in order to produce faster times. Rebecca Soni's success in improving her times after the polyurethane-suit era, including breaking the world

record at the 2012 Olympics, demonstrates how she has found a way to substitute the effect of the suit herself through her own training.

The question of whether the polyurethane suits increased buoyancy could not be answered because of the different ways that different bodies assembled with the suits. The suits had been accused of breaking the rules because they increased a swimmer's buoyancy through trapping air. However, sports journalist Harvey ([2009](#)) claimed that this was unable to be tested because the ability of air to be trapped was entirely dependent on the shape of an individual swimmer's body and the fit of the particular suit. Harvey's claim suggests that the determining factor is the network assemblage of body and suit, not the swimsuit alone.

As FINA struggled to determine conclusively whether the suits increased buoyancy or aided speed through examining the suits themselves, its decision eventually to ban the suits was based on different criteria entirely. A report by Manson, presented to the FINA Bureau in 2010, details the approach that led to their decision to ban full-body swimsuits. FINA took the approach of analysing the improvement in world record times that occurred between 1992 and 2009. They noted that over the long term there were a variety of explanations for the constant improvement in times, including technique shifts, professionalisation, accessibility of the sport for a larger population and technology. But in the short term they determined that the number of world records broken at the 2009 World Championships (forty-three) was so much larger than any previous individual competition that a specific factor was almost certainly responsible. They then matched this up with the fact that this was the only championships in which 100 per cent polyurethane, full-body swimsuits had been permitted. Consequently, FINA determined that from 2010 onwards new types of technology would be enrolled into the sport in order to test swimsuits to ensure they met the criteria of the new rules.

The rules prevented swimmers from using any non-textile material (Craik, [2011](#); Manson, 2010). Additionally, it also banned the use of suits that were fully body-length, with men being allowed suits from waist to knee, and women from shoulder to knee (FINA [2011](#)). With the introduction of these rules, journalists presented doubts about whether any world

records would be broken in swimming ever again (see, for example, Partridge, [2011](#)). However, at the London Olympic Games in 2012 eight swimming records were broken, exactly the same number as at the Athens Games in 2004, suggesting that swimmers are still able to improve their times without wearing full-body suits.

Conclusion

This chapter has confirmed the value of viewing the athlete, and sport, as an actor-network. From this perspective there is no doubt that the enrolment of new enhancements to technology and equipment is not a simple matter. The functionality of the particular enhancement is not necessarily a reason for athletes to enrol it. Instead, the athletic process exists as a carefully balanced actor-network where athletes have limited time and must therefore weigh up the impact of any new enhancement on all aspects of their network. For example, various swimmers weighed up the impact of using a polyurethane swimsuit on their performance as well as on their sponsorship agreements. In some cases these two aspects aligned, so enrolling the new suit was therefore an easy decision. But in others they had to choose between these two aspects of their network. At the same time, the athletes' bodily network – their make-up of bones and muscles etc., along with their training – determined whether their bodily assembled with the suit in a significant way. In some cases the body assembled with the suit to produce a far better performance, but not in every case. Similarly, in the case of the kayakers, a crucial point was the necessity for the athletes to sit further back in the boat in order for the new boat to work most effectively. But the athletes' training meant that they were familiar with sitting in a particular position in the kayak, and changing it might have changed other aspects of the network, including how they moved carefully trained body parts.

Both these examples illustrate Latour's insistence that actor-networks should be understood as rhizomes through emphasising the way that every point in the network can potentially affect any other point. It is particularly important that sports managers, coaches and manufacturers are aware of this. Enrolling new enhancements is not as simple as the coaches in Trabal's ([2008](#)) study assume, when they argue that they need to be sold to athletes in order for athletes to try them.

The coaches' assumption oversimplifies the complexity behind athletes' use of technological enhancements.

Viewing athletes as actor-networks also explains the results of Butryn's (2003) study, which found that athletes ranged from enthusiasm to indifference in their discussions of implement technologies. For some athletes, technological enhancements are of great importance and a significant part of their network. For example, Dara Torres explained to the media how she felt the need to wear the polyurethane swimsuit in order to keep up with other athletes, regardless of her sponsorship agreements. For her, ensuring she was using the most up-to-date technology was of great importance. By contrast, Michael Phelps did not opt to wear the fully polyurethane swimsuit; this was clearly a less important part of his actor-network than it was for Dara Torres.

The cases in this chapter also reveal the difficulty of determining whether a particular enhancement was effective. In kayaking, Trabal's (2008) survey revealed a variety of ways to determine which boat was the most effective, with no clear evaluative criteria being identified. Determining how a technology acts to affect performance can be extremely difficult. This was strongly emphasised by FINA, who could not identify particular tests to identify whether the polyurethane swimsuits broke any swimming regulations, and instead decided to ban the suits purely on the grounds of statistical analysis. The rapid increase in times and world records set were the only evidence that FINA had for the effect of the swimsuits.

Nonetheless, the evidence was sufficient for FINA to add fourteen new tests to their swimsuit requirements. The increased complexity of the rules illustrates the way that actor-networks are continually shifting and expanding, depending on the actions of humans (such as swimmers, coaches and manufacturers) and technologies (swimsuits) but particularly owing to the way these combine to have a transformative effect on performance. The result of the transformative action is a new inscription in the form of new rules as part of FINA's regulations. The story of the polyurethane swimsuits thus becomes folded into these regulations, but the regulations will soon become black-boxed, meaning the story of how and why such strict regulations came to be required will be obscured from view, and perhaps eventually forgotten.

Both cases discussed in this chapter include technologies that were publicly visible. In the two cases the type of boat or the type of swimsuit was easily observable. This contrasts sharply with other technologies in sport that are either utilised only in a training context or used under clothing or in the body, rendering them invisible. The following two chapters now focus on far less visible technologies: altitude chambers, GPS units and doping.

3

The integration of ‘foreign’ technologies into sporting practice

In 1999 I was employed as a gymnastics coach in the USA, and one of the gymnasts I coached was trying to obtain a college scholarship. So I enrolled a device foreign to the gymnastics environment, a video camera, and brought it to the gymnasium to film her performing her routines. Following this exercise, she made numerous copies of the videotapes and posted each tape to a different college. In this example the enrolment of the video camera allowed the performance of the gymnast to be made mobile. Indeed, the performance was transformed from a live moment in time to one that could be watched as many times as desired, through the enrolment of a video camera and tape. The video camera and tape acted as intermediaries, in allowing the gymnast’s performance to be captured and mobilised.

I am no longer a gymnastics coach, but I continue to be a gymnastics fan. As a fan, I particularly enjoy the existence of YouTube, in allowing me to view routines that I would not otherwise be able to watch from my remote location in New Zealand, where elite gymnastics is rarely televised. But my searches on YouTube have revealed more than merely elite routines; I also come across numerous YouTube sites by athletes such as the one I coached in 1999, set up to display their performances in order to entice colleges to provide them with scholarships. So I am aware that the process of college selection has altered since 1999. In one sense it is the same, since the tool of video is still utilised to stabilise the routine and to make it mobile. However, it is also fundamentally different, as the necessity of posting out tapes is no longer required. College selectors can instead simply trawl through applicants’ YouTube sites in order to view their footage and use it to make their decisions. The laborious process of sending out individual tapes to each college no longer needs to take place.

These examples illustrate some of the central concepts of this chapter. First, the introduction of foreign technologies into sporting environments can act to change sporting processes in

a variety of ways. The presence of YouTube has changed the way that athletes can now make their performances visible to college selectors. At the same time, the basic application process remains the same, and both the videotape-and-postal-service method and YouTube act in the same way, as intermediaries that make the performances of the gymnasts mobile to the selectors.

As in the above examples, sporting performances and processes can be strongly influenced by technology and equipment that are not considered a standard part of sport. This chapter focuses on the introduction of 'non-sport' technologies into the sports training environment. It includes two case studies: a study of the use of global positioning systems (GPS) in Australian rules football (AFL) and an examination of the use of technologically constructed hypoxic environments (TCHEs), commonly known as altitude chambers. The [previous chapter](#) introduced the concept of enrolment, an ANT idea employed to determine how an actant comes to be part of an actor-network, which is also drawn upon in this chapter. In particular, both cases highlight the difficulty of creating equal opportunities for enrolment. In the case of GPS, the difficulty concerns equalities between all teams in the league, while for TCHEs the inequalities are reflective of global economic disparities.

This chapter also continues the theme of sport as a socio-technical network, which runs throughout the book. The [previous chapter](#) argued that an athlete's network contains a myriad of factors that influence whether athletes utilise new enhancements, and this chapter expands on this notion by considering how it is that technologies can act to produce particular outcomes. GPS units are found to act as intermediaries, mediators or as methods of surveillance, all of which have very different outcomes. Also included in the understanding of a socio-technical network is the argument that it is not merely physical objects and humans that make it up, but that it has a range of ideas 'folded' (Latour and Venn, [2002](#)) within it. The incorporation of historical and current discourses as part of the network is considered through the case of TCHEs. With TCHEs I argue that the range of discourses connected to an understanding of these technologies together with an athlete's individual network strongly influences enrolment and use of the devices.

The ANT conception of power

One focus of this chapter is the notion of 'technologies as actants' within the socio-technical network that makes up sport. The chapter therefore illustrates how examining the network reveals the power relations within it, often through the production or prevention of action.

The ANT perspective conceives of power as an action or effect that occurs through interactions within the network (Latour, [1996](#); Law, [1992](#); Matthewman, [2011](#)). Through understanding power as an effect, ANT shows how both humans and non-humans can equally cause action but also, more importantly, that action occurs through humans and non-humans working together. For example, Latour ([2009](#)) describes how the statement 'guns kill people' is flawed in the sense that it is neither the individual gun nor the individual person that performs the killing, but a third actant, what Latour refers to as a 'citizen-gun' that causes the action. ANT theorists emphasise that agency is shared between humans and non-humans and that it is the way the actants assemble as a network that creates the action. As such, power flows through the network. The gun and the person do not necessarily have to assemble to kill someone, but killing is one effect that the network can produce.

In acknowledging that effects are produced because of the make-up of the network, ANT is interested in following the strands of the network to understand the way that local agency is enacted at every level of an apparent hierarchy (Matthewman, [2011](#)). This notion resembles Foucault's conception of power, which described it as existing in a 'capillary-like network' where every point in the network can affect other points in a flat, rather than hierarchical, structure (Markula and Pringle, [2006](#), p. 36). Latour emphasises that it is the size, shape and scope of the network that will determine what is produced. Different kinds of actor-networks, or assemblages, will produce different kinds of effects (Edwards and Nicoll, [2004](#); Kerr, [2014](#)).

As noted in the Introduction, Latour ([2005](#)) argues for the existence of what he terms intermediaries and mediators. He describes intermediaries as non-controversial actants that behave in a particular way each time (Bencherki, [2012](#); Kerr, [2014](#); Latour, [2005](#)). By contrast, a mediator is an actant

that behaves unpredictably and disrupts the network. For example, in the context of sport, a competitive cyclist consists of a particular network assembled from a person and a bicycle plus numerous other components, such as a helmet and skin-tight suit. If the bicycle propels the cyclist at a fast rate, it is behaving as an intermediary as expected. However, the cyclist may be prevented from cycling as fast as desired through the presence of mediators. In cycling, hair acts as a mediator through creating wind friction which slows the cyclist down, so intermediaries such as shaving and an aerodynamic helmet are introduced to suppress the hair.

These distinctions are significant, as mediators demonstrate how it is that non-humans can act to disrupt the desired action, holding power through causing unexpected outcomes, while intermediaries hold power through ensuring action and at times suppressing mediators to perform as desired. However, Latour's central point is that in all contexts, humans work together with non-humans in order to function, and that therefore *both* the human and non-human can cause action: hence the emphasis on seeing the world as networks, not individual components. A cyclist is an assemblage of human and non-human actants that act together to travel faster than either can alone. Agency is shared equally between the human and non-human actants (Bencherki, [2012](#); Latour [2005](#), [2009](#)).

Such a view reverses the standard sociological conception of agency. For Actor-Network Theorists, agency is produced through a heterogeneous network rather than individually. In the cyclist example above, agency is produced through the human cyclist, bicycle and other associated non-humans such as helmets, shaving and skin-tight suit, which, depending on the properties of each and how they assemble, will determine the speed at which the cyclist moves.

This chapter explores the notion that technologies act as mediators or intermediaries through the case study of the GPS units introduced into AFL. Following this, the example of hypoxic chambers (TCHes) is used to understand the breadth of what makes up a network and its ability to act. TCHes are shown to have a variety of ideas 'folded' (Latour and Venn, [2002](#)) within them that make their use both understandable and also controversial.

Case study: the use of global positioning systems (GPS) in Australian rules football

The introduction of GPS units into the Australian Football League (AFL) provides fruitful study for understanding how different actor-networks can produce particular effects, how technologies can act within the network and how surveillance can be enacted through new technologies. The cases thus far have focused on the issue of enrolment. In this case enrolment is only a small part of the discussion, since GPS units have been enrolled in Australian Football League for several years. Instead, this section focuses on GPS units as actants.

AFL is one of the most popular sports in Australia, and boasts the largest number of attendees of any sports: 6.5 million in 2011 (Foreman, Deegan and Wigley, [2012](#)). The AFL was an early adopter of GPS, having used it within the league since 2005 (Foreman, Deegan and Wigley, [2012](#); Wisbey, Rattray and Pyne, [2010](#)). AFL has possibly the highest uptake of GPS of any sport (Aughey, [2011](#)).

The GPS units used in the league consist of small units worn on the backs of players that transmit data to satellite and then to a computer or other device able to receive the satellite signals. Foreman, Deegan and Wigley ([2012](#), pp. 1–2) describe the exact details:

Athletes wear a small (approximately 80x50mm) transmitter on their upper back in a purpose-built supportive harness ... which measures and analyses data from sensors, including multi-axis accelerometers and heart rate monitors ... The data is collected and broadcast simultaneously to the remote computer for 'real time' analysis. Sports scientists can therefore view real time performance and tactical data during matches or training sessions. From the analysis of the data, the coaching team can make tactical changes, analyse player effort or manage player rehabilitation.

The use of GPS units allows a significant amount of data to be collected that can be used to assist sport scientists and coaches with maximising athlete output throughout the game (Foreman, Deegan and Wigley, [2012](#)). During the play, the data generated through the GPS systems includes player speeds, player intensity, player workload, player rotation and player movement patterns (Wisbey, Rattray and Pyne, [2010](#)). In the training environment GPS can be used to evaluate athlete strength and conditioning and to set programmes for tactical and strategic analysis, for play rehabilitation and for injury

management (Foreman, [2009](#)). Many of these applications are essentially ways of making the internal workings of the body, or of a complex game, easily visible to scientists who are employed to improve sporting performance. So, unlike technologies that act directly to improve athletic performance, these act indirectly, needing the translation of a scientist in order to be useful. The scientist is necessary for interpreting the data provided by the GPS through comparing and contrasting it with expected norms and other previous information in order to inform coaches about which players are operating at their best and therefore assist the coach with making decisions within the field of play. It is the networked arrangements between the GPS units, the scientists and the coaches that make the GPS units particularly useful within the game and not simply the technology itself.

GPS units were introduced somewhat slowly into AFL competitions. In 2005 and 2006 AFL clubs were permitted access to GPS units but were allowed to use them for only five players per team over ten games per year (Le Grand, [2007](#)). At this point only half the teams in the league used the units (Wisbey, Rattray and Pyne, [2010](#)). In 2007 all sixteen AFL clubs lobbied to lift the restrictions. Initially, the league argued against this for a number of reasons. First, they were concerned about the issue of equality. The units cost around \$4000, so were expensive for clubs to buy (Foreman, [2009](#)), and the league were anxious that richer clubs would therefore be at an advantage in being able to purchase more of the units than the poorer clubs. Given the need for data analysts to interpret the data, as discussed above, the need to employ them was an extra cost for clubs to bear. Another issue of concern was that of athlete safety.

As the units are worn on the upper back of the players, there is a possibility that they could cause injuries during tackles (Le Grand, [2007](#)). While the problem here could be understood as being introduced by the technology itself, in reality it is an issue caused by the particular network of sports rules, humans and technologies. Other sports have not enrolled the GPS units because their particular network includes elements that would make it unsafe for players to wear the units. For example, rugby union has not enrolled GPS units because the sport includes tackles as a significant part of its network.

Finally, the league was also concerned that the increased GPS data would allow teams to circumvent newly introduced rules brought in to slow the game down (Le Grand, [2007](#)). However, these concerns were not considered sufficient to prevent their use. Therefore, the restrictions were lifted, and now every team in the league uses GPS (Wisbey, Rattray and Pyne, [2010](#)).

Does GPS provide the promised benefits?

It appears to be agreed that the GPS units do provide a large quantity of data that many teams find useful (Aughey, [2011](#)). In that sense, these units are intermediaries, acting as expected every time they are used. Aughey ([2011](#), p. 302) describes how the use of the units has changed and extended over the years since their adoption in 2005, moving 'from general descriptive work on player movement in matches to the analysis of fatigue, comparison of real-time to post-game analysis of data, and comparisons among playing levels'. This quote suggests that GPS units act through fulfilling their desired role of providing extensive information to players, coaches and scientists.

Foreman's ([2009](#)) analysis found GPS to be particularly useful in three different areas. First, GPS can maximise player fitness through monitoring player fatigue levels and thereby providing information to coaches that allows players to be rotated off the field during competition, and through confirming overall fitness levels so coaches can prepare individual training programmes to maximise individual fitness. Second, GPS can provide information to assist coaches with tactical decisions, such as showing them precisely where all the players are during a live match. Finally, GPS can assist with rehabilitation by providing feedback on whether a player is over- or under-loading their training when they are returning from injury.

Aughey ([2011](#)) goes on to describe the usefulness of the GPS data in comparative terms. He argues that GPS data has been useful in comparing expenditure of energy 'across a match, between matches, between levels of competition, and between types of matches' (Aughey, [2011](#), p. 303). Comparative data of this nature is described as providing greater understanding of the demands made on players, thereby allowing coaches to configure training sessions to

work on areas of weakness revealed by the data (Wisbey, Rattray and Pyne, [2010](#)).

Foreman, Deegan and Wigley ([2012](#)) investigated thoroughly the question of whether GPS units are useful devices. One finding from their study was that the accuracy of the GPS units is questionable. They point out that, although the manufacturer's website claims that the units have a high degree of accuracy, with a margin of error of only two to four per cent, other independent studies reveal inaccuracies of up to 140 per cent (see, for example, Aughey and Falloon, [2010](#)). They further argue that these margins are for straight-line sprinting, which is rarely the case in AFL as the game requires players to change direction constantly, in line with what is happening in the game. Therefore, they conclude that although GPS units are an effective tool to use during training sessions, their accuracy prevents them from being useful for the purpose of tracking player movement during the game. In this example the GPS units are essentially acting as mediators, rather than providing the exact positions of the players as desired, which would mean the units were acting as intermediaries.

In addition to the accuracy issue, in keeping with the ANT perspective, the GPS units cannot be considered without examining the socio-technical network in which they operate. This chapter will now discuss the network that surrounds the GPS units with a view to determining whether the units can be viewed as intermediaries when examined as part of an actor-network. In all the examples below, it is found that the GPS units can only do their job as intermediaries if the appropriate network is in place. In some cases, it is found that an aspect of the existing network acts as a mediator in preventing the GPS units from acting.

One of the major considerations when using GPS is the analysis of the data provided. Unfortunately, at the current time, there is no technology that can automate the data analysis: significant advances in the field of computer vision would be required for it to be achieved (pers. comm., Richard Green, 2013). Therefore, clubs have created different kinds of networks to solve this problem. The richer clubs have opted to employ several skilled specialists to analyse the data and edit it into a form useful for coaches and athletes. By contrast, those clubs that lack sufficient economic capital as part of their network must instead resort to measures such as the one

adopted by Richmond, who employed a student performing work experience to 'crunch' the data (Le Grand, [2007](#)). In this respect, the GPS devices require the addition of a human in order to allow them to act as intermediaries.

Further, different ways of using the data need more specific expertise. For example, one useful tactic is to synchronise the GPS data with game or training time to allow coaches to correlate what is happening on the field with the GPS data. Foreman, Deegan and Wigley ([2012](#)) found that it was unexpectedly difficult to align the two as they have different timestamps, and therefore that very few clubs were able to afford to access the specific expertise needed to utilise this aspect of the programme. It thus remained a feature that was not enrolled, and again the GPS was unable to act unless the network included this highly specific expertise.

Similarly, Foreman, Deegan and Wigley ([2012](#)) described one of the most heavily advertised features of the GPS as not being used: the ability to track the structure, movement and space of the team. They argued that this is impossible to achieve unless clubs own an individual GPS unit for every player and, because of the cost very few clubs can afford this. Therefore, this is another feature that remains not enrolled, with the units unable to act.

The network can also contain features that actually prevent technologies from acting, as is the case with the various stadiums that clubs use. If a stadium includes a closed roof, the GPS signals are unable to get through, rendering the technology completely useless. As sports journalist Le Grand ([2007](#), p. 43) describes, a number of teams are affected by this: GPS 'doesn't work under the closed roof of the Telstra Dome. This puts clubs such as St Kilda, the Western Bulldogs, Essendon, Carlton and the Kangaroos, who all use Telstra Dome as a home venue, at a disadvantage.' However, Le Grand ([2007](#)) also notes that one of these clubs, the Bulldogs, found a way around it by partnering with the Victorian University of Technology, who provided an alternative way for them to receive some of the data that would normally be received through the GPS units. In this last example, the job of the GPS was delegated to an alternative technology in order to create the necessary action, but it is ironic that this is necessary, given that the data provided is one of the main reasons for using the GPS units.

GPS units have also been found to include features that are simply not useful in the AFL scenario. One such feature is the ability to compare a player's intensity during a game with their intensity during training. While on the surface this sounds useful, the goal of an AFL training session is not necessarily to mirror the intensity experienced in a game, so this feature is not useful (Foreman, Deegan and Wigley, [2012](#)). This scenario is similar to the situation in French kayaking described by Trabal ([2008](#)). In both cases the designers of the technology, whether boats or GPS devices, approach sport with a different understanding from that of the athletes and coaches who are directly involved. Therefore the requirements of the two groups do not necessarily align and the result is, again, non-enrolment.

All the above examples demonstrate the importance of understanding technology as part of a heterogeneous network if maximum usage of a technology is the desired outcome. When making the decision to allow GPS units to be used, the league considered the units as *singular* technological items made up of boxes to be worn on players' backs. The league raised concerns about the individual costs of the units and factored this into their decision to allow GPS units, but omitted consideration of the many other components that produce the network of a working GPS unit. As a consequence, the units are not able to act in the way that they were set up for, and the league is losing some of the potential value of the units. Other parts of the network act as mediators in preventing the GPS units from working to their full potential. The GPS units could have been of greater benefit in AFL if the additional parts of the GPS network, such as experts and roofs, had been considered in the planning around the use of the devices.

Acting through surveillance

In contrast to the above examples where the GPS units were not able to act, there was one way that the GPS units were able to act very effectively: to provide player surveillance. One of the ways that an ANT perspective differs from others is through the assertion that power is enacted through non-human devices. This point is well illustrated through an examination of the way GPS units act as surveillance units.

One of the most prominent theorists who explored surveillance is one whose work shares many similarities with

ANT, Michel Foucault. In previous works (see Kerr, [2014](#)) I have noted that ANT and Foucauldian theory hold a number of similarities, most importantly their understanding of power; indeed, one of the most prominent ANT theorists, John Law, claims that ANT owes a debt to Foucault in this regard (Law, [1992](#)). However, in line with the ANT perspective discussed throughout this book, ANT goes further than Foucault in arguing for the significance of non-humans as actors in the workings of society.

Foucault argued that power reaches bodies through what he terms 'dispositives', also at times translated as 'apparatus', which refers to anything that affects the behaviours, beliefs or views of any living being (Legg, 2011). Prison architecture was one type of apparatus that Foucault described (Hekman, [2009](#)), with Foucault arguing that the famous Panopticon prison design would have a distinct effect in creating self-regulation on the part of the inmates. It is Foucault's concept of power being enacted through a material form that connects strongly with Latour's work (Dorrestijin, [2012](#)). For example, in his book *Discipline and Punish*, when discussing the Panopticon, Foucault states, 'Power has its principle not so much in a person as in a certain concerted distribution of bodies, surfaces, lights, gazes' (Foucault, [1977](#), p. 220), thereby acknowledging the way power relations are enacted through material forms.

Within the sporting context, Manley, Palmer and Roderick ([2012](#)) utilised the ideas of both Foucault and Latour to demonstrate the way surveillance took place through material forms in their study of a competitive football academy. They described ([2012](#), p. 306) how the academy collected a wide range of data that was used to regulate the athletes' bodies in a very detailed manner:

Control functions took the form of documentation, data or information that was retrieved from a process of video surveillance, human observation and physiological testing. These data were then used to collate knowledge that was presented to those further up the academy hierarchies. Fitness tests, physiological tests and review sessions within the football academy aided the shaping and regulation of the athletes' behaviour so they may improve their performance ... The categorisation of the athletes' qualities allowed for the regulation of the minutest detail in relation to performance.

The process described here essentially reduces the athletes' performances to numerical values, or to 'data', for the specific

purpose of influencing the athletes. The data was used to situate athlete performance within the parameters of successful performance, which had the effect of ensuring that athletes self-regulated their behaviour in order to meet required standards.

The use of GPS units in AFL echoes this process. In AFL the GPS units were also used for the collection of 'data'. This information could take the form of details around player speed and movements and data about heart rate that is believed to demonstrate how hard a player is working. The information is then utilised primarily by coaches and other officials in order to make decisions. As such, the GPS units act as a way for coaches to increase their level of surveillance of the players. Manley, Palmer and Roderick ([2012](#), p. 308) suggest that such data

can be processed to create a 'digital persona' (Clarke 1994) constituting a 'Superpanopticon', i.e., 'a system of surveillance without walls, windows, towers or guards' ... It is the creation of a 'digital persona' and the collation of data that enabled the coaches and managers to survey their athletes in a range of aspects.

Deleuze ([1992](#)) refers to a digital persona as a 'coded body'. Both concepts describe the notion of an electronic body that acts as a different version of a player who also possesses a physical body.

Given the physical presence of the GPS units on the players' backs and the inclusion of data analysts as part of the coaching team, players could not help but be aware of the collection of this data. Foreman, Deegan and Wigley ([2012](#), p. 5) argued that the athletes were aware of the increased surveillance and at times resisted it, stating 'players do not feel comfortable wearing GPS devices as they believe they are not being trusted by coaching staff to perform their on-field role'. This remark suggests that players feel as though the coach is using the GPS units to test whether they are working hard enough and resent the fact that coaches feel the need to do this.

Additionally, the increased surveillance was felt outside of traditional training time. Pierik ([2013](#)) describes how GPS units were used by coaches to monitor their players' fitness during their pre-season break, even when the players were not officially training. However, this practice has recently been banned, owing to the perceived need for players to address their work-life balance through having a complete break from play (Pierik, [2013](#)).

In this final section I argue that the wearing of the GPS units allows coaches to increase their level of control over players through providing additional information about the players' whereabouts and level of exertion. From the coaches' point of view, the GPS unit works as an intermediary in working to provide information that the coaches desire. However, as the ANT perspective points out, the GPS unit cannot be considered in isolation, and so from the players' perspective, the GPS device can disrupt effective performance through providing unwanted information to the coach. In this sense, the GPS is closer to the role of a mediator than an intermediary, as it prevents players from working as effectively as their coaches might hope. This is particularly the case during the pre-season break, when the player may believe he needs time for rest and recuperation, whereas the coach may believe the player should be staying in shape.

The case of the GPS units within the AFL league highlights two of the most important aspects of the ANT view of technology that were introduced in [Chapter 1](#). First, it demonstrates how understanding technology as singular, rather than an actor-network, can be problematic for organisations who want to maximise sporting performance through the use of technology. Through considering the enrolment of only one part of the network (the unit worn on the player's back), the other parts that were necessary for the GPS units to work to full potential were not enrolled and consequently reduced the ability for the GPS units to act as intermediaries. Second, the case highlighted the way that non-humans can act to produce or prevent action. The material properties of the GPS units meant that they were able to provide coaches with genuinely useful information, and within this context the units acted as intermediaries. Indeed, the information the units provided proved so useful for coaches that they then began using the units to survey their athletes and monitor their performance in a way that the athletes did not anticipate. This led to resentment of coaches and the creation of an official ruling to prevent such a high level of surveillance.

I now turn my attention to a very different technological device, where use is decided on an individual rather than league basis, and the benefits of the device are potentially more questionable than the GPS units.

Case study: the use of technologically constructed hypoxic environments

In the case described above, the introduction of the GPS units into the AFL was relatively uncontroversial. By contrast, the use of devices that imitate the effects of altitude training, such as technologically constructed hypoxic environments (TCHEs), remains controversial in sport because of the argument that the effects mirror those of doping: in particular, EPO and blood doping. Nonetheless, they remain a legal technology in sport. This section will investigate the legality of TCHEs through the notion of what is 'folded' (Latour and Venn, [2002](#)) in a technology. Like the case of the GPS units, this section again emphasises the significance of viewing technologies as actor-networks. However, where the GPS unit's effectiveness was hampered by lack of support from the necessary network that existed beyond the physical unit, in the case of the TCHEs I will argue that it is the actor-network within the units themselves that produces the controversy. Where for the GPS case I needed to follow the units outwards to the network, in this case I will instead follow the TCHE network inwards. Specifically, I argue that TCHEs have a particular history folded within them, including the decisions made at the 1968 Olympic Games and the apparent natural superiority of long-distance runners from places such as Kenya and Ethiopia, which are at a high altitude. In a way, this approach has some similarities to that of authors such as Magdalinski ([2009](#)), who notes that the cultural meanings of technological devices are important for understanding their use. In this chapter I adopt a related though somewhat different approach of following the history of the debate, which I argue has become a significant part of the network that we call a TCHE. I argue that the network also incorporates a simplicity of use and lack of medicalisation that results in athletes feeling more comfortable using the devices.

TCHEs are an interesting case to explore, as they sit at the very edge of technologies permitted for use by the World Anti-Doping Agency (WADA). In 2006 WADA commissioned an inquiry into the use of TCHEs and decided not to place them on the banned list, despite their conclusion that TCHEs met two of the three criteria that would entail banning. WADA describes how a technology that meets two of the three criteria 'may, but is not required to, be added to the Prohibited List' (WADA, [2006](#), para. 6).

From altitude training to TCHEs

Major international research and discussion around the effects of training or competing at altitude began in a significant way with the 1968 Olympic Games, which were held in Mexico City, a city at higher than normal altitude. Kasperowski (2009) reports how the organisers of the games addressed the issue of altitude in their bid in 1963, stating that concerns with competing at altitude had been

artificially created, undoubtedly in good faith, but due to a lack of familiarity with the facts. It is definitely refuted by the various documents that follow ... athletes only require a 3 or 4 day period in order to adapt themselves completely to Mexico City's altitude. (Mexican Olympic Committee, 1963, cited in Kasperowski, 2009, p. 1264)

Currently, it is understood that athletes require four to six weeks in order to adjust to altitude; however, the Mexican Olympic Committee's statement is unsurprising given the lack of research that had been conducted at that time. While there had been some experimentation with overcoming issues associated with altitude in order to climb high mountains, there had been no research undertaken on the effects of medium-level altitude (in the range 1800–3000 metres, with Mexico City at 2300 metres). Consequently, between 1964 and 1968 a large amount of research was undertaken into the effects of altitude in the lead-up to the Games (Kasperowski, 2009).

There were several reasons for the interest in the effects of altitude. First, there were concerns over the health of the athletes in competing at altitude, with some citing risks of black-outs and even death. Second, there was a concern with inequality (Kasperowski, 2009). Standardised rules exist in sport in order to ensure fairness. While 'natural' inequalities such as differences in physiological and psychological make-up are tested through sport, artificial inequalities are seen as undesirable and often limited, as described in the [previous chapter](#) with regard to the availability of full-body swimsuits. However, while an issue such as a swimsuit was easily solved owing to its agreed-upon artificiality, the question of altitude was far more complex.

On the one hand, there were athletes whose actor-network included already living at high altitude and were therefore already adapted, giving them an advantage at the Mexico games. But their physiological make-up as a result of living there could be seen as 'natural' and therefore impossible and unnecessary to regulate. The IOC also suspected that wealthier teams might spend time living at altitude prior to the games in order to gain an advantage. But it was deemed too

difficult and not appropriate to segregate competitions into high- and low-living athletes. Therefore, in order to attain fairness, the IOC issued the following statement:

No athlete other than those who usually live and train at such heights shall specially do so more than 4 weeks in the last 3 months before the opening of the Games. The IOC points out that to break this rule would be a gross breach of good sportsmanship and it is sure that no-one connected with the Olympic Movement would wish in any way to be guilty of taking advantage over the other competitors. (IOC, n.d., cited in Kasperowski, 2009, p. 1269)

While this statement was perceived to solve the problem in terms of fairness, national teams were still concerned about the effects of altitude on their athletes, with several nations sending scientists to study the effects of altitude. Through a study of Belgian athletes it was noted that athletes who trained at altitude often performed better once they returned to sea-level. This notion soon became commonplace, through the concept of 'living high, training low', developed as a way for athletes to gain the benefits from altitude training while still training at normal intensity (Kasperowski, [2009](#); Levine, [2006](#)).

Bowers ([2009](#)) describes the principle behind altitude training. At altitude the body increases its oxygen-carrying capacity (through producing erythropoietin (EPO)) in response to the low-oxygen environment that occurs at high altitude. However, this effect only lasts for a short duration, with EPO production peaking at about forty-eight hours of altitude acclimatisation, and base-lining again after five to ten days. Furthermore, training intensity is negatively affected by altitude. Therefore, through 'living high, training low' an athlete is able to maximise their oxygen intake while still ensuring maximum training intensity. However, the problem of training this way is gaining access to mountains and valleys that allow athletes to move from high to low altitude while still allowing-high intensity training.

TCHEs were developed as an attempt to mirror the effects of living high and training low. Levine ([2006](#), p. 297) describes how

Heikki Rusko ... decided to use an old industrial technique designed to filter oxygen molecules and dilute a room with nitrogen to create a hypoxic environment similar to the mountains. Athletes could then live and sleep in the 'nitrogen house' and train at sea level.

There are now various versions of these environments available, consisting of either tent-like structures, smaller sleeping-bag-like tubes or devices that control the air in a single room (Bowers, [2009](#)).

However, the outcomes from using these devices remain unclear (Bowers, [2009](#); Levine, [2006](#)). Study design differences have complicated the issue, and while studies measuring simply EPO production have consistently recorded a modest increase, whether this translates into increased performance is debatable (Bowers, [2009](#)). For example, in one study it is argued that 'the physiological response to altitude is quite variable and unpredictable among individual athletes – for example, the increase in EPO levels at an equivalent altitude of 3000m may range from a 400 per cent *increase* to a 40 per cent *decrease* after 24 h' (Ri-Li et al., 2002, cited in Levine, [2006](#), p. 298; italics in Levine). TCHEs are quite unusual in having such uncertainty, and therefore the general rule of thumb appears to be that each athlete must determine individually whether it is effective for them. For example, a marathon runner's blog records how her husband found them effective for his training, but that she personally had not found them useful, and instead experienced breathing difficulties (Herron, [2011](#)).

Should altitude chambers be permitted?

Several philosophers and sports scientists have used a number of different criteria to examine the acceptability of TCHEs (see, for example, Fricker, [2005](#); Levine, [2006](#); Loland and Caplan, [2008](#); Miah, [2006](#)). Fricker ([2005](#)) simply states that, as TCHEs do not alter the athlete in a superhuman way or cause harm, there is no ethical problem associated with them. In a more detailed analysis, Levine ([2006](#)) analyses WADA's decision not to ban TCHEs using the WADA criteria of whether they are performance-enhancing, whether they are safe and whether they are in the spirit of sport. WADA found that they could be performance-enhancing, therefore violating the spirit of sport, but they are also safe (Levine, [2006](#)). In his article, Levine ([2006](#)) argued against two of their conclusions. First, he asserted that the potential for TCHEs to enhance performance is by no means certain since, as described above, the reactions of an individual are unpredictable. Second, he argues against the reasoning that TCHEs are against the spirit of sport on the grounds of 'passivity' in that they do not require active training to use, as WADA claims. He explains that the science of athlete recovery is an important part of training, despite it

being passive, that many other passive actions in sport are acceptable and, finally, that TCHEs should be allowed, based on the fact that they simulate living at altitude, which is also acceptable. Miah (2006) agrees with Levine (2006) that the passivity argument is illogical, also pointing to other examples of passivity, including the role of the athlete in accepting advice from a coach. Miah (2006) further argues that TCHEs do not affect the doing of sport but may potentially contribute to the development of sport, with technologies increasingly being integral to improvements and developments in sporting performance, and for these reasons sees it as illogical to ban TCHEs.

Loland and Caplan (2008) evaluate TCHEs against the criteria of benefit, safeness and the possibility of providing fairness to determine whether they align with the spirit of sport. They conclude that the answer is ambiguous, stating that the benefits are clear – they are safe – but the last criterion depends on context. They argue that if TCHEs are used by athletes to help them adjust to altitude, then this is acceptable, but if TCHEs are used purely in an attempt to increase the oxygen-carrying capacity of the blood, this goes against the spirit of sport.

The ANT perspective on why TCHEs can be viewed as acceptable

In contrast to the arguments discussed above, the TCHE will now be considered as an actor-network, with distinctive ideas folded within it that make the decision to allow TCHEs potentially understandable. It is argued that because the actor-network that makes up the TCHE is very different from the actor-networks of doping and the use of other banned substances, TCHEs can be understood as natural and unproblematic.

First, the TCHE is designed, first and foremost, to simulate altitude training. Altitude training is indisputably allowed, given that the actor-network of some athletes includes living at higher altitudes. As Levine (2006, p. 300) points out: 'there is appropriately no movement to regulate where an athlete can live. That is, an athlete can choose to live wherever on the planet he or she can, regardless of the barometric pressure of the environment.' Therefore, TCHEs have the idea

folded within them that they have the same effect for an athlete as happening to be living at high altitude.

Altitude training is further understood as acceptable owing to the popular discourse that one of the reasons that long-distance runners from nations such as Kenya and Ethiopia have been so successful is that they live at higher than normal altitudes (Bale and Sang, [1996](#)). In their intensive study of Kenyan runners, Bale and Sang discuss how the association between Kenya's high altitude and their success in running has led to the assumption that there is a causal relationship between the two. They describe a long history of environmental determinism tied to racist beliefs which has led to this discourse, but argue there is no conclusive evidence of it being accurate. They also point out that athletes who live at altitude in other areas do not necessarily succeed at long-distance running, and instead describe the intensive training performed by Kenyan runners, which, they argue, has had the greatest impact on their success. Nonetheless, despite the lack of evidence, the belief that athletes who live at higher altitudes are more successful remains a part of the understanding of why TCHEs are an acceptable training method.

The understanding of TCHEs as producing 'natural' bodily effects is confirmed through their link with the high-profile banned drug artificial EPO, which is now, particularly after the 2012 Lance Armstrong scandal, a well-known 'evil' in the study of sport. On one hand, TCHEs mirror the effects of taking artificial EPO since the goal of TCHEs is to increase the body's production of EPO. However the contrast between artificial EPO and using a TCHE is marked. Artificial EPO causes the body to change instantly, which can be viewed as a very unnatural response, while TCHEs allow the body to adapt more gradually, as it would do 'naturally'.

The problem is the additional actant of the TCHE, which acts as an intermediary in ensuring that the actor-network that makes up the inner workings of the body changes to include a higher production of EPO. But if we only consider the effects on the body, we can see how using a TCHE mirrors the bodily response of someone living at altitude and not the response of someone using artificial EPO.

A rather different component folded within the TCHE's actor-network is the price. TCHEs can be very expensive, and

therefore only available to athletes with significant resources at their disposal. For example, while some simple versions of 'altitude tents' are easily available over the internet for only hundreds of dollars, these have the drawbacks of being hot and humid and increasing the production of CO₂, which undermines the effect of the tent. Acquiring a device that overcomes these barriers can run to US\$100,000 (pers. comm. Michael Hamlin, 2013). These costs mean that it is only athletes or nations who are prepared to invest heavily in elite sport, and therefore those who commonly sit at the top of the medal table, who can afford these devices. Beamish and Ritchie (2006) describe how inequalities produced by performance-enhancing substances are very often the same inequalities as produced within sport more generally. It is the same with TCHEs. However, in this case the inequality can be rationalised through the idea that using these devices enables a less talented runner to reach the same level as runners from Kenya or Ethiopia, who are assumed to have these abilities naturally because they live at higher altitudes. Further, the discourse that African runners have a natural advantage owing to altitude simulates the historical ideas embedded in the concept of race that assume a natural advantage to all dark-skinned athletes. In this way, TCHEs and altitude training confirm normalised ideas surrounding inequalities in sport, confirming that 'white' athletes can gain success through hard training and access to resources such as TCHEs, while 'black' athletes are naturally superior.

There is, further, little concern about inequality in terms of availability because, unlike the swimsuits discussed in the [previous chapter](#), the use of these devices is relatively invisible. A swimsuit is easily visible to all watching the race, but training, and particularly sleeping, are private activities not usually seen by outsiders or other athletes. This also connects to a point made by Levine (2006), who argued that, if TCHEs were banned, policing their use would be extremely difficult owing to the invisibility of their use, so would have to rely upon the creation of a culture of spying.

Finally, the behaviours involved in using the devices are not questionable in the way that, for example, doping is. Using TCHEs involves breathing in a different environment. It involves either a plastic tent or a sleeping-bag-like tube, which the athlete uses to perform activities such as sleeping or resting. The actor-network only includes very standard behaviour.

This is quite different from an activity such as doping, which has connotations of deviance and anti-social behaviour (Miah, [2006](#)) owing to the similarities to recreational drug-taking, and includes questionable devices such as syringes as part of its actor-network. Doping also can involve the introduction of artificial substances into the body, whereas TCHEs do not (Miah, [2006](#)).

In sum, TCHEs imitate natural processes so effectively that their very artificiality almost becomes irrelevant. They produce the same effects as natural altitude training, including the same gradual change process within the body. The process of using TCHEs also encompasses only 'natural' behaviours. Athletes are able to live their normal lives, apart from breathing in a different environment for some part of the day.

This example highlights the importance of understanding athletes as cyborgs, or as network assemblages made up of human and non-human elements. The effects of the TCHEs are so well designed to imitate the natural that they have less artificial effect than a runner wearing shoes. The assemblage of the human athlete with a TCHE produces the same effects as a human athlete living in a particular natural environment. With this in mind, the only reason to suggest that TCHEs should be on the banned list is that they are artificial. But if we dispense with the understanding that an athlete is an entirely natural entity and understand that, as a network assemblage, an athlete exists as a network of human and non-human, then TCHEs can be seen as entirely acceptable. This is a similar scenario to the case of Oscar Pistorius's legs, which are artificial but designed to imitate human legs so effectively that several years of examination could not determine any discernible difference. In both cases, the technologies act as innocuous parts of the athlete's network in the same way as running shoes, and it is only that they have the concept of artificiality folded within them that makes them problematic.

Non-enrolment of TCHEs by athletes

Despite the above, which can be seen as an explanation for why WADA has chosen not to ban TCHEs, this does not mean that they are always easily enrolled by athletes. The above description followed the actor-network of a TCHE in itself. But

when TCHEs are utilised by athletes, the actor-network grows to include the athletes' own actor-network, which does not necessarily allow the two actants to assemble easily together.

An obvious reason for not enrolling TCHEs is, as described above, cost. Not all athletes or nations can afford them. Moreover, those nations that can afford them must find a way to provide access to all athletes. For example, nations that adopt a more centralised training model, where all athletes are concentrated together in one area surrounded by sports science support, would be more likely to find it easier to provide athletes with TCHEs than those who adopt a more independent model, in which, athletes are more likely to be scattered throughout the country, making it difficult to site a TCHE in a place which would benefit all athletes equally.

Also described earlier was the doubt surrounding the effectiveness of TCHEs. While most studies reveal that they generally increase EPO, it is not clear that this always leads to an increase in performance. Therefore, athletes are unlikely to adopt a practice where the benefits are unclear.

There is also the question of whether enrolling the device will actually be of use to that particular athlete. One goal of the production of new technologies can be to overcome obstacles. From an ANT perspective, this is described as the creation of a programme to overcome an anti-programme (Latour, [1991](#)). For example, in the sport of mountaineering, the obstacle of 'lack of oxygen' is overcome through the use of oxygen canisters which can be carried up the mountain (van Hilvoorde, Vos and de Wert, [2007](#), p. 175). In this example, 'lack of oxygen' acts as an anti-programme as it is a factor that makes the climbing of the mountain very difficult. Adding the technological device of the oxygen canister to the actor-network of the mountaineer overcomes the anti-programme and improves the chances of mountaineer reaching the top of the mountain.

For some athletes the TCHE does not overcome any obstacles because it is not present in their particular case. This could take the form of athletes already residing at altitude, or having greater genetic capacity to carry oxygen as part of their actor-network.

Finally, the ANT approach points out that all aspects of the network are connected. So if one aspect of the network is altered, some other part of training may also not work so well. For example, in distance runner Herron's (2011) online blog, she described how using a TCHE made the rest of her training regime less effective making her less inclined to adopt the practice. This is similar to the argument made in the [previous chapter](#) where the kayakers identified other parts of the network that were as important as the kayak itself.

As with the kayak designs discussed in the [previous chapter](#), the non-enrolment of TCHEs calls into question the assumption that athletes are always seeking to improve their performance through taking on new technological developments. Instead, athletes' own individual genetic capacities and beliefs in what works for them are important in determining whether an athlete will enrol a new technology. Thus, the concern that natural sporting competitions may be ruined by the increasing inclusion of technologies appears to be unfounded.

Conclusion

This chapter considered the integration of 'foreign' technologies into sport through the cases of GPS in AFL and TCHEs. Both GPS and the TCHEs make interesting cases for study since their effectiveness has been questioned by researchers in both cases. With GPS, researchers suggest that the units are not used to full capacity. However, the devices are used to survey players, which players perceive to be problematic. With TCHEs, there is inconclusive evidence regarding their ability to improve performance. This chapter describes how other aspects of the socio-technical network have a strong influence on decisions surrounding the use of both technologies.

In both cases, I examined the technology as an actor-network and examined its enrolment and use through following the network. In the case of the GPS units, I followed the network outwards from the individual box and determined that there were other important parts of the network that were necessary for the GPS units to be used effectively which had not been considered by the league in their initial introduction. The league's lack of consideration of the GPS units as networks led to the units not being used to their full potential.

Nonetheless the process revealed two dominant reasons why the units have become common practice in the AFL. First, GPS units provide sufficient data to be useful to coaches and scientists. Second, GPS offers a level of surveillance that is very useful to coaches and managers, who want their teams to perform at their best, and so the ability to monitor players to ensure all are contributing to this goal is highly attractive. Both these reasons indicate that coaches and managers are more likely to make the decision to enrol GPS than players. However, the process also found that, because the league did not consider the need for a) other intermediaries to make the GPS work and b) ways of overcoming mediators such as roofs, the GPS units were not providing the level of value that could do.

Following the case of the TCHEs revealed a similar issue with the devices not providing value for all athletes. In this case, the lack of value was simply due to the fact that the way the TCHE assembles with each athlete is different in every case (which is not the case with the GPS units, which work with all athletes in the same way). The case of the TCHEs particularly emphasises the importance of understanding athletes as networks of human and non-human, or as cyborgs, rather than viewing new technologies as intrusions on a natural body. TCHEs have been designed to imitate natural processes so effectively that their artificiality becomes irrelevant, and so they should not be subject to the same scrutiny as practices such as doping, which will be considered in the [next chapter](#).

Both cases illustrate the importance of understanding technologies as heterogeneous networks. Purely examining their material value and seeing them as isolated physical artefacts prevents an understanding of how they can be used within sport. A similar argument is made by Magdalinski (2009), who argues for the importance of understanding the cultural meaning of technologies within the sporting arena. However, ANT takes this notion further by arguing that meaning, history, physical materiality and combining with the athlete are also significant in understanding how and why technologies are utilised and regulated within sport.

4

The actor-network of doping

No writing on sport and technology would be complete without a discussion of doping. Doping has been the centre of a vast number of controversies centred on health, fairness and, more importantly for this book, purity of the human body. Doping is a particularly interesting case for ANT, as all discussions of doping concern how the human body assembles with artificial substances or techniques. The problem for those trying to eradicate doping is how to establish that the assemblage is occurring at all, and this chapter details a variety of ways in which various groups have attempted to examine the assemblage.

This chapter is all about power relations. Specifically, it examines how various organisations have utilised inscriptions and a range of other surveillance methods in order to control doping. The type of control varies between organisations, with some aiming to control doping discourses, some to control doping in order to prevent it, and some aiming to control athletes. Essentially, this chapter follows the actor-network of doping with a view to determining the power relations that occur within this very contentious area.

The history of doping and the creation of doping policy

For as long as sport has existed, athletes have used a variety of stimulants with the goal of improving performance (Beamish and Ritchie, [2006](#); Hoberman, [2009](#); Houlihan, [1999](#)). Until World War Two, drug use was very crude and generally ignored by sports authorities. However, during the war, pharmaceutical experimentation and the use of various stimulants by the military revealed the possibilities offered by doping in the realm of sport. Following the war, amphetamine use by cyclists was thought to be prevalent during the 1950s, although it continued to be of little concern to authorities until the death of a cyclist during the 1967 Tour de France, which forced them to raise the issue. Experimentation with steroids is also believed to have begun in the 1950s, with a rapid growth in use continuing through the 1960s and 1970s (Houlihan, [1999](#)).

Houlihan ([1999](#)) argues that, although doping policy began to be introduced in the 1960s, it was uneven across nations and sports. He describes how national governments varied in their wish to control doping. Some were highly motivated, such as France and Belgium, who passed legislation in 1965, while others, such as Australia and Canada, were inactive and apathetic about the issue. Some nations, such as Great Britain, only offered inducements to athletes to refrain from doping rather than carrying out testing programmes themselves. Similarly, some sports federations such as cycling organisations were faster to take action, creating drug-testing programmes in the 1960s, while more inactive organisations, such as the IAAF, only began to form policy in the 1970s.

At an international level, Houlihan ([1999](#)) states that the IOC officially banned doping from 1962 onwards, and the first Olympic Games to test for doping were in 1972. Hanstad, Smith and Waddington ([2008](#)) describe how the IOC began to take ownership of the prevention of doping from this time forward. It took on an increasingly central role in fighting doping, primarily through the accreditation of laboratories for performing drug tests, and through the creation of the first official list of banned substances in 1971. These initiatives highlight the way in which organisations such as the IOC use particular networked mechanisms, which include non-humans, in order to retain power. For example, the laboratory is valuable only because of the network of chemicals, test tubes and other scientific apparatus that combine together to test urine and blood samples effectively for evidence of doping.

Another non-human that proved particularly important for the IOC and their control of doping was the creation of the list of banned substances. Catlin, Fitch and Ljungqvist ([2008](#)) describe how initially, in the 1970s and early 1980s, the list contained only substances for which a test existed. At the time the IOC felt banning was pointless until a test existed to test culpability. However, an incident of blood doping at the 1984 Olympic Games, widely reported in the media, proved that this approach was not effective, and from then onwards substances were added to the list even if detection was not possible (Catlin et al., [2008](#)).

The creation of the list demonstrates the importance of what Latour ([1999b](#)) refers to as an 'inscription'. Latour describes how, through inscribing on a two-dimensional sheet

of paper, scientists are able to describe a world and make things visible that were not previously apparent:

An inscription device is 'a system for producing traces out of materials that take other forms ... an apparatus of a particular configuration of items that can transform a material substance into a figure or diagram which is directly usable by others'. (Latour, 1986, cited in Law, [2004](#), p. 20)

Using this definition, it is the existence of the list that transforms a particular substance such as a steroid, or a technique such as blood-doping, from being a physical activity into a banned substance. This cannot happen without the inscription in place. The ban only exists through the inscription, with the inscription black-boxing each particular substance as disallowed. However, the inscription proved only partly effective for deterring athletes from doping, with it proving necessary to extend the actor-network in several directions in order for a thorough testing programme to exist (Catlin, Fitch and Ljungqvist, [2008](#)).

Shackleton ([2009](#), p. 288) claims that, although use of steroids was 'known' to have 'occurred as early as the 1950s, and was rife by the 1960s', enforcing sanctions was not possible until the 1970s, when a reliable test was found. Similarly, Franke and Berendonk ([1997](#)) report how testosterone injections were used extensively in the late 1970s in the GDR because testosterone testing was not introduced until 1982.

The effects of the introduction of testing are illustrated in a description by Shackleton ([2009](#), p. 292), where he recounts an incident of an East German athlete's sample testing positive in 1977. At that time there were no regulations regarding how samples were stored in order to be tamper-proof, and so some unusual situations occurred:

Occasionally athletes insisted on their innocence and demanded testing of the reserve, or 'B' sample in the presence of their representatives. The first time this happened to us was following the 1977 European cup in Helsinki when two or three guys showed up at short notice at our lab in the London suburbs with Arnold Beckett (of the Chelsea College of Pharmacy) and a secretary of the IAAF. We were to analyze some B samples from Bulgarian weight-lifters I believe, and an East German athlete. The high profile attendance of the East Germans seemed odd at the time, and not officially sanctioned since IAAF rules only specified one witness. One of the DDR representatives was a team doctor, the second a coach and the third a minder from the embassy, probably there to ensure the others didn't stray. The first conflict arose when Beckett produced the samples and the

doctor complained that their 'client's' sample was not genuine because he maintained he had put a scratch on the seal at time of collection and it was no longer there. The IAAF secretary promised to look into possible tampering but in the end the decision was made to continue; the seal was broken and the analysis begun. By the first evening we had the samples ready for conjugate hydrolysis, but clearly we had to stop for the day. However, the observers didn't trust that we wouldn't tamper with the samples during the night so one of us had to go to a hardware store in town to purchase a padlock for our cold-room where the samples were to be kept. We ceremoniously secured the test-tubes with sealing wax, the Germans locked the samples away and kept the key. Protocol was made up as we went along in those days because a couple of the observers came home with me as I lived close by and I cooked dinner. They loosened up with wine, enjoyed their unexpected Western freedom and I had difficulty getting them to leave. The following day the rest of the procedures were carried out and by day's end, to the consternation of the observers we produced perfect mass spectra of 6 α -hydroxy Dianabol or the metabolites of 19-nortestosterone. Although we analysts didn't know it at the time one was a very high profile case. We had proven the East German star shot-putter Ilona Slupianek guilty of nandrolone abuse and DDR athletes had the reputation for never getting caught. She was banned for 12 months but competed successfully in the following year's world-cup in Prague. As a result of our work the DDR took direct control over their doping lab at Kreischa (in Saxony) and from then on tested all athletes before they left the country. No East German female athlete was ever again convicted of doping.

This remarkable story demonstrates how the creation of inscriptions in the form of regulations essentially replaced the numerous actants that were enrolled in this case in order to ensure the sample was not tampered with. Scratching the seal, a padlock and sealing wax were all enrolled as ways to prevent tampering. This story also reveals the way different parts of the doping actor network came together to produce quite different outcomes. Franke and Berendonk (1997) report how, following Slupianek's positive test, the GDR initiated internal testing to ensure athletes were free from banned substances prior to departing for an international competition. If an athlete tested positive, they would not attend that particular competition.

Perhaps because of programmes such as the GDR's internal testing, there were fewer positive results found on the international stage than might be expected. For example, IOC testing at the Olympic Games recorded only fifty-two positive results between 1968 and 1992 out of an athlete population of 54,000 (Hanstad, Smith and Waddington 2008). These statistics led to suggestions that the IOC programme was ineffective. During the period between the 1970s and 1990s, national and sporting bodies heavily criticised the IOC's programme for its lack of success. These bodies argued that the IOC did not take

drug-testing seriously as they were nervous that it would have a negative commercial impact on the Olympics through negative publicity (Hanstad, Smith and Waddington [2008](#)). Certainly, Franke and Berendonk ([1997](#)) suggest that it is curious that no out-of-competition testing was ever initiated despite the suspicions aroused by female athletes with unusually deep voices.

Houlihan ([1999](#)) points out that prior to the establishment of WADA in 1999, the various national and sporting organisations were not working together towards a combined goal. WADA was necessary as an organisation that joined a number of very disparate groups under a single umbrella. Houlihan ([2002](#)) argues that prior to WADA's existence there was no dedicated group prepared to take responsibility for anti-doping, with distrust among the international federations and IOC making it difficult for such groups to work together towards a common goal. Houlihan's ([2002](#)) emphasis on the distrust echoes Latour's ([1991](#)) and Callon's ([1986](#)) arguments that in order for an actor-network to stabilise, there must first be an alignment of points of view. In this case there was no alignment between various sporting and national bodies and the IOC, which meant no effective action to detect doping occurred.

Given the lack of alignment, it was perhaps inevitable that those groups who were determined to see serious doping eradication efforts put into place would combine together to take control of anti-doping and create a more stable actor-network. The resultant actor-network was WADA, created at the World Conference on Doping in Sport, held in Lausanne on 2–4 February 1999, and convened by the IOC (Hanstad, Smith and Waddington [2008](#)). These authors state that the conference was called following events at the 1998 Tour de France, when French police and customs officials uncovered evidence of widespread doping. They describe how various sporting bodies put pressure on the IOC to respond to this scandal because it was the police and customs officials who revealed the scandal rather than the sports authorities. Sport has always been in an interesting position in that it has rules with sanctions and other deterrents and yet sits outside of any formal legal framework. Indeed, many countries have restrictions on the ability for the law to interfere with 'field-of-play' decisions. So in this case it is not surprising that sporting bodies reacted unfavourably to the police's involvement in doping, given the

strong history of sporting bodies being able to operate in a reasonably autonomous manner. This provided strong motivation for them to remain in control of doping, rather than risk losing authority to the police or other legal entities.

WADA was set up as a body with representatives from government and other public authorities, as well as sports organisations such as international federations and the IOC (Houlihan, [2002](#)). Funding remains shared between these groups (Hanstad, Smith and Waddington [2008](#); Houlihan, [2002](#)). Houlihan (p. 188) describes the initial role of WADA as:

the funding of research, the development of educational materials, the drafting of the World Anti-Doping Code, the conduct of an independent drug testing programme and the provision of independent observers at major sports competitions, such as the Olympic Games.

In performing these actions, WADA took on the role of a 'command centre' in directing worldwide anti-doping operations in a variety of nations. WADA's structure and surveillance mechanisms have allowed the organisation to remain in firm control of the fight against doping.

Doping as black-boxed?

In June 2002 WADA published the first Anti-Doping Code (Houlihan, [2002](#)). With the establishment of the code and its consequent adoption by both sports authorities and governments, it acted as an inscription that black-boxed doping as censured. Latour describes black-boxing as

the way scientific and technical work is made invisible by its own success. When a machine runs efficiently, when a matter of fact is settled, one need focus only on its inputs and outputs and not on its internal complexity. Thus, paradoxically, the more science and technology succeed, the more opaque and obscure they become. (Latour, [1999b](#), p. 304)

In the case of doping, WADA and various other sports governing bodies have worked hard to try to black-box doping as a bad behaviour that is detrimental to sport and must be eradicated. For example, the WADA website (WADA, [2014](#)) includes very little discussion of why members of the athletic community should take an anti-doping stance as it is assumed that the 'doping is bad' message is unarguable. This is a good example of how the internal complexity surrounding doping has been obscured. The black-boxing means that the 'input' of an athlete who dopes results immediately in an 'output' of that athlete being viewed in a negative way (Latour, [1999b](#)). This section will now explore why and how doping came to be black-boxed in this way.

Lopez (2012) utilises a model of technological change developed by Brian Winston that adopts the view that any technological innovation must be considered within the broader social context of its development. As demonstrated by previous chapters, such a perspective strongly resembles ANT, which argues that the entire actor-network must be considered in order to understand how action takes place. In the case of doping, Lopez argues that the contradictions inherent in the doping debate can be understood through identifying two groups of actors. The first is the sports community itself, which derives status from the continued push for improvement in performance that is seen as a hallmark of sport. In opposition to this are journalists, medical professionals and various governing agencies, who hold a different understanding of sport, as discussed below.

Lopez (2012) and Moller (2004) both argue that from within the sport community the eagerness to ban doping, and to black-box it as negative, stems from what they interpret as an anti-modernist argument. They point out that the desire to keep the sport 'pure' harks back to the ideals of amateurism ideals, which viewed the professionalisation and commercialisation of sport as ruining its character. However, Lopez (2012) argues that such a view runs counter to the very essence of competitive sport: the goal of becoming 'higher, faster, stronger'. The use of doping to produce superior performances is entirely in keeping with the logic that an athlete should be aiming to improve on their performances at all times, both in terms of improving their own individual efforts and through eclipsing what others have achieved historically.

In support of the notion of doping confirming the goal of sport, a number of sports sociologists or philosophers have pointed out the contradictions inherent in doping policy. These are summed up by Kayser and Smith (2008), who published a summary of the problematic nature of doping policy in the *British Medical Journal*, signed by twenty-four researchers working in medicine, philosophy or sociology. These contradictions are the 'internal complexities' (Latour, 1999b, p. 304) of doping, which generally remain obscure to the majority of the population.

Kayser and Smith (2008, p. 86) describe four conventional reasons for the banning of doping: 'the need to

ensure a “level playing field”; the need to protect the health of athletes; the need to preserve the integrity of sport; and the need to set a good example’. They point out that all four of these arguments have flaws.

First, the level playing field argument is illogical in the face of sport being already a competition between profoundly unequal bodies (Houlihan, [2008](#)). Athletes are unequal owing to genetic and biological differences, along with other inequalities stemming from access to equipment, technologies or expertise, as discussed in the [previous chapter](#). It is the differences between these bodies and their relative success and identification of who is superior that interests fans who watch the sport. Therefore, arguing that doping violates the level playing field is nonsensical, since the playing field is far from level to begin with (Kayser and Smith, [2008](#)).

The argument that doping is dangerous to the health of athletes is similarly illogical. Sport entails athletes taking a large number of risks that often impact negatively on athlete health. Such risks may result in direct injuries or injuries from overuse or overtraining, or athletes may develop particular psychological or other health disorders. Confirming the notion that banning doping for this reason is illogical, it has been pointed out that doping could in fact make some sports safer. For example, Olympic medallist in downhill skiing Bode Miller argued: ‘I’m surprised it’s illegal because in our sport it would be pretty minimal health risks and it would actually make it safer for the athletes, because you have less chance of making a mistake at the bottom and killing yourself’ (Smith, 2005, cited in Cameron and Kerr, [2007](#), p. 408). Miller’s argument confirms the serious risk of injury and even death already in place in downhill skiing, and points to the illogical nature of arguing that doping would be more dangerous than the sport in its current form.

The health argument further falls down as a result of the lack of scientific evidence that doping really does cause harm. For ethical reasons, clinical trials have not been able to take place to confirm the effects of doping. Additionally, because doping is currently banned, it leads to doping occurring in a clandestine fashion. Athletes have no choice but to acquire banned substances in whatever way they can, which means the quality of the substances cannot be guaranteed and opens up the possibility that athletes may self-administer rather than

seek medical advice. It is possible to argue that through banning doping, these practices, occurring in an underground fashion, are potentially harmful (Houlihan, [2008](#)).

The integrity argument is based on the supposition that doping runs counter to the ethical foundations upon which sport exists. However, as Houlihan ([2008](#)) points out, it is very difficult to identify common ethical foundations upon which sport rests. He observes that many of the rules that exist in sport are arbitrary and without any strong ethical foundation, so banning doping for this reason makes little sense. A related argument is offered by Lopez ([2012](#)), who claims that one of the strongest foundations of sport is the belief in 'faster, higher, stronger', which entails encouraging athletes to use whatever means they can in order to improve performance. Doping fulfils this notion very well, rather than countering it.

Finally, the argument that all athletes must be role models means that athletes must be held to higher account over their behaviour than other individuals, despite the fact that their expertise is in athletic excellence and not moral behaviour. Other individuals are not held to account for their behaviour in the way that athletes are (Kayser and Smith, [2008](#)).

Given this lack of logic, it is perhaps curious that doping has so effectively been black-boxed as censured. Lopez ([2012](#)) attempts to answer the question of how the black-boxing came about through identifying a number of groups and techniques that have created this categorisation. First, he identifies a range of conservative European ex-athletes who, upon retiring from competitive sport, began to hold influential administrative or medical positions within a range of national and international sporting organisations. These ex-athletes 'wanted to fashion sport in their image: the established amateur traditional culture' (Dimeo, 2007, cited in Lopez, [2012](#), p. 63). They pursued the romantic idealised notion that sport should be kept pure, and in their view doping sat outside of this pure image.

Lopez ([2012](#)) further notes that sports journalism has been dominated by ex-athletes who either hold the view outlined above, or who come from nations that have deliberately taken a strong anti-doping stance as a perceived way to further their own nation's results. For example, France

has always taken a strong anti-doping stance in contrast to the superpowers of East Germany or the Soviet Union (Houlihan, [1999](#)).

Ahead of both these groups, however, Lopez argues that the group that has been the most influential in black-boxing doping is the medical profession. Lopez ([2012](#), p. 64) claims that the drive to spurn doping was led by:

a group of physicians – often former elite athletes – involved in elite sport as medical advisors who spearheaded the cultural revolution which in the 1960s turned doping from a more or less accepted (and, for some, even desirable) practice into an intolerable violation of the spirit of sport.

Lopez names four particularly influential physicians who moved from dealing with doping from purely a medical perspective to introducing the notion that doping was counter to the spirit of sport. He argues that these four, along with others, eventually succeeded through a large propaganda campaign which was effective because of its links with the societal fears of technological intervention around bio-medicine that were present in the 1960s and 1970s. The campaign culminated with the establishment of WADA in 1999, but anti-doping ideals then came to be adopted by a number of high-profile athletes who joined the anti-doping campaign. Their cases were printed in the media, leading to a number of journalists adopting a strong anti-doping stance and moving beyond the role of unbiased journalists to become anti-doping spokespeople (Lopez, [2012](#)).

Yet the media cannot hold any power unless there is an audience to listen, and several authors have already pointed out the links between the moral panic over doping in sport and the wider moral panic occurring around the use of recreational drugs (Kayser and Smith, [2008](#); Waddington, [2000](#)). Kayser and Smith ([2008](#)) point to the way that the 'war on drugs' has become synonymous with the 'war on doping', as evidenced by the addition of recreational drugs that provide no performance enhancement, such as marijuana, to the banned list.

WADA plays on the moral panic to promote the anti-doping message. As mentioned earlier, WADA's anti-doping campaign includes very little discussion of why members of the athletic community should be against doping, as it is

assumed that the 'doping is bad' message is unarguable. Instead, the community is invited to contribute their own anti-doping messages and to promote the message of anti-doping in whatever way that they choose (WADA, [2014](#)). WADA also ensures that athletes are constantly given the message that, if they dope, they will be caught. This is a very simple 'input-output' message that WADA has attempted to convey. However, this discourse on its own is insufficient to deter athletes from doping, with WADA's control of anti-doping stemming from a vast array of surveillance mechanisms, which I will now discuss.

Doping and surveillance

A range of authors have examined how WADA operates as an extensive surveillance regime in its attempts to eradicate doping (see, for example, Hanstad and Loland, [2009](#); Park, [2005](#); Sluggett, [2011](#); Waddington, [2010](#)). In 2003 WADA introduced a new requirement that all athletes registered as competing at the elite level must report their whereabouts to WADA in order that they could be located for random doping tests at all times (Hanstad and Loland, [2009](#); Waddington, [2010](#)). As part of their agreement with WADA, national and international sports federations must keep a record of all athletes competing at the top level and undertake regular doping tests. Athletes can then face sanctions if they do not fill out the details of their movements or if they miss doping tests (Hanstad and Loland, [2009](#); Waddington, [2010](#)). In 2008 WADA reviewed their policy to demand more details from athletes. Since 2009 athletes have been required to report their exact whereabouts on a daily basis every three months. These requirements have led athletes to criticise WADA for using an extreme level of surveillance, reminiscent of 'Big Brother' (Waddington, [2010](#)).

Foucault ([1977](#)) specifically argues that organisations such as governments utilise a range of surveillance mechanisms in order to produce effective citizens. He says that these are in the language of ensuring the health of the population, and indeed sport is a commonly used by governments to ensure the health of the population.

Utilising Foucault's ideas, Park ([2005](#)) argues that the primary programmes used by WADA do not only test for doping but also shape athletic conduct through creating a

culture of surveillance. He provides three examples. The first is the requirement that all athletes must be available for unannounced out-of-competition testing at any time. This requirement legalises the intrusion of athletic authorities into athletes' private and everyday lives. The second example is the extensive research into potential new drug tests and the saving of blood and urine samples for twenty years or more. The saving of samples acts as a potential threat to athletes who can potentially be punished by being stripped of their medals many years after they have finished competing. The final example is the athlete passport, an online site designed to make it easy for athletes to update their details, thereby facilitating WADA's surveying of the athletes' movements. While WADA emphasises that participation in the passport programme is voluntary, they also claim that participation demonstrates an athlete's commitment to the fight against doping, again shaping the behaviour of athletes.

The case of Lance Armstrong demonstrates a further and more recent form of surveillance: the gaze of other competitors. Lance Armstrong was accused of doping not because he had failed any doping tests but on the basis of testimony from other cyclists, in particular Tyler Hamilton and Floyd Landis. In Armstrong's case this testimony, together with that of ten other anonymous cyclists, acted as evidence of Armstrong's doping, despite the lack of evidence through testing. Houlihan (2002, p. 191) points to the section of the first anti-doping code, which said that athletes

are quite understandably required 'to take responsibility, in the context of anti-doping, for what they ingest and use', but are also required, much more controversially, 'to report anti-doping rule violations of which they have knowledge, to an appropriate anti-doping agency'. (WADA 2002, Article 5, Paras. 5.1.3 and 5.1.5)

Houlihan (2002) suggests that, while it is entirely appropriate for athletes to be held responsible for their own actions, it seems harsh to sanction athletes for not reporting the violations of others. In a related argument, Sottas et al. (2008, pp. 191–192) describe how witness statements can be used as evidence of doping despite their unreliability:

Reliable means can be widely interpreted and include documentary evidence, witness statements or any other analytical information that could be presented to a disciplinary panel. We have seen recently cases where athletes have been convicted of doping and

sanctioned based on these non-analytical reliable evidences (see CAS decisions – USADA v. Tim Montgomery, CAS 2004/0/645, or USADA v. Chrystie Gaines, CAS 2004/0/649).

Given that competitive sport requires athletes to compete against one another, it seems somewhat dubious to allow the testimonies of athletes in direct competition with others to stand alone as a proof of guilt. However, it is an effective doping deterrent since it creates a situation where potentially all athletes are surveying other athletes at all times. It therefore illustrates effectively Foucault's concept of technologies of the self (Foucault, [1988](#)), which argues that individuals modify their own behaviour owing to the belief that others may be watching. In the case of doping, athletes may be surveyed by other athletes or through analysis of their urine and blood, and the surveillance can occur at any time.

Sluggett ([2011](#)) argues that, while Foucault's ideas are valuable for examining some of the surveillance mechanisms utilised by WADA, they may not be sufficient for examining the full range of processes that it has in place. Sluggett claims that Foucault developed his ideas with reference to enclosed spaces such as prisons and mental institutions, but with the proliferation of forms of surveillance that utilise more technological techniques including web-based surveillance, other theoretical approaches may be of more value. He suggests that an approach that moves beyond Foucault to acknowledge the way surveillance has extended is to use Deleuze's ideas on the 'control society'.

Deleuze ([1992](#)) argued that surveillance mechanisms changed in form throughout the twentieth century. At the beginning and middle of the century, the consequent disciplining that took place through surveillance, occurred through the existence of physical facilities. These institutions, such as schools, factories and hospitals, enacted surveillance within the enclosed confines of their various facilities. In this context the panoptic model (Foucault, [1977](#)) was highly effective as it was possible for individuals to be surveyed fairly constantly throughout these various institutions. However, in the late twentieth century, globalisation has led to a different societal model where individuals are constantly on the move and constantly networked (particularly through the internet) rather than passing through institutions. Deleuze ([1992](#), p. 6) used a sporting analogy to illustrate his point by arguing that traditional sports that require formal training, practice and

competition in an enclosed facility have been replaced by forms such as surfing, where athletes do not necessarily receive formal training, are not always part of competitive or institutionalised structures and may be constantly on the move. In this context, surveillance is more likely to occur through many small dispersed points rather than through a single physical location. Instead of athletes being physically surveyed, they are now provided with access to particular information or 'places' with the help of particular entry codes.

Sluggett's ([2011](#)) study of WADA's surveillance system identifies the proliferation of surveillance processes that go beyond those discussed above. Sluggett details how WADA connects with and shares information with a range of organisations that allow them to build up individual profiles on athletes and coaches. For example, WADA has signed a memorandum of understanding with Interpol on the sharing of information, and has agreements with a range of other pharmaceutical and police bodies. A very specific case is their agreement with Australian customs, who routinely share information with WADA about any intercepted pharmaceuticals addressed to coaches. Information is also collected through the Athlete Passport programme, in which WADA monitors an athlete's biological profile through regular testing, not with the goal of identifying doping directly but to identify any changes that resemble the side-effects of doping. Athletes whose profiles raise suspicion are then targeted for more thorough investigation.

The information from all these sources is collected into a database and combined together to build up a very distinct profile about each athlete. For example, Sluggett described one case where the collection of information clearly led to the detection of doping:

If I can give you an example without naming the rider, there was a rider we targeted out-of-competition because all the pieces of information came together. We observed his test results in-competition and out-of-competition and although he had not tested positive we felt there was a case to be followed up. Then he pulled out of a race he was expected to do well in, with a case of tendonitis. This was a few days after it became public that CERA¹ was detectable. So, we thought, this sounds strange. He's got a very dodgy profile, let's go and see him at home. Bingo, that [CERA] was what he was doing. (Gripper, 2008, cited in Sluggett, [2011](#), p. 396)

Sluggett argues that this example shows how it was the invisibility of WADA's data collection that allowed doping to be detected, which is in contrast to the very visible surveillance provided by cameras and other mechanisms described by Foucault (1977) as utilised by institutions. At the same time, he notes how the two connect through the 'coded body'. The coded body is the collection of data about a particular body that identifies it as suspect. The coded body exists as an assemblage and in multiple forms. For example, the same 'body' (or named athlete) exists in both an electronic form and as a biological entity. Sluggett argues that this view of the body moves it beyond the clean/doped binary that was previously identified through drug testing, with the body instead being seen as more or less at risk of doping. Indeed, he confirms how bodies are allocated a number on a scale of one to ten, where the higher the number, the more likely the coded body is to be doping. Once a coded body is identified as having a high number, visible surveillance is used in the form of drug testing in order to try to identify doping.

Sluggett concludes that Deleuze's assemblage model is valuable for drawing attention to the multiple forms of surveillance that now exist, and as a way to identify connections between multiple points. However, he also argues that the model is too flat, and does not provide sufficient understanding of how state or sovereign power (Foucault, 1977) operates through the assemblage.

A remedy for this defect may be offered through Latour's (2005) notion of the oligopticon. Similar to Deleuze, Latour also describes an assemblage surveillance model, incorporating multiple forms of surveillance occurring through multiple connections. Where Deleuze and Latour differ is in Latour's insistence that the assemblage has a central command point, which he refers to as the oligopticon. Through arguing that the assemblage works outwards from a particular point, Latour's model is closer in nature to Foucault's (1977) model of sovereign or state power. But, unlike Foucault, Latour sees multiple relationships occurring between the command point and between other parts of the network. It consists of a 'more dispersed form of surveillance supported by multiple sites' (Manley, Palmer and Roderick, 2012, p. 310). Latour compares the panopticon and the oligopticon by describing the panopticon's gaze as absolute while the oligopticon is made of multiple strands that do not have absolute sight, but which see

narrowly and well. Latour uses the example of the army control tent to illustrate how the oligopticon works. The tent is only one small physical area, yet owing to a surveillance system that covers many miles, a battle can be directed from the command tent, provided that it remains connected to the front lines.

WADA can similarly be likened to an oligopticon, since the networks that contribute to the detection of doping stem from a central control point. WADA is run by an executive committee, which is described as 'WADA's ultimate policy-making body' (WADA, [2015a](#)), and a foundation board, which is described as 'WADA's supreme decision-making body' (WADA, [2015b](#)). While there are a range of other committees that hold different advisory remits or representations from different groups (such as athletes), these two committees act as the central control point in the same way as Latour's ([2005](#)) example of the army control tent acts as the leader of an army. In both examples, the 'fighting' takes place at a different location from the control centre and involves many more people and more action than the control centre. Nonetheless, the control centre firmly directs the operations, but only insofar as it remains connected to those at the front lines, and also insofar as the different groups at the front lines also remain connected. As Sluggett ([2011](#)) confirms, it is the connections between the different groups that allow information to be collected and doping to be detected, but, confirming Latour's ([2005](#)) point, it is WADA's central committees that sign the memorandums between organisations, creating connections and directing the overall operations. Through these actions, WADA directs the anti-doping actor-network. The actor-network is made up of national anti-doping bodies who coordinate testing in their own countries, and the network includes all the medical staff and laboratory equipment required to carry out the testing. The network also includes police and customs agents, who similarly have their own data collection methods and a vast number of inscriptions on the WADA database, which detail information about the athletes and their histories as well as their movements collected through a range of methods. Finally, the actor-network includes athletes, who, as the Lance Armstrong case demonstrated, can also act as surveyors of athletic conduct. As an oligopticon, WADA is able to direct anti-doping operations through the information generated through these various networks.

But the oligopticon of WADA is also constantly shifting. It may stabilise at particular times, when doping cases are identified, but it cannot remain stable as it must be responsive to the new developments constantly occurring in doping in order to continue to detect it. Scientists are constantly working to find ways to beat the testing, and in this way the actor-network that makes up doping continually expands. For example, as already described in this chapter, originally substances were only placed on the banned list once a test had been determined. However, this was soon altered and the actor-network grew through the inclusion of more banned substances. With the establishment of WADA, the network expanded through an increase in funding, which allowed more extensive research in an attempt to stay ahead of the game. This research identified substances such as designer steroids: steroids that were deliberately manufactured in a way to avoid detection through the testing system (Kazlauskas, [2010](#)). Therefore the network expanded to include extensive scientific research on both sides, as it was needed to identify these substances and the methods to create more. Further, as the influence of WADA increased, and doping became a greater public issue, it became more and more difficult to obtain any banned substances. Therefore the actor-network grew further through the addition of organised crime, identified as part of the doping network in the Australian inquiry in 2013 (Gerrard, [2013](#)).

These examples demonstrate the way that doping exists as an ever-expanding actor-network, continually increasing as more human and non-human actants are enrolled in order to act against each other. One of the results of this ever-larger actor-network is the difficulty of working out who should be blamed. As my ANT analysis has shown, doping consists of an extensive actor-network where any part can affect the results in another, so it is difficult to identify who is at fault. A recent case that demonstrates this issue was the case of the Belarusian shotputter Natalya Ostapchuk. Ostapchuk failed a doping test at the 2012 Olympic Games, costing her the gold medal. In her defence Ostapchuk claimed that she had been framed and was not at fault. Her coach later confessed to dusting her food with steroids without her knowledge, but this claim has been greeted with scepticism (Kirk, [2012](#); Plumb, [2012](#)). This incident demonstrates how when a part of the black box fails, the internal problems within it come to light. It became apparent that, despite the extensive surveillance performed by

WADA, there was little clarity with regard to whether the athlete or coach was at fault. The most famous case where this issue came to light, one that has appeared in numerous court cases over the last decade, is that of East Germany, discussed in detail in the final section of this chapter.

State Plan 14.25: the East German state-sponsored doping programme, 1974–1989

The East German sporting regime is now known to have been responsible for one of the most famous cases of systematic doping of a large number of athletes. We now know that the experimentation with steroids began in the 1960s and essentially continued until the collapse of the political regime in 1989.

Steroids began to be used by East German male athletes from 1960 and by females from 1968 (Franke and Berendonk, [1997](#)). Their use became more common in the 1970s, and doping was formalised into State Plan 14.25 in 1974 (Dimeo and Hunt, [2011](#)). The creation of State Plan 14.25 is evidence that from early on there was direct government facilitation of the doping programme. However, the secrecy of the system was such that although there were suspicions of doping amongst the East Germans, there was no awareness of the state-sponsored system until the collapse of the GDR in 1989. The GDR avoided international positive doping tests by using their own laboratories to test athletes, ensuring that the steroids were flushed out of their system during competitions (Dimeo and Hunt, [2011](#); Franke and Berendonk, [1997](#)). The secrecy was further ensured by placing control of the doping programme under the Ministry of State Security, otherwise known as the Stasi (Dimeo and Hunt, [2011](#)).

The secrecy surrounding doping was so successful that they only became aware of the GDR doping programme through some of the inscriptions that came to light in the 1990s. The inscriptions contain over 150 documents, including PhDs, medical reports and Stasi security documents, that detail the types and doses of drugs administered to thousands of athletes (Franke and Berendonk, [1997](#)).

Since these revelations there have been numerous court cases where athletes have testified to the debilitating side-effects produced by the high doses of steroids they were given

(Dimeo and Hunt, [2011](#)). Former athletes revealed they had developed excessive hair growth, infertility problems, and kidney and liver problems, amongst other effects (Kettman, [2000](#)).

Dimeo and Hunt ([2011](#), p. 587) described the workings of the GDR's doping programme thus:

Athletes were not given a choice: once an individual reached a certain standard of performance their coach would provide them with the pills. The coach would be following the instructions of the doping working group, and each sports federation would have a doping programme. The doctors would support the coaches in their delivery of the pills. However, the athletes were often told that these were simply vitamins, while pressured not to discuss them (or any other aspect of their training) with family, friends or other athletes.

This description depicts the individual athletes, the coaches and the doctors as all simply following orders from above, which was the conclusion of many of the trials. For example, the doctor in charge of the swimming team, Dr Lothar Kipke, denied being culpable, on the basis that he was just following orders and was unaware of the side-effects of the steroids (Dimeo and Hunt, [2011](#)). Furthermore, the network of those involved in doping was enormous. Franke and Berendonk ([1997](#)) report that the documentation they researched revealed that seven different ministries were involved in the doping research programme, which included a network of over a thousand different individuals.

Dimeo and Hunt ([2011](#)) also point out that, even if the athletes had been told of the doping programme, many were too young to make a choice, and none had access to any rational information to assist with decision-making. For example, many athletes reported that they were aged between twelve and fourteen when they were first doped. They were given pills that they were told were vitamins, or special drinks, or injections where they were not allowed to look at the labels on the vials. The athletes were also told not to discuss these with their parents or anyone else (Dimeo and Hunt, [2011](#); Franke and Berendonk, [1997](#)). Therefore it is very difficult to argue that the athletes were in any way at fault for doping.

However, Dimeo and Hunt also present a counter-argument by suggesting that some of the athletes were very aware of the nature of the pills and discussed it with each other.

Similarly, they report how there were coaches who believed the state-sponsored doping plan was too tame compared with what they believed was occurring in other nations. Some of these coaches are described as having personally overdosed athletes, against the advice of the doping working group, and were disciplined by their superiors for doing so. Franke and Berendonk ([1997](#)) also report how the doctors complained of the constant demands for steroids from the coaches, so it is likely that in some cases the coaches were at fault.

Franke and Berendonk describe a report that details the exact doping procedures in weight-lifting and who was involved in the decision-making processes. They claim that the coaches and team doctor made the decision about which athletes should receive doping assistance, with the central government working group responsible for determining the exact form the doping should take. Such a process suggests that all of the coaches, doctors and politicians were equally responsible, as all appeared to be involved.

Franke and Berendonk also report a situation where the director of the doping working group, Manfred Hoepfner, reported to the Stasi that he refused to take responsibility for the administration of a new steroid: mestanolone. This was administered to athletes before official approval of its administration to humans, including any clinical trials. This case indicates that, while it would be difficult to claim Hoepfner was innocent of any involvement in the extensive doping, at times the network extended beyond the normal reach of the state, with clandestine trials occurring outside of the state's jurisdiction.

The other area that presented a difficulty was determining who had awareness of the side-effects and the long-term effects of doping. Dimeo and Hunt ([2011](#)) report that coaches and doctors both claimed not to be aware of the effects. By contrast, Franke and Berendonk ([1997](#)) cite evidence that doctors were aware of the effects and that many found the treatments unethical, only continuing the work because of pressure from the Stasi.

In legal trials that occurred in 2000, where hundreds of East German athletes sought compensation, the head of the GDR sports system, Manfred Ewald, was given a twenty-two-month suspended sentence, and Manfred Hoepfner, director

of the doping regime, an eighteen-month suspended sentence (Magnay, [2005](#)). Only 197 athletes received compensation, as in many cases there was no documentary evidence, no inscriptions, to provide evidence of other athletes who were doped (Magnay, [2005](#)).

While it is understandable that there was a wish to provide some sort of accountability and compensation for those who were affected by the doping regime, an ANT analysis would argue that doping is the result of a heterogeneous actor-network. More than a thousand individuals were involved. Additionally, doping occurred through the creation and administration of non-human actants such as pills, injections and drinks, which were created, tested and manufactured by laboratories with specialist equipment. Records of the administration were kept as inscriptions, which allowed the tracking of the effects of the drugs and the revelations of their use in the future. Doping occurred through the use of these non-human actants. It is impossible to argue that any of these factors were by themselves fully to blame, but together, they proved to have a very definite effect of improving sports performance as well as impacting on athletes' health.

Further, it has been very difficult to determine exactly what happened because of incomplete inscriptions. The incomplete inscriptions essentially act as mediators, disrupting the easy identification of what exact doping regime was administered to which individual. This is the opposite to the intermediary function for which the records were originally created, as the detail included in the records was able to show conclusively the effects of the particular drugs. For example, Franke and Berendonk ([1997](#)) include photographs taken from original Stasi files that consist of detailed graphs showing the administration of particular steroids and their effects on performance. These graphs were immensely valuable in determining the effects of the steroid most commonly administered during the GDR's regime – Oral Turinabol – clearly indicating the increase in performance that resulted from the steroid.

Latour (1990, cited in Smith et al., [2000](#)) argues that graphs are a particularly important type of inscription, because they possess five distinct features. First, they are able to transcend time and place, through utilising representations

to show clearly what would otherwise be invisible. The graphs featured in Franke and Berendonk demonstrate the link between the steroids and performance in a way that is invisible to anyone simply looking at the athletes' performance or watching them take the pills. Second, graphs can be compared, thus allowing understandings of differences and developments across different times and places. This was a crucial feature of the GDR's regime, as the meticulous keeping of records in the form of graphs allowed an understanding to be gained as to the long-term effects of steroids. For example, one of the problems identified in the regime was that athletes quickly adjusted to the doses of the steroids and, as the years passed, needed larger doses in order to produce the same effects, which meant the risks of side-effects became greater (Franke and Berendonk, [1997](#)). It was the existence of graphs that allowed the effects of steroids to become visible. Third, graphs are easily transportable. They can be carried to different laboratories or sent over the internet. In the case of the GDR, it was this transportability that allowed the identification of the doping regime to come to light, as graphs can be viewed with understanding years later. Fourth, they are immutable, both in the sense that they can be physically moved around while still holding their shape and in the sense that their meaning is retained regardless of the groups that look on them (Law and Singleton, [2004](#)). Again, graphs such as those discussed above maintain their of regardless of where they are moved, and the meaning from the graphs is retained regardless of the context, meaning we can examine a graph in 2015 and derive the same understanding as derived in the GDR in the 1960s, when the graph was first produced. Finally, because of the qualities already described, graphs can be enlisted to convince other scientists of the data (Smith et al., [2000](#)). The GDR's graphs could easily be used to convince those with doubts about the effects of steroids on sporting performance. In all likelihood, graphs such as these would indeed have been used by the scientists who conducted the tests to convince wider groups, such as the Stasi, of the potential offered by steroids. The inscriptions reveal that this is exactly what happened, and that once the effects of the steroids become apparent, the state-controlled doping programme began in earnest. Essentially, the doping programme worked through inscriptions, which also allowed the details of the programme to be revealed in the 1990s.

The numerous inscriptions available about the East German programme make it possible to understand at some level what occurred. However, this is very unusual in the case of doping, where extensive inscriptions of this nature rarely exist. For example, despite the 1998 Tour de France scandal acting as a catalyst for the creation of WADA and overall awareness of doping, there is still no clarity over exactly who was involved.

Conclusion

Throughout its history, a range of organisations have controlled doping through multiple mechanisms. The IOC's creation of the banned list was the first inscription that transformed various substances from innocuous to problematic. But the IOC's network included a range of commercial connections, such as media and sponsors, which meant that the IOC did not want to draw attention to doping in sport because of concerns about risking its reputation. Consequently, the IOC's efforts to ban doping were relatively weak. This changed in 1998, when the discovery of a significant doping ring by police and customs agents led sporting bodies to question the IOC's efforts and produce a more stable and effective actor-network in the form of WADA.

Since its formation, WADA has utilised a range of different methods in order to attempt to eradicate doping. WADA has consistently black-boxed doping as 'bad' despite the lack of evidence to confirm this claim. Indeed, the mass media and sports fans appear to have now accepted anti-doping as an important aspect of the workings of sport.

In order to identify doping athletes, WADA has operated various forms of surveillance since its formation. Some of this surveillance has taken the form of physical tests that constitute a form of direct surveillance reminiscent of the panoptical institutions described by Foucault (1977). I argue that WADA has more recently operated as an oligopticon. WADA has a central command point made up of two committees, and these direct operations with significant global reach. Through connections with police, customs and pharmaceutical companies, along with information about athletic performance and changes in the internal make-up of athletes, WADA is able to piece together a coded body (Deleuze, 1992) to identify whether each athlete is likely to be doping. It is the connections

between these various groups that are important in allowing the information to be pieced together to determine guilt, as opposed to direct surveillance.

WADA's operations are in contrast to those adopted by East Germany as part of State Plan 14.25. In the context of East Germany I argue that the most important elements that made the coded body visible were the inscriptions. These allowed the effects of steroids on the body to become visible to coaches and scientists at the time, and they allowed these to remain visible many years later.

The ANT concepts of inscriptions and oligoptica are significant for understanding power relations. This chapter shows how inscriptions are a crucial tool used by organisations to retain power. They were used by the IOC to seize control of the anti-doping campaign through the banned list, by East Germany to determine the significant performance effects of steroids and therefore justify the programme, by the legal profession to hold East Germany accountable and by WADA to confirm its position as the director of the anti-doping campaign. Similarly, WADA's case demonstrates how the concept of the oligopticon is significant for understanding how institutions use networked operations in order to confirm overall power.

This last point is particularly relevant for future examinations of institutions. Deleuze ([1992](#)) suggests that physically enclosed spaces and the surveillance that occurred throughout them in the twentieth century are no longer applicable in today's networked society, where there is significantly more mobility. However, as Sluggett ([2011](#)) notes, Deleuze's concept of the network emphasises the connections and the importance of all aspects of the network so strongly that it becomes difficult to identify power relations. By contrast, Latour's ([2005](#)) concept of the oligopticon assumes that institutions and organisations still make efforts to retain power but that they do so through a dispersed network rather than through direct surveillance.

Note

1Continuous erythropoiesis receptor activator, an artificial substance that mirrors the effects of EPO and which is consequently on the WADA banned list.

5

The integration of science and medicine into sports training

Every athlete's body consists of a unique assemblage of physical attributes. In order to maximise performance, these attributes must be trained and honed, but this can be a difficult task as the inner workings of an athlete's body are not visible to the naked eye. Sometimes, an athlete's particular skill-set reveals information about the inner workings of their body. For example, an athlete who can sprint quickly is likely to have fast-twitch fibres as part of their bodily assemblage. But in many cases, it is very difficult for an athlete or coach to determine the exact state of the actor-network inside the body.

This problem is generally solved by enrolling sports scientists and medical professionals into the sporting arena. Indeed, experts in sports science and medicine are now assumed to make up a significant part of a competitive athlete's actor-network. These experts have a range of technological tools at their disposal that are able to reveal the inner workings of the body and suggest solutions. For example, doctors may take blood tests in order to test whether an athlete's body is lacking in any particular type of nutrition. If this is the case a specialist dietician or nutritionist may be enrolled in order to solve the problem.

This chapter investigates the processes used by athletes and coaches to integrate sport scientists into the sporting context. While it would be easy to assume that enrolment would easily take place because athletes, coaches and scientists all have the common goal of improving performance, the two cases in this study demonstrate that the integration process is more complex and encompasses a range of perspectives and understandings, as well as specific actants, that contribute to enrolment or non-enrolment.

The development of sports science and medicine

Sports medicine has not always existed as a discipline. Instead, it has grown in line with the development of modern sport. Waddington ([1996](#), p. 177) defines sports medicine as

the more or less systematic application of the principles of medicine and science to the study of sporting performance, and the institutionalization of this practice in the form of professional associations, research establishments, scientific conferences and journals.

Waddington ([1996](#)) describes how sports medicine came into being as a discipline in the 1920s and 1930s: the first college of sports medicine was created in Germany in 1924, and the first use of the term 'sports medicine' is recorded as occurring in 1928. However, it was after the 1950s that the growth of the discipline really accelerated. Waddington ([1996](#)) argues that this came about as a result of the medicalisation of society, which encompassed sport, and the increasingly competitive nature of sport. These two influences resulted in sports science and medicine becoming normal and recognisable parts of modern sporting practice. Several authors (Safai, [2007](#); Theberge, [2008](#); Waddington, [1996](#)) have established that the integration of sports scientists into sports training programmes has come to be seen as an important path to improving performance. Moreover, Safai ([2003](#)) acknowledges that the constant stream of injured athletes provides regular work for sports scientists, leading to them being easily integrated into the field. Therefore, it is not surprising that sports medicine has flourished and, more recently, come to incorporate some complementary or alternative practitioners alongside the traditional physicians and physiotherapists (Theberge, [2008](#)).

Consequently, the modern athlete is understood as surrounded by a range of support staff with scientific or medical expertise who assist with ensuring the he or she performs at maximum capacity. For example, Theberge ([2008](#), p. 21) describes the range of sports medics that made up the medical delegation for the Canadian Olympic teams in 2004 and 2006:

At the 2004 Athens Olympics, the Canadian medical delegation included medical doctors, physiotherapists, athletic therapists, chiropractors, massage therapists and psychologists. At the 2006 Olympics in Turin, the delegation included these professions, and the addition of a nutritionist.

Similarly, large medical teams are frequently used to support professional sport. For example, Lance Armstrong had a three-member medical team assisting him, which was not questioned as unusual until Armstrong's doping scandal, when all three members were banned together with Armstrong (Vinton, [2012](#)).

Within the sociology of sport, attention has been paid to the role of scientists in its risk culture (Nixon II, [1992](#); Safai, [2003](#)), the history and development of sports medicine as a discipline (Safai, [2007](#); Waddington [1996, 2000](#)); and the specific roles of and power relations between different sports medicine professions (Malcolm D., [2006](#); Theberge, [2008](#)). However, there has been only little attention paid to the enrolment processes through which sports scientists become part of the sporting network. Exceptions include Nixon's ([1992](#)) study, where the concept of the 'sportsnet' is utilised to describe how athletes and coaches identify external resources, Pike's ([2005](#)) exploration of how rowers step outside the traditional medical framework in order to identify alternative practitioners and my own (2012) examination of how gymnasts in New Zealand enrol sports scientists. The case studies in this chapter are drawn from the work of Pike ([2005](#)) and myself (2012), with a view to understanding how it is that athletes make choices about utilising various practitioners. The cases are similar in the sense that neither the rowers nor the gymnasts have formal access to sports medicine support as part of their training regime, meaning that both the gymnasts and rowers (and/or at times their coaches) must make their own arrangements in order to access medical support.

The study of medicine through ANT: the work of Annemarie Mol

A theorist who has received significant acclaim for her ANT-orientated work is Annemarie Mol. In *The Body Multiple: Ontology in Medical Practice*, Mol sets out to investigate 'the way the tensions between sources of knowledge and styles of knowing are handled inside present-day allopathic medicine' (Mol, [2002](#), p. 1). Mol's work is of relevance, since this chapter examines the integration of sports medicine and sports medical professionals into sport, where similarly there are tensions regarding knowledge sources and ways of knowing.

Mol ([2002](#)) emphasises that she is interested in multiple understandings and not perspectives. She argues that the term 'perspective' refers primarily to a point of view, or a particular meaning, whereas, in line with ANT, her view is broader than that, in aiming to incorporate physical reality. She is not only interested in the meanings ascribed to particular instances of the body; she is also interested in the body itself, and in the non-humans artefacts attached to medicine that allow different understandings to co-exist. She argues that the term 'perspective' refers only to a way of thinking, whereas 'understanding' incorporates a physical reality.

Mol is also interested in how diseases come into being. She observes that diseases do not exist until they have been identified by the medical team, and then they come into being with a range of associated treatments. She argues that diseases are thus 'performed' (Mol, [2002](#), p. 32) by doctors and patients, together with a range of heterogeneous actants such as a microscope, which allows the doctor to identify particular signs and 'produce' the disease. Her argument aligns with the argument made in the [previous chapter](#) that substances only come into being as banned once WADA identifies them as banned and includes them on the banned list. Both arguments emphasise the way that identification by a medical team of diseases or substances transforms them from a range of apparently innocent symptoms or chemicals into potential 'evils'.

Thus far in this book there has been little attention to the methods used by ANT theorists, primarily for the reason that there are very few studies of sport that utilise an ANT methodology to draw on. Mol's ethnography, however, provides an excellent example of the ANT methodology at work.

In one sense Mol undertook a traditional ethnography. She located a setting, in her case a Dutch hospital, where she situated herself and undertook extensive observation. Mol ([2002](#), p. 3) describes her experiences:

I observed technicians handing diagnostic tools in the vascular laboratory. I followed the tracks of radiologists and pathologists in their leadings with leg arteries. I went for months to the weekly meetings where the treatment options for patients with complicated cases of vascular disease were discussed. I witnessed several operations. Spent some days in the research laboratory of the haematologists. Held interviews or had conversations with

epidemiologists, physiologists, internists, surgeons, and general practitioners. A couple of them read my articles and we talked about their reactions. I also went to the library and studied the textbooks and journal articles written, or mobilised as a resource, by 'my doctors' and, when the references and my curiosity took me there, compared them with other publications. For two years I followed the monthly research colloquium on atherosclerosis. I co-authored with a junior doctor an article about the introduction of a diagnostic protocol. I supervised a medical student who interviewed vascular surgeons in several smaller hospitals and another one who analysed discussions about the intake of cholesterol. And finally, I had the temporary luxury of a research assistant ... who held long patient interviews, transcribed them, talked them over with me, and co-authored publications about this material.

The actions Mol describes here are very similar to a traditional ethnographic account in the sense that she describes immersing herself in the hospital environment and observing and talking to a wide range of participants. However, the first line indicates that there is a substantial difference between Mol's work and that of the 'normal' ethnographer. Mol begins by stating that she 'observed technicians handing diagnostic tools'. By describing the observation of tools as her opening, Mol indicates her intention not merely to observe people, but also to observe objects, in line with ANT methods. She argues that through considering objects, or non-humans, and the way they act, it is possible for multiple, rather than singular, realities to be revealed. The method that Mol employs in her work enacts the argument that humans and non-humans should be considered as of equal importance in the production of reality. She pays equal attention to humans and non-humans.

The structure of Mol's book draws attention to a further aspect of the ANT method. Each page of the book has two sections. It has a 'main' narrative, which is in a standard-sized font and takes up half to three-quarters of the page. But below that, in a subtext, is a different narrative. The upper narrative consists entirely of the description of Mol's time in the hospital. Encounters are described, field notes are recorded and interviews are quoted. Below that, in a separate section, is the reference to literature that is expected as part of standard academic method. Mol separates these sections because ANT argues that the descriptive narrative provides sufficient information without the need for a formal explanation. Latour (2005, p. 147) expands on the need for a detailed description to stand on its own as the method for understanding a situation:

What is meant by a 'social explanation' most of the time? Adding another actor to provide those already described with the energy to act. But if you have to add one, then the network was not complete ... I have never seen a good description in need of an explanation.

By a 'good description' Latour refers to a description of sufficient detail that takes into account both human and non-human actants. He argues that providing a description of this nature allows the explanation to be revealed without the need for further work. Mol's account of the hospital is what Latour would term a 'good description', as in the upper (main) section of the book Mol does indeed provide a highly detailed account of the hospital while paying attention to both humans and non-humans.

What follows are two case studies. While the first uses work from a traditional ethnography, the second is one of the few sports studies that adopts an ANT approach. As such, the second case consists predominantly of description.

Case study: the enrolment of sports medical practitioners by female rowers in the UK

Elizabeth Pike's study of rowers in the UK provides a useful account of the different understandings held by medical professionals and athletes, and the consequences in terms of enrolment of sports scientists. Pike performed a two-year ethnography of two women's rowing clubs in the south of England with a goal of examining their medical support in a bid to begin to remedy the lack of research into the practices of sports medicine. Because the findings reveal the use of alternative rather than traditional medical practitioners, Pike notes the different understandings that those with different roles bring to the athletic body and the resultant tensions between these understandings. Her argument resonates strongly with Mol's observations of the way different medical professionals hold different sets of understandings which affect how they operate. The following considers two of the understandings identified by Pike: the bio-medical paradigm and the sport ethic.

The bio-medical paradigm

Pike (2005) observes the dominance of the bio-medical paradigm within both researchers of sports medicine and

medical practitioners. She describes how researchers agree that the bio-medical model has dominated Western medicine throughout the twentieth century (see, for example, Nettleton and Gustafsson, [2002](#); Wade and Halligan, [2004](#)). The bio-medical model can be summarised as resting on the following five key assumptions (Nettleton and Gustafsson, [2002](#)):

1. The mind and the body are treated as separate entities, with mental phenomena considered in isolation from physical symptoms.
2. The body is treated as though it is a machine and therefore doctors are understood as akin to engineers.
3. It is assumed that the most effective way of healing what is viewed as an unwell body is through technological intervention.
4. Diseases and illnesses are explained in terms of biology without consideration of social and psychological factors.
5. Every symptom, disease or sign is understood as being caused by a specific, identifiable agent.

In Mol's ([2002](#)) terms, these five assumptions combine to form a particular understanding of the body. This is the understanding that many in the medical profession bring when encountering an athletic body. Related to the bio-medical model is the sport ethic, which similarly works as a particular understanding of how elite athletes should behave.

The sport ethic

Hughes and Coakley ([1991](#)) argue that sport is dominated by a particular understanding of the body that they refer to as the 'sport ethic'. They describe how 'the sport ethic refers to what many participants in sport have come to use as the criteria for defining what it means to be a real athlete' (Hughes and Coakley, [1991](#), p. 308). The four dimensions that are agreed to make up the sport ethic are: extreme dedication to sport, a drive to distinguish oneself through sport, accepting risk and playing through pain, and rejecting any obstacles that stand in the way of success (Hughes and Coakley, [1991](#); Malcolm N., [2006](#); Sefiha, [2012](#)).

Several researchers have identified how athletes learn to take on these understandings through the messages they receive from sports coaches, sports officials, other athletes and the media (Hughes and Coakley, [1991](#); Malcolm N., [2006](#)). Specifically, Malcolm N. ([2006](#)) identified how athletes are socialised into adhering to the sport ethic through coaches making light of athletes' injuries, ignoring complaints about pain and demonstrating adherence to the sport ethic. The behaviour resulting from adhering to the sport ethic may be deemed deviant, as it may consist of disordered eating, overtraining or playing through injury, but the underlying motivations are viewed as positive owing to their role in achieving highly in sport (Sefiha, [2012](#)). Therefore the components of the sport ethic act as behaviour expectations for athletes involved in competitive sport.

Pike ([2005](#)) found that the rowers in her study both adopted and rejected the above two understandings, which led to them dealing with injury differently and enrolling different forms of treatment. First, she found that many of the rowers and coaches accepted injury as a natural part of rowing. This belief was rationalised through an understanding that rowing technique involves 'twisting the back to one side, knee compression, and repetitive wrist movements', which inevitably lead to injury (Pike, [2005](#), pp. 203–204). Yet it also conforms to the sport ethic through demonstrating the way that athletes accepted the risk of injury and the assumption that it would be necessary to play through pain as entirely normal. Further evidence of conforming to the sport ethic was found through the way the majority of rowers said that they would continue to train with their injury, despite being aware that further damage might be caused.

The desire of athletes to conform to the sport ethic at times ran counter to the advice they received from doctors. Doctors were described as not understanding sport, which led the rowers to lack faith in their diagnosis or advice. This was particularly the case if the doctor's advice ran counter to their own beliefs regarding how they should behave as an athlete. For example, many of the rowers expressed dissatisfaction that their doctors told them to rest. Rest was not seen as an option for the rowers, since they felt the need to continue training to ensure their 'place in the boat' (Pike, [2005](#), p. 204). This reflects the strength of the sport ethic in the way that athletes expressed a wish to do everything they could to remain part of the rowing

team, and therefore did not see rest as an option. Furthermore, the reaction of the rowers in feeling that this advice was insufficient also suggests that the rowers had taken on the belief in the bio-medical model in expecting doctors to be able to fix their problem. The assumption is that a doctor will be able to identify the problem and fix it, in line with the notion that there are particular symptoms that can be fixed through identifying a specific agent and intervening technologically to fix it. Instead, the doctor simply prescribed rest and/or painkillers without fixing the problem.

In perceiving painkillers to be insufficient, the rowers demonstrated their expectation that any technologies or techniques utilised by doctors should be able to do more than simply mask the pain. This suggests that the rowers were uninterested in enrolling technologies or techniques that did not fix the problem, owing to their belief in the bio-medical model. Consequently, their understanding made them reluctant to enrol the pain killers and, by extension, the doctors who prescribed them.

The dissatisfaction with the doctors led some of the rowers to choose 'alternative' practitioners instead. Pike ([2005](#)) suggests that the rowers preferred these practitioners because of their holistic, whole-body understanding, which differed from the bio-medical paradigm. The rowers described how doctors would not treat them as 'people', instead adopting the view of them as a machine to be fixed. By contrast, the rowers enjoyed the collaborative aspect of the alternative treatments, where they were able to be an active participant in their treatment rather than being treated as a passive machine. Pike notes how the active nature of their participation was indicative through the language used, with doctors seeing 'patients' and alternative practitioners seeing 'clients'.

Pike ([2005](#)) notes that cost was another factor in determining the choice to visit an alternative practitioner. She observes that traditional medicine is covered by government funding, while visiting an alternative practitioner is not, as determined by government policy. As with doping, this demonstrates the power of inscriptions in determining outcomes. The policy inscription in this case did not allow the government to cover visits to alternative practitioners, thereby making it difficult for those without disposable income to do so. The actor-network for alternative medicine includes the

policy inscription as an anti-programme that could only be overcome through the presence of sufficient funds to cover the cost of visiting.

Pike (2005) also found cases where athletes chose to accept one practitioner's advice over another. For example, she describes how a rower she called Sally saw a consultant surgeon about her shoulder injury who advised her that she required surgery, but by contrast, she saw an osteopath who told her it was fine. Sally followed the advice of the osteopath since it allowed her to keep training. In Mol's (2002, p. 32) terms, this example demonstrates the concept of diseases, or injuries, being 'performed'. Sally's consultation with the surgeon produced an injury in need of fixing, in line with the bio-medical model's understanding that medical problems require technological intervention in order to be fixed. In contrast, the injury disappeared through her consultation with the osteopath. Mol (2002) also discusses how different practitioners' views on a problem clashed at times, and when they did, the findings from one were given more weight than the other.

Pike's (2005) study suggests that the different understandings held by rowers and practitioners resulted in different levels of enrolment, though enrolment was not the focus of Pike's study. Rather, her study focused on the different understandings, which were similarly important in Mol's work. Acknowledging that enrolment may not occur as a result of the existence of different understandings is a significant part of the theory of enrolment. As discussed earlier, enrolment is unable to occur without the alignment of different points of view or, as Callon (1986) described it, *intéressement*. As Callon and later Latour (1991) note, *intéressement* does not mean that all parties must agree and have the same motivations, only that all parties must have an agreement that enrolment is beneficial. In Pike's (2005) case, the athletes frequently chose not to enrol mainstream medical practitioners because they believed it would not be beneficial because of the very different understandings held by themselves and the medical parties, encapsulated in the contrast between the bio-medical model and the sport ethic.

Identifying the link between the viewpoints of the different parties and the enrolment process is one of ANT's most significant contributions. Many theoretical approaches

focus on the identification of the viewpoints held by particular groups, such as the work of theorists who identified the sport ethic and the bio-medical model. ANT is not interested in what makes up these points of view per se, but provides a process for identifying the impact these different understandings have on action taking place. In this example, the important point is that the contrasting points of view led to non-enrolment, or a lack of action, between the athletes and traditional medical practitioners, rather than the exact points of view themselves being the focus.

The next example continues the exploration of the enrolment (or non-enrolment) of sports scientists through examining the sport of gymnastics in New Zealand. However, unlike Pike's (2005) study, this study stems from my own research, in which I deliberately used the ANT method of 'following the action' (Latour, 1987).

Case study: the enrolment of sports scientists into the sport of gymnastics in New Zealand

In previous chapters of this book I introduced the ANT concept of enrolment in order to examine the integration of technologies into the sports environment. In the following case the concept of enrolment is again employed in order to understand how different understandings of sport and medicine, such as those discussed in the case of the rowers, influence whether sports scientists are enrolled by athletes or coaches. The case study used here is one of the few ANT studies that have been conducted in sport, and examines how gymnasts and coaches in New Zealand enrol or choose not to enrol sports scientists to work with them as part of their training regime.

Methods

In line with the ANT perspective, this study used ethnographic methods where 'actants' (Latour, 1991; 1999a; 2005) such as gymnasts, coaches, sports scientists and sport policy documents were followed through the process of creating gymnastics. 'Following' refers not to the round-the-clock observation of individuals, but to a 'mapping of the moments' (Michael, 2000, p. 131) when gymnastics makes its appearance. This research mapped the moments in which elite gymnastics and its integration with sports science occurred.

The mapping began with the aim of observing all the elite training gymnasiums in New Zealand. I visited and observed all ten elite gymnastics training venues in the country and spent a minimum of two full days observing at each. Depending on my access, the period of observation was usually much longer and in some cases weeks or months of weekly observations took place, along with interviews with any consenting participants at the gymnasium. The process of interviewing involved seeking out participants who appeared to be informed and competent. Finding informed participants is a key aspect of all sociological research that Latour argues is equally significant and necessary in ANT (Farnsworth and Austin, [2005](#); Latour, [2005](#); Simpson, [2007](#)). Formal interviews took place with forty-seven participants, ranging from gymnasts, coaches and judges to parents, administrators and scientists, all of whom are referred to by pseudonym and role within this chapter. All were heavily involved in the sport at the elite level and therefore highly informed about the workings of the sport. Some other participants declined to be interviewed formally but agreed to answer informal questions by email or in person.

In the interviews I asked the gymnasts and coaches to describe which sports science services they had utilised and to explain how this had occurred. Similarly, I asked the sports scientists to describe how they had worked with gymnasts and how such arrangements had come about. A definition of 'sports scientist' was not given to the participants; instead they were invited to interpret the term in whichever way they wished. The most commonly discussed sports scientists were physiotherapists, nutritionists, psychologists and biomechanists, and participants revealed a range of methods for enrolling them into the gymnastics network, as described below.

One-off enrolment

While some highly successful athletes enrolled scientists through a government-funded system known to athletes as 'carding', very few athletes were able to access funding to enrol scientists in this way. Instead, the most common enrolment of scientists occurred as one-off enrolments. These would occur with the coach, gymnast or gymnast's parents enrolling a scientist to assist with a specific issue. Usually these

enrolments were for a single session only, with the scientist being paid for their work by the gymnast or their parents.

The majority of gymnasts had at some point attended a joint session with either a nutritionist or a psychologist in order to provide them and their parents with general information and skills. Some gymnasts, such as the trampolinist Esmerelda, described how they had attended a large number of these sessions at sports camps for talented athletes of all ages. In other cases, such as one of the women's gymnastics coach Jessica described, it was something that the coaches organised in the gymnasium, asking each gymnast to pay a small amount to cover the scientist's fees. Mary, a rhythmic gymnastics coach, described how she found group sessions like these extremely useful both as a way of imparting new knowledge and as a reminder, using the example of how she enrolled a dietician for a one-off session:

Dietician is the other one I use occasionally, and invite the parents. They prepare the meals and do the shopping. And that's where you get some interested and some not, but most of the parents are pretty good. Even the ones who are trained in nutrition say it's still good to hear it.

Mary emphasised the importance of the parents as part of the gymnastics actor-network, as those who prepare the meals for the gymnasts. She acknowledged that parents are empowered to control the diet of the gymnasts and was happy that most chose to utilise the knowledge gained from these sessions to benefit the gymnasts. Enrolment was easy to achieve because the parents, coach and dietician all perceived the dietician to be directly helpful in ensuring the gymnasts remain healthy while training through receiving the correct nutrition. Their exact reasons for believing this varied, with some there to improve athlete health and others for performance enhancement, but regardless of individual motivation, enrolment occurred and action took place in the form of an education session by a dietician.

In contrast to Mary's example, other coaches and athletes said they found nutrition sessions disappointing as the information was not necessarily specific to their sport or their situation. Gilbert (2009) confirms how many sports are under-represented in the sports nutrition literature, making it challenging for the sports nutritionist to work with athletes from these sports. Mike described the difficulty in finding a

nutrition expert who understood the long and demanding training hours of gymnastics:

I don't believe that a lot of the nutritionists actually know gymnastics well enough to give expert advice. Which is not to say they couldn't learn, they've obviously got the knowledge but they don't know the sport well enough to help.

Esmerelda, a trampolinist, agreed with Mike, describing how many sports science sessions she had attended focused on other sports, including artistic gymnastics, but omitted trampolining:

How do I apply it to tramp(oline)? They've based it on netball and rugby and they'll go 'how many rugby players? How many cricket players?' (Artistic) gymnastics is totally represented, but I went with another rhythmic gymnast once and they didn't mention our sports (trampolining or rhythmic gymnastics) once the whole time ... That's the hard thing, finding someone – and I mean, where would you find someone that's trampoline specific?

In these cases, although scientists are enrolled in the sense that they provide an educative talk and receive payment, full enrolment is not achieved because the gymnasts and coaches are not enrolling the knowledge imparted by the scientist. Often, one reason for knowledge not being enrolled is a lack of understanding on both sides about the athletes' requirements. For example, in his discussion of eating practices of rhythmic gymnasts, Johns (1998) describes a case of a nutritionist struggling to assist a gymnast because the gymnast was unable to explain the exact weight she was required to be. Johns highlights how, although the judges and coaches have an idea about how a gymnast should ideally look, this is not always translated into a form that a nutritionist is able to help with. In the New Zealand study, Kelly, a rhythmic gymnastics coach, described how she solved this problem by translating the needs of a rhythmic gymnast into the need to be at the lowest end of the healthy weight range. When one of Kelly's gymnasts and her mother visited a nutritionist, Kelly instructed the mother to ask the nutritionist for advice about how to stay at this weight, an instruction the nutritionist was able and willing to work with. Therefore in this case, the translation provided by Kelly allowed enrolment to occur.

The role that Kelly played in providing this translation contrasts strongly with other studies of gymnasts' eating behaviour that identify gymnastics coaches as requiring

athletes to eat very little and retain a very thin body shape regardless of the health consequences (see, for example, Johns and Johns, [2000](#); Kerr and Stirling, [2012](#); Ryan, [1995](#)). Few solutions to this culture have been identified. Further research examining the role that translators of any form may play in ensuring gymnasts and other at-risk athletes remain healthy within environments with stringent expectations may be of benefit.

Participants identified nutritionists as one of the most commonly enrolled scientists by both parents and coaches. Whitson et al.'s ([2006](#)) study of the knowledge level of sports coaches in the USA about assisting athletes with eating disorders found that the coaches acknowledged the necessity of having knowledge of nutrition and eating disorders, and that they would have liked more education about these matters. However, Whitson et al. do not question how enrolment may occur in situations where the nutritionist and coach are not able to agree on a goal or articulate their needs, which is where employing an ANT perspective could be of value. Similar to Whitson et al.'s study, many gymnasts in this study acknowledged the usefulness of enrolling a nutritionist. However, some coaches described how they found attempting to enrol nutritionists to be a waste of time because the athletes lied to the nutritionists about what they normally ate. Natalie, an aerobics coach, reported:

the hardest thing is dieticians. And it's not that the dieticians aren't good, they are good, the ones we use. The problem is getting the athlete to listen to them ... They don't necessarily give all the information. For example, the dietician tells them to fill out a food diary for three days. So they change their diet for those three days.

Amy, a trampolining coach, described the same experience of athletes doctoring their food diaries. A 'food diary' is supposed to act as an inscription, in documenting each day's actual consumption. However, as in the scallops domestication case described by Callon in his landmark study, the gymnasts have mixed responses to aligning themselves to the plan set out by the scientists. While some agreed with the scientists' reasoning that a proper diet is necessary to training and competing well, and aligned themselves to this task accordingly, others rejected this and therefore *intéressement* (Callon, [1986](#)) did not occur.

Natalie's and Amy's experiences highlighted the difficulty of making the internal workings of the body visible,

a difficulty that technology is potentially able to solve. For example, the technology of testing blood can reveal severe problems such as low iron. In such a circumstance, the technology acts as an intermediary in revealing the make-up of the blood and its deficiencies. By contrast, without such an intermediary there is no way for the nutritionist to know the precise food consumed by gymnasts short of following the gymnast around and observing exactly what they eat. The literary device of the food diary is created in order to make food intake visible; however, it fails to work because the gymnasts fail to enrol it. In a very extreme example of overcoming this difficulty, Johns (1998) described how in his study he discovered an incident where some gymnastics coaches physically locked gymnasts in their hotel rooms while away on tour so that they could police the gymnasts' food intake.

Non-enrolment

The majority of discussions about sports scientists and coaches assume from the outset that it is the coach and gymnast who can learn from the sports scientist. It is assumed that the scientists have specialist knowledge which it will benefit the coach to learn. However, coaches with great confidence in their knowledge often did not enrol sports scientists because they had previous experiences of scientists interfering with their programmes in a negative way. For example, Anna, a women's coach, described how one of her athletes visited a sports psychologist in order to reduce her fear of performing a new skill. The psychologist made suggestions to Anna to assist the gymnast, which Anna, using the knowledge derived from her coaching experience, believed to be absurd. Consequently, Anna made a deliberate decision not to enrol any other psychologists into her programme. Liam, another women's coach, agreed with Anna's view that his own psychology training was sufficient and that enrolling a psychologist could in fact confuse the issue: 'I'm not a great believer in it. I think that sometimes psychology can make you think too deep rather than thinking about what you actually need to do.' Like the medical professionals in Mol's (2002) study described earlier, Anna and the psychologist came to the gymnast's problem with two different sorts of training, which resulted in differing understandings about the problem. Anna's coaching knowledge leaned her in a different direction from the psychologist with specialist psychology knowledge. In

confirmation of Anna and Liam's opinion that they had sufficient psychological knowledge on their own, Cote et al.'s (1995) study of the coaching skills of seventeen elite gymnastics coaches found that the ability to prepare gymnasts psychologically for competition was considered a standard skill.

My New Zealand study also found that lack of enrolment of sports scientists by coaches came about because, as in both Anna and Liam's cases, coaches have often studied sports science in order to gain their coaching qualifications. They possess the academic knowledge that legitimises the sports science profession (Abbott, 1988). In New Zealand all coaches need to have attended some short sports science sessions in order to be permitted to coach, a practice that is policed at competitions. Many have either a Bachelor of Physical Education or a coaching qualification which will have required them to pass sports science courses. Coaches who had studied in other countries were often even more highly qualified. For example, there are now a large number of coaches in New Zealand who received qualifications under the former Soviet-run system (Kerr and Moore, 2015). These coaches were required to attend four to six years of university, where they passed numerous courses in sports science disciplines as well as specialist gymnastics courses. These coaches often resist enrolling specialist sports scientists as they believe their own knowledge to be equal to or greater than many New Zealand sports scientists. For example, Amy, a trampoline coach, described how, although she enrolls nutritionists to give talks to her trampolinists, she monitors their eating and their food diaries as she describes herself as having qualifications in this area. Similarly, Jessica, a women's coach, described how she saw no need to enrol a sports psychologist as she majored in psychology at university.

The strongest example of how coaches may have identical knowledge to sports scientists, causing coaches to resist enrolling scientists, occurred in the area of biomechanics. Judy, a biomechanist and women's coach, described the crossover between the work of the artistic gymnastics coach and the biomechanist to be a 'grey, murky area', with the two roles having many similarities. This became very apparent through the lack of enrolment of a biomechanist, Jim, who happened to have offices connected to a women's and men's artistic gymnasium and was keen to be enrolled in the

programme on a voluntary basis. Jim described how he had found the elite coaches in the club to be uninterested in his help and would not enrol him, whereas the lower-level coaches were the opposite. Jim demonstrated how, through using his computer, he had assisted a non-elite coach with teaching a gymnast a very difficult skill. Jim and the coach used a method of trial and error. The gymnast would attempt the skill, then Jim would video the attempt, take the footage back to his computer, analyse it, compare it with other top athletes, then come back to the gymnasium and suggest corrections. The gymnast would try it again, and Jim would repeat the process until they succeeded. Although ultimately Jim's method resulted in the gymnast eventually learning the skill, this approach contrasted very strongly with how a very experienced and successful elite coach, who had coached world and Olympic medallists, taught the skill. The experienced coach directed the gymnast to perform a number of carefully crafted 'lead-up' drills before attempting the skill. He changed the gymnast's conditioning programme to ensure they had the necessary strength and flexibility to perform the move. Then the gymnast worked through a number of 'progression' skills, until finally attempting the skill with the coach assisting, and then by themselves. Cote et al. (1995) described this as the dominant method used by coaches to teach gymnasts new skills. A priority of this system is the fact that the gymnast is safe when attempting the skill for the first time. By contrast, when Jim's gymnast attempted the skill, he landed very painfully a number of times. Despite this, because Jim was successful in teaching the skill, he made the assumption that this ability would be a useful tool for the elite coaches and was surprised they did not want to work with him and learn from him. He was not aware that the elite coaches felt they already had the knowledge that he wanted to provide. This led to Jim losing respect for the coaches in assuming they did not want to learn from him, and the coaches losing respect for Jim in assuming he did not want to learn from them.

In this final example, the coaches and the biomechanist approached the situation with very different sets of understanding and produced gymnastics through very different actor-networks. Each utilised different technologies that produced different outcomes. The biomechanist used video plus specialist computer software, while the coach used a range of equipment from the gymnasium. The different understandings, and the resultant actor-networks that each

professional produced, meant that neither network was able to extend to enrol the other.

Conclusion

This chapter introduced the work of one of the most prominent ANT theorists who works in the area of health and medicine: Annemarie Mol. This chapter found Mol's (2002) work to be very useful in a sporting context for examining how medical practitioners bring different understandings to their work, which leads to differing outcomes for athletes, including the 'performance' of particular diseases or injuries. This chapter used Mol's work to examine the use of alternative practitioners in Pike's (2005) study of rowers in the UK. The rowers were found to adopt the sport ethic strongly and both adopted and resisted the bio-medical model when seeking medical treatment, which led to them at times accepting the advice of certain doctors while rejecting that of others. In particular, the rowers were found to favour the use of alternative practitioners owing to their lack of use of the bio-medical model, which resulted in the athletes being able to be active in their treatment rather than being treated as machines or commodities to be fixed. The athletes further appreciated the way the alternative practitioners adopted a holistic understanding of the body rather than focusing on specific agents as problems. In doing so, these practitioners deliberately went against the bio-medical paradigm.

Mol's (2002) work was also of interest because of its demonstration of ANT methodology. As previously discussed, methodology is central to the use of ANT, given the emphasis on including the non-human and human and the inclusion of a detailed description that acts as the entire explanation for a phenomenon. In this chapter the second case, examining gymnastics in New Zealand, demonstrated the ANT methodology at work, since ANT methods were adopted from the outset. This case describes the actions of the gymnasts and coaches along with any non-humans that were identified as significant, in order to understand why particular sports scientists were enrolled into the gymnastics actor-network while others were not.

Both the studies examined in this chapter identified one of the central issues in sports medicine: the boundaries between the different professions. While Theberge (2008) uses

Abbott's work on professions to examine this issue in relation to the integration of chiropractors into the line-up of sports medical professionals, in this chapter I suggest that focusing on the different understandings and the concept of enrolment can be equally fruitful in understanding how different professions become part of a particular field. The ANT emphasis on the enrolment process rather than individual beliefs shifts the focus to why action occurs or does not occur, and therefore why a particular field stabilises or changes.

In the case of sports science, it would be easy to assume that enrolling scientists into the sports training environment would be unproblematic. As Safai (2003) points out, sports scientists are specifically trained to rehabilitate sporting bodies and to assist them to work at their fullest potential. However, this chapter reveals how performance enhancement is an insufficient motivation for ensuring the enrolment of scientists by athletes and coaches. In both studies, participants were found to hold strong views that did not correspond with those of the sports scientists and prevented enrolment. The first study found that rowers opted to enrol alternative practitioners who were not as strongly attached to the bio-medical model in order to adhere to the sport ethic. The second study found that gymnasts and trampolinists, and their coaches, did not have enough confidence that the scientists were sufficiently versed in their sports to believe that enrolment would have any effect. These findings suggest that the assumption that athletes are now commonly surrounded by a competent medical team that proves crucial to their performance success is questionable. Instead, this chapter suggests that athletes and coaches make varied decisions based on their own actor-networks, which include individualised sports science training and perspectives. Consequently, the enrolment of sports scientists is highly unstable and can involve unexpected scientists.

6

Technologies for judging, umpiring and refereeing

In many sports, referees, umpires or judges are placed under immense pressure to make accurate split-second decisions that determine or contribute to the outcome of the sporting competition. In some sports, such as figure skating or gymnastics, the judges are responsible for the entire score. In other sports the referee or umpire has the ability to make field-of-play decisions that significantly contribute to, or in some cases may determine, the outcome. In order to function effectively such decision-makers must have full knowledge of the rules of the sport and be able to apply their knowledge in split-second decisions made under often very stressful conditions. If they make the wrong decision, they are often blamed for the outcome of the game.

Given the pressure that these individuals face and the importance of ensuring accurate results, several sports governing bodies have attempted to increase the accuracy of officiating decisions through implementing new technologies in their sports (Woodward, 2013). These officiating technologies, often based on video systems, allow movements to be replayed and judgements to be confirmed or reviewed. In some cases these systems have been developed specifically for an individual sport, but in other sports the push for technological intervention has come from commentators and coaches who have access to more advanced technology than the referees themselves (Leveaux, [2010](#)). For example, the slow-motion replay that commentators make use of on television was available to commentators before it was available to referees.

This chapter considers the actor-networks of various sports that have enrolled technological devices for assisting with umpiring or judging. The cases of cricket, tennis and artistic gymnastics are drawn upon to examine how the actor-network of each sport is affected by the new technology. Each sport is followed beyond the point at which the governing body introduces the new technology, to look at how the new assemblage affects other, often unexpected, parts of the actor-network.

The translation from movement to score

The motivation for introducing technology stems from the aim of sporting competition. In order for a sporting competition to occur, the rules of every sport must have a method for determining a winner. In some sports, such as swimming or running, this is a relatively simple matter, with the winner being the person who completes a particular distance in the fastest time. In these sports the numbers describing the time taken to finish the race translate directly into a ranking system. These sports employ devices such as stopwatches and photo-finishes in order to determine an accurate and direct translation. Such devices obtain empirical data, then convert the data into a score without human intervention. For example, in swimming competitions, the moment swimmers touch the end of the pool, which is equipped with sensors, they can look up at the scoreboard to see their times. In races that are very close it is common to see all swimmers rush to look up at the scoreboard to see who won. This can be seen as an 'ideal' form of evaluation for sport, as the performance translates smoothly into a number in order to rank performers and establish a winner. This allows little scope for controversy, with the times recorded generally accepted as the correct outcomes.

However, in many other sports the rules include much greater complexity so a smooth translation is difficult to achieve. Determining the winner may involve factors such as whether they adhered to the rules, or even subjective judgements from human umpires or judges. Subjective judgements are not seen as ideal in sport, as they are perceived to be unreliable, so technology is often introduced in order to assist with the provision of reliable, empirical data.

In order to arrive at the correct results, a range of sports have introduced different pieces of technology. In all cases, the assumption is that the technology will act in a more reliable or accurate manner than a human performing the same role, or that the technology will provide more information to a human making the decision. Latour ([1992](#)) asserts that technologies can often be relied upon more than humans since they generally perform a repetitive, boring function without any interruption. Latour illustrates his argument using the example of a door hinge. He describes how humans can be notoriously unreliable at remembering to close doors after they have passed through them, which can, of course, lead to wind or rain

coming inside. He argues that one solution to this could be to employ a porter to close the door; however, the porter, being human, is likely to find the job very boring and tedious and will also require lunch breaks etc. in order to function. Another solution could be to place a sign by the door, reminding people to close it; however, people who may be absorbed in their thoughts or a conversation when they enter are not likely to pay attention to such a sign. By contrast, if the porter or sign were to be replaced by a door hinge that automatically closed the door, this would be a far more reliable solution. The door will be closed every time without the door hinge becoming bored, forgetful, requiring a break or requiring pay. While this example is very simple, it illustrates one of the fundamental arguments of this chapter: that delegation to non-humans can produce a more reliable result, or is assumed to be able to do so. In sport, the accuracy of the results of a game or competition is important in order for the sport to be deemed valid, but in many cases in sport humans cannot always provide reliable results, as in the swimming example described in the previous paragraph. Here the technology capable of determining the precise point when a swimmer touches the wall to finish the race is far more effective than a human. The human eye can easily distinguish between swimmers who are several seconds apart but is not able to determine the winner when the intervals are in fractions of a second.

Latour ([1991](#)) further argues that, when an actor-network arrives at a state of relative stability, it is usually due to the presence of a non-human ensuring that the network is functioning well. This is illustrated in the above example where, without the technology that provides timing differences to fractions of a second, it would be necessary to rely on the human eye to determine winners. In such a scenario it is likely that those watching the swimmers would disagree on which swimmer won the race if the swimmers finished the race at what appears to be the same time. Such a situation would result in many arguments and could result in rule changes regarding who is allowed to make the final decision about the winner, and where they should stand etc. In contrast, with the current technology in place, swimmers can be confident that the technology will reliably tell them who won the race, and there is no need to argue for any changes to how the sport is run in this area. Therefore, swimming has obtained a desirable form of stability in possessing a piece of technology that is able to reliably determine the winner. This is quite different from a

sport such as gymnastics, which instead employs large numbers of judges who must be constantly re-educated about rule changes in the sport. Gymnastics lacks the technology that swimming possesses, and so instead exists in a state of constant instability. The rules and regulations are formally updated every four years, with other changes also occurring on sometimes a monthly basis. But even in gymnastics, stability is possible at particular competitions owing to the presence of an inscription, a rule book known as the Code of Points that everyone at the competition agrees to follow.

Technologies utilised in team sports competitions

Thus far in this chapter, very little in the way of technologies for team sports have been referred to. Stopwatch-style technologies such as that used in swimming, and rule books as used in every sport are relatively simple types of technology that are easy to understand. But with the variety of types of sports, both individual and team, comes a variety of types of technologies that are used to ensure that the results of a competition are valid and correct. I will now discuss some of the more common types of technology utilised by different team sports.

Post-match

After a match is over, many sports employ an expert, often referred to as a 'citing commissioner' (Leveaux, [2010](#), p. 5), to review video footage of the game. Any incidents that are seen during this process can be viewed from multiple angles, and any offending player/s can be brought before the sport's judiciary or tribunal (Leveaux, [2010](#)). This technology is more likely to be utilised in team sports, where there are multiple players on the field. For example, in the sport of rugby union, where there are thirty players on the field at once, it is impossible for the referee to see the behaviour of all these players at all times. Here the use of the citing commissioner following the game has at times resulted in players receiving yellow or red cards, owing to the commissioner observing behaviours such as eye gouging or biting that were not observed by the referee during the game. These examples indicate that the use of the citing commissioner who reviews replayed footage is effective for identifying rule-breaking behaviour.

At the same time, from a legal standpoint, Nafziger (2004) notes the necessity of sports having clear regulations around the use of video footage. He describes a case where a rugby player had his suspension overturned by an English court because video footage had been used to determine that he should be suspended, but the player had had no opportunity to view and comment on the footage before the decision to suspend him was made. Nafziger's emphasis on the need for regulation acknowledges the usefulness of considering officiating technologies within the network of the sport in which they operate rather than as standalone items. The policies and regulations around how video footage is used to make decisions can be as important as the technology itself.

During the match

Some sports use video replay systems during the match. In several sports a system is employed where the referee may opt to use a third party to make a decision if they not feel they were in a position to make an accurate call. Some examples are a line call in tennis, the fall of a wicket in cricket and a try in rugby (Leveaux, 2010). A problem with viewing video during the match is that it requires the brief suspension of the match while the decision is made, which can be frustrating for players and spectators alike (Nafziger, 2004). The following case study discusses this issue in more detail. Typically, the third party is a referee stationed outside the field of play who has access to video footage that allows the viewing of the situation from a variety of angles. A rugby referee in Leveaux's study (2010, p. 5) describes how he is only able to use the third umpire in certain situations, and then must be very specific in what he requests of them:

I can only call to the video ref in certain situations, for example, about a try being scored with regards to matters relating to the grounding of the ball or if I might be undecided if a breach of the rules occurred in that play, such as a forward pass – and when I do use the video ref(eree) I have to be explicit in what I ask, e.g., was so and so in an off-side position when receiving the ball or with correct grounding of the ball in a try.

This referee's comments indicate how the rules are carefully spelt out as to the use of the video referee, and do not allow the referee to use them in a way that may hold up the game or require clarification. Sports vary in the processes for consulting the third referee or umpire and as to whether players can also request their assistance. For example, in tennis, players can

consult the third umpire but are only permitted two incorrect challenges per set (Leveaux, [2010](#)).

Other sports such as taekwondo do not use any form of third umpire or video referee during the match, as the time taken to pause and consult is too disruptive to the sport (Leveaux, [2010](#)). This highlights how the different actor-networks of sports influence whether a piece of technology is utilised or not. In taekwondo, where two athletes physically fight each other, the necessity for the match to continue unimpeded is far greater than the need for a video referee. Similarly, the concept of allowing a player to challenge a call, as in tennis, was seen by the referees in Leveaux's study as open to far too much exploitation by players to be considered appropriate.

However, the taekwondo referees do view the use of a video replay system to be useful during a 'sudden death' match. An example the referees described to illustrate this was when both fighters score a kick at what appears to be the same time (Leveaux, [2010](#)). This scenario resembles the swimming example discussed earlier, where technology is useful for determining what the human eye has difficulty seeing. In the taekwondo example a video replay would allow pausing of a video reply at the exact point of the kick, making it possible to determine which athlete scored first.

Behind-the-scenes technologies

One of the central claims of ANT is the importance of following all the strands in a network. Latour ([1996](#), p. 371) describes how society has 'a fibrous, thread-like, wiry, stringy, ropy, capillary character' where understanding the workings of the network involves following all the capillaries. In researching in this manner, action is revealed that is often not noted in traditional sociological analyses that focus on single issues or large-scale phenomena and miss the smaller capillaries. In sport there is a range of actions that could be argued to make up these smaller capillaries. For example, when watching a sport, the spectator sees only the actual performance by the athletes. Hidden from view are a complex array of organisational factors that make the sport run, which often include a variety of technologies. One type of technology that makes sport run is the systems put in place to schedule tournaments, including the selection of and scheduling of umpires and referees. In examining tennis,

Farmer, Smith and Miller ([2007](#), p. 187) describe how 'Behind the scenes, an intricate system of hierarchies, experience, and qualifications dictates the proper assignment of umpires to tennis matches.' They describe how the scheduling of tennis umpires in a large tournament can be very complex, with up to eighteen matches being played simultaneously with up to ten umpires per match, and with the need to take into account nationality, player histories and experience. In order to facilitate such complicated scheduling, the United States Tennis Association (USTA) developed a software package. Unfortunately, this software did not prove to be a success for a range of reasons. One factor that limited the software was it was created specifically for the US Open, not taking into account that different tournaments have different scheduling practices. Additionally, the software did not consider the global commitments of the umpires. Finally, in the event of a rain delay, the software could not adapt itself to the new conditions, but rather required the schedule to be rewritten completely from scratch. With this as an example, one of the goals of this chapter is to open the black box and examine technologies that more commonly exist behind the scenes.

Anti-programmes and 'networks' within the study of technology and sport

In one of his landmark articles, 'Technology is society made durable', Latour ([1991](#)) introduces the concept of anti-programmes. These are any programmes that work counter to the desired programme. In the case of tennis, the 'programme' is for a tennis tournament to occur. For this many things need to be in place including umpires, who need to be specifically scheduled. In order to make this happen, software is added to the actor-network of tennis. However, as discussed above, Farmer, Smith and Miller ([2007](#)) describe how the original software that was enrolled was a failure because it was interrupted by several anti-programmes: the differing practices of other tournaments, the global commitments of tennis umpires and the rain. The remainder of the article details the creation of a new software that was written in order to overcome these difficulties. The article illustrates Latour's ([1991](#)) argument that actor-networks can become ever more complicated and extensive as anti-programmes are identified and overcome.

With this in mind, the ANT theorist's role is to follow and describe the actor-network. It must be remembered, however, that the ANT understanding of 'network' is somewhat different from the mainstream. Latour ([1999a](#)) describes how 'network' came into use in ANT studies prior to the invention of the worldwide web, yet with the ubiquity of the web the word has come to be understood as the creation of instantaneous ties and connections. Yet Latour argues that this is the exact opposite of the original intention. He argues that the use of 'network' was intended to refer to a concept similar to Deleuze's 'rhizome', which refers to 'a series of transformations' (Latour, [1999a](#), p. 15). The word 'transformations' emphasises Latour's argument that bringing things together produces new assemblages and forms that have different qualities from the disparate parts that combined together. Therefore, the ANT theorist's role is to examine these transformations through following the network, with an understanding that every point in the network can connect to another point and form new associations. The following examination of Hawk-Eye technology aims to demonstrate how the actor-networks that exist in cricket and tennis have facilitated a variety of outcomes through the way that they have connected with Hawk-Eye. This case particularly emphasises the transformative nature of the network.

Case study: the use of Hawk-Eye in cricket and tennis

In terms of its history, the case of Hawk-Eye demonstrates one of the most significant connections currently in existence in sport: the sport-media connection. This connection is immediately apparent through the way that Hawk-Eye was developed almost simultaneously as both a technology for enhancing the viewing experience for spectators and for improving the accuracy of officiating decisions (Hawk-Eye Innovations, [n.d.](#)). Hawk-Eye was first used in public in 2001 by UK's Channel 4, where it was introduced to enhance the coverage of the Ashes cricket series. While still under development it was trialled at the Davis Cup tennis tournament in 2002. Collins and Evans ([2012](#), p. 910) provide the following description of its workings:

Hawk-Eye is an example of what we call a 'Reconstructed Track Device' or RTD. RTDs use visible-light television cameras to follow the path of the ball and a procedure to filter the pixels in each frame. Certain pixels are taken to represent the position of the ball and others to indicate the position of the line or other features of the playing arena. The space

and time coordinates of these pixels are represented numerically and a statistical algorithm reconstructs the flight and impact point of the ball and crucial features of the playing area by combining information about the pixels in the different frames with information about the size of the ball, the physics of its distortion, the width of the line, and so forth. From these calculations, the system then determines what decision should be given – for example, should the ball be called ‘in’ or ‘out’?

This description explains how Hawk-Eye relies upon a particular actor-network of cameras, which are placed around the field or court and provide the data Hawk-Eye needs in order to reconstruct the exact movements of the ball. For the actor-network to work, and for this particular assemblage of disparate parts to transform and become useful, cameras need to be carefully placed to see the ball from different angles, and particular algorithms need to be integrated into the system. Then these separate parts to combine together to produce a device with unique capacities.

Spectators and umpires both find it desirable to be able to identify where the ball is in relation to other factors. For umpires, Hawk-Eye is useful for determining the correct call to make in cases where it can often be difficult for the umpires themselves to see to make the correct call. For spectators, Hawk-Eye allows more information to be given than may be provided by the television cameras alone. Indeed, for television viewers Hawk-Eye is particularly transformative. Viewers are provided with a ‘virtual reality graphic’ that consists of ‘either an image or a short video clip showing the path and impact point of the simulated ball’ (Collins and Evans, [2012](#), p. 910). With this clip, the viewing experience is transformed to become similar to the umpire experience, where viewers use the images provided by Hawk-Eye to make their own decisions on the match.

A range of sports, including cricket, tennis, football, snooker and badminton, have adopted Hawk-Eye (Singh Bal and Dureja, [2012](#)). Hawk-Eye has become part of a very large actor-network that incorporates these sports along with the assemblages that make up the umpiring processes of each sport, and the sport–media connection. It is beyond the scope of this chapter to examine the whole breadth of this extensive actor-network, so this chapter will focus on the introduction of Hawk-Eye as part of the umpiring processes of two sports: cricket and tennis. The [following chapter](#) will then examine the actor-network of sports media.

Hawk-Eye in cricket

The sport of cricket incorporated Hawk-Eye into the umpiring actor-network of cricket for test matches in 2009 and for one-day matches in 2011 (Steen, [2011](#)). Cricket took an unusually long time to adopt Hawk-Eye technology as part of its officiating process in international cricket, even though it had existed as a broadcasting tool since 2002. One of the most interesting reasons for the slow enrolment from an ANT point of view is the difficulty in determining how the umpire and Hawk-Eye should assemble together. Steen ([2011](#)) emphasises that, unlike technologies such as the stopwatch, which, as previously discussed, are designed to translate movement directly into a score, Hawk-Eye is not designed to work as a standalone device and it is not a substitute human. Instead, Hawk-Eye in cricket was designed to be part of a 'system of review' (Steen [2011](#), p. 1430). It is a piece of technology that was designed to 'enhance perception', and is quite different from technologies that 'take decisions' (Collins and Evans [2012](#), p. 907). Collins and Evans state: 'Where these technologies are used, the replays are usually reviewed by a newly created class of "off-field" officials who then advise the on-field officials.' This is exactly the case with Hawk-Eye in cricket, where a third umpire uses what is essentially an animated reconstructed replay of the incident in order to review the decision of the on-field umpire. Steen ([2011](#)) emphasises that Hawk-Eye's purpose is frequently misunderstood by the media, where he explains: 'The final decision remains with the on-field umpire – the decision is reviewed by, not referred to, the third umpire' (ICC, 2011, cited in Steen, [2011](#), p. 1430). This statement confirms that Hawk-Eye is only permitted to be enrolled as a way to assist the decision-making process, not to determine any actual outcomes. McFee ([2004](#)) argues that assuming technologies can do the work of humans better than humans can be problematic, because technologies lack the capacity to explain. The set-up of Hawk-Eye prevents this problem because the work of making a decision is not delegated to Hawk-Eye itself; instead, a new assemblage of human-Hawk-Eye is produced that is used to support a decision made by a human. The assemblage is acknowledged as effective through the praise it has received for improving umpires' decisions in cricket (see Steen, [2011](#)).

However, as Latour ([1991](#)) notes, new forms of technology can also generate unexpected consequences. Such

consequences reflect the notion of the network as transformative, where connections between parts of the network can transform the way action takes place or generate new forms of action. In the case of Hawk-Eye, Steen (2011) notes how the technology has become utilised as a method of surveillance of cricket umpires. In this example Hawk-Eye can be seen as not only a device for assisting umpiring but also as a method of transforming the practice of umpiring into a monitored act. By noting how many times the third umpire views Hawk-Eye, the ICC can evaluate various umpires' skills. Through using Hawk-Eye in this manner, the ICC found that umpires believed to be the most skilful really do make good decisions, compared with those umpires who are believed to have less skill. In the 2011 Cricket World Cup there were a total of 182 referrals to Hawk-Eye across forty-nine games, where 20.33 per cent led to reversals in decisions. In tracking which umpires had their decisions reversed, Steen (2011, p. 1437) described:

The vaunted emerged with heads high – Dar was challenged 14 times and not once reversed, Billy Bowden (six challenges) also defied contradiction, Taufel was proven right in 10 of 12 reviews and Steve Davis (perfect after his first 10) affirmed his growing reputation. At the opposite end of the scale, reservations about Asoka de Silva (four reversals in his first four reviews, which led to him being dropped for the final group matches) and Daryl Harper (seven in 14) had been underscored.

Steen's argument here is that the monitoring performed through Hawk-Eye confirmed Dar, Bowden and Taufel as good umpires, and de Silva and Harper as not so skilful. The findings of the differences between umpires reveal two different aspects of Hawk-Eye. First, as discussed, these findings reveal the way that technology can affect sporting practice in unexpected ways. While the goal of utilising Hawk-Eye is to improve umpiring decisions, its deployment has revealed that it is also useful for demonstrating the ability level of different umpires. The actor-network further expands with the addition of the actant, the ICC, which can now select umpires appropriately, which may result in an improved level of umpiring in the long term.

Second, given that Hawk-Eye is a hybrid system and not a substitution for a human, the ability of a human to use it correctly becomes crucial. In this example, the actor-network extends to the umpires needing to acquire new skills. Steen (2011) discusses how cricket officials are understandably aware

of the need for good umpires to work with Hawk-Eye and have therefore adopted a system where perceived 'good' umpires are rotated throughout a test match so that they take turns being on the on-field or third umpire. This rotation demonstrates how the introduction of a new piece of technology in sport can be very disruptive, requiring significant reworking of the actor-network. In this case the hybridised nature of Hawk-Eye resulted in the need for a third umpire, which further resulted in the anti-programme of insufficient umpires with the necessary skills. This then led to a further expansion of the network through the need for introduction of a rotation system to ensure that umpires are used equitably and effectively.

This example has implications for sports policy-makers who intend to enrol new pieces of technology. Through viewing the case as an actor-network, we can see the way that introducing a new piece of technology may also result in the need for restructuring or further resourcing. The example highlights how, although new technologies can improve sporting practices and processes, they can require extensive networks around them in order for the technology to be used for its maximum effectiveness. In the case of cricket, significant work has been performed by the ICC over several years in order to finalise an effective structure, but this work was not foreseen prior to Hawk-Eye's introduction.

Earlier it was argued that the actor-network of cricket acknowledges Hawk-Eye as a hybrid system rather than expecting it to be a full replacement for a human umpire. However, there are suggestions that the hybrid format can be problematic. For example, Mahmood et al. ([2012](#)) suggest that it would be more effective if the human element were eliminated and an entirely automated system produced instead. This would be akin to Latour's ([1992](#)) example of the speed bump replacing the human policeman. Mahmood et al. provide two arguments for the effectiveness of removing the human element through identifying two anti-programmes at work: game time lost in consultation, and the problem of human error.

In terms of game time, the use of the third umpire is supposed to take only thirty seconds, but in reality it more often takes up to a minute for them to reach a decision. This is understandable, given the role of the third umpire in reviewing

the footage provided by Hawk-Eye and coming to a conclusion. However, this amount of time is argued to be enough to break a player's concentration and therefore acts as an anti-programme, disrupting the player's performance and the flow of the match. Mahmood et al. (2012, p. 12282) describe cases where the referral to the Hawk-Eye system has resulted in altered performance:

We witnessed that several bowlers bowled brilliantly before a referral, by preventing the batsmen from scoring lots of runs. However, after the referral, the same bowlers lost their rhythm, hence leading to an increased scoring rate. Similarly, there were several batsmen who were scoring lots of runs before a referral, but after a referral, their scoring rate decreased, or they got out, due to a disruption of their rhythm.

The result here of a distinct change in performance, is a highly undesirable outcome from both the players' perspective and for spectators. A drop in performance is obviously undesirable for players, and for spectators the potential excitement offered by high scores and continual play is disrupted. Again this is an unexpected consequence of the introduction of a new piece of technology, with potential follow-on effects to other parts of the network: in this case, player performance and resultant spectator interest.

This argument points to the lack of perspectives that have been adopted in examining technology in sport. While theorists have examined technology as adopted by athletes and its impact on performance (see, for example, Butryn, 2003; Haake, 2009; Magdalinski, 2009; Tangen, 2004), the lack of any perspectives that utilise the idea of sport existing as an actor-network has meant that there has been very little consideration of how the integration of technologies for other purposes affects athletes. An exception is Butryn (2003), who notes the impact that the large 'jumbo-screens' placed around the Olympic athletics stadium have on performance. Butryn (2003) and Mahmood et al. (2012) leave little doubt that the technologies that are introduced to improve the watching of sport (by both spectators and umpires) have a significant effect on athlete performance. Yet interestingly providing ways to produce programmes to overcome these anti-programmes is viewed as part of the role of the athlete's coaching and scientific team rather than a wider concern. This is in contrast to an issue such as doping, which is commonly understood as a problem for all parts of sport. Further research about the impact of decisions about the use of officiating and media technologies

on athlete performance that acknowledges the connections between these two areas of the actor-network would be of benefit.

The second argument of Mahmood et al. (2012) against the use of technology that exists as a hybrid is that of human error. Both Steen (2011) and Mahmood et al. (2012) discuss the problem of human error as evidenced by cricket being a sport with a long history of contentious umpiring decisions. Steen (2011) and Collins and Evans (2012) describe numerous instances of questionable umpiring decisions as a way of justifying the need for a technologically assisted system. In other sports the reliability of the human umpire, referee or judge has also been raised. Nationalistic bias (Ansorge and Sheer, 1988; Dixon, 2003; Ružena, 2000), expectations of success (Findlay and Ste-Marie, 2004; O'Brien, 1991) and evidence of genuine mistakes (Ste-Marie, Valiquette and Taylor, 2001) have all been found at various studies of judging. In contrast to human fallibility, technology is assumed to be free of these sorts of mistakes, since it is not able to be persuaded. This reasoning mirrors the argument made by Latour (1992) that non-humans can be more reliable than humans. However, a counter-argument put forward by Collins and Evans (2012) opens the 'black box' of the Hawk-Eye system by positing that the system is seriously lacking in its reliability. In this sense, it is similar to the human judges being subject to making genuine errors. Collins and Evans describe the immense difficulty in determining decisions regarding leg-before-wicket (lbw). In an lbw situation the umpire must make a call based on where the ball would have gone if it had continued uninterrupted, which is extremely difficult. Given the difficulty of the decision, Hawk-Eye is often used to confirm lbw decisions, but it is also unable to calculate this with complete accuracy. Collins and Evans (2012, p. 912) describe how, when reconstructing the path of the ball, Hawk-Eye includes a 'zone of uncertainty': if the ball is found to land in that area, the third umpire cannot overrule the on-field umpire's decision. This lack of accuracy demonstrates that despite the belief that technologies can produce more accurate and reliable results than humans, in the case of Hawk-Eye the technology is not completely reliable. The question of reliability becomes more complicated and interesting when the use of Hawk-Eye in cricket is compared with its use in tennis.

Hawk-Eye in tennis

Tennis adopted the Hawk-Eye system earlier than cricket. It was first used for broadcasting in 2002, and 2006 was the first time the system was used for umpiring purposes in a professional tennis match (Fischetti, [2007](#)). Clarke and Norman ([2012](#), p. 1765) describe how Hawk-Eye is used in tennis, which is quite different from how it is used in cricket:

In tennis, it displays a schema of the court lines along with a mark where the ball is believed to have bounced, along with a decision on whether it was in or out. (Interestingly, the path of the ball is never shown with any error bounds: the public and players appear to accept that it is exact and infallible.) The interesting development in tennis was that the players, not the umpires, under certain conditions were allowed to challenge the umpire's decision by referring to Hawkeye. If Hawkeye sided with the appealing player, the umpire's decision was reversed.

This quote outlines two clear differences between the actor-network of tennis and that of cricket. First, in tennis it has always been the case that the players are allowed to challenge the umpire's decisions and refer them to Hawk-Eye, which was not originally the case in cricket. The implications of this difference will be discussed later. Second, in the case of cricket, there is an awareness of the existence of the zone of uncertainty by both the officials and the spectators. During a cricket broadcast, commentators discuss the zone of uncertainty when the Hawk-Eye reconstruction is shown, leading to spectators having a greater understanding of why decisions are made in the way that they are. However, in the case of tennis a different actor-network exists, in which the International Tennis Federation (ITF) has not seen fit to acknowledge any zone of uncertainty. It remains an unacknowledged anti-programme. The reconstructions produced by Hawk-Eye are presented as accurate, with the ball conclusively being in or out. Therefore, spectators have no sense that there may be apparent inaccuracies in tennis as there are in cricket. Collins and Evans ([2012](#)) argue that the lack of acknowledgement of a zone of uncertainty is problematic as it allows incorrect decisions to be made that are understood to be correct. They argue that the ITF should introduce similar rules to cricket that acknowledge that Hawk-Eye is not 100 per cent accurate and note that a zone of uncertainty exists. They suggest that part of the problem is identical to the one already discussed in cricket: the assumption that Hawk-Eye is a standalone device that can produce the 'correct' answer, rather than acknowledging that

Hawk-Eye works as an assemblage with a human. They argue that if Hawk-Eye were understood as a device to assist umpires to avoid making mistakes, rather than being seen as an unarguable voice of authority, more accurate line calls, and consequently more effective operation of tennis, would occur.

Collins and Evans ([2012](#)) argue that the actor-network that makes up tennis is less effective for producing accurate results than the cricket actor-network. However, as previously described, it also points to the way that the cricket actor-network has been forced to become larger and more complicated as a result of acknowledging the existence of a zone of uncertainty. By contrast, tennis has not acknowledged the limitations of Hawk-Eye, which means it has been possible to keep the umpiring actor-network 'black-boxed' without seeing the need to extend the network. The anti-programme of the zone of uncertainty remains unacknowledged, and therefore the need to extend the network to overcome the anti-programme is not seen as necessary.

As briefly mentioned earlier, another difference between the cricket actor-network and the tennis actor-network is the inclusion of permission for players to challenge the umpire's decisions and refer the decision to Hawk-Eye. A result of this ruling is that players whose actor-network includes the ability to understand how this ruling can work to their advantage can quite deliberately benefit. In tennis players have been able to challenge a call and ask for it to be referred to Hawk-Eye from the outset, whereas with cricket, allowing players to initiate a challenge has only recently been introduced. But despite this, many tennis players do not use their ability to challenge the call to their best advantage. Players are allowed a limited number of challenges: up to three unsuccessful challenges in a set and four if it reaches a tie-break, but when they choose to use these challenges can make up to a five per cent difference in the outcome of the game (Clarke and Norman, [2012](#)). After using dynamic programming, to analyse the effect of challenging calls at particular times during matches, Clarke and Norman ([2012](#), p. 1771) conclude:

the optimal strategy depends on the importance of the point – the more important the point in winning the set, the more likely a player should challenge. Since importance increases in later points of close games, and in later games of close sets, this implies that players should save their challenges until needed deeper into close games and sets. However this must be balanced against the possibility that another challenge opportunity

may not arise. A player well ahead will have more chances of challenge opportunities should his opponent make a comeback, and so might be sensible to save his challenge. But a player well behind may not get another opportunity, so should be more aggressive with his challenges.

Clarke and Norman ([2012](#)) suggest that tennis players should deliberately adopt a strategy for when to challenge points during a match. However, this would also mean that traditional tennis coaching and training should be altered to include education about this issue. This reflects the same idea as that already identified in the discussion about cricket, that the effects of technologies that improve the watching of the game can also have an impact on other parts of the actor-network of the sport that might not appear connected. In this case, understanding the workings of the Hawk-Eye was found to make a significant potential difference to a tennis player's ability to win the match; and it would therefore be useful to integrate it into tennis training and coaching. Again, the Actor-Network Theory approach demonstrates how connections can exist between areas that may appear disparate. This is important for sports policy-makers when considering introducing new technologies into the sport.

Case study: IRCOS in artistic gymnastics

Just as cricket has been identified as a sport with a long history of contentious decisions, so too has the sport of artistic gymnastics. Artistic gymnastics has had judging scandals on a regular basis almost since its inception. There are numerous cases of gymnasts and coaches feeling they were judged unfairly or incorrectly for a range of reasons. One of the most famous occurred at the Athens Olympics in 2004, when Paul Hamm was incorrectly crowned Olympic champion as a result of a judging error.¹ In a reflection of the emphasis on the human as opposed to the non-human in the study of sport, there have been several studies examining the process of judging. Judging studies examining artistic gymnastics, rhythmic gymnastics and figure skating have found examples of judging errors as a result of nationalistic bias (Ansoorge and Sheer, [1988](#); Dixon, [2003](#); Ružena, [2000](#)), expectations of success (Findlay and Ste-Marie, [2004](#); O'Brien, [1991](#)) and genuine mistakes (Ste-Marie, Valiquette and Taylor [2001](#)). Improvements in technology and the close sponsorship of the Swiss company Longines led to an attempted solution to the problem of judging inaccuracies or bias. At the 2005 World

Championships, a video replay system developed by Longines, known as IRCOS (Instant Reply and Control System), was used for judging men's and women's artistic gymnastics. It simply allowed some of the judges to replay the routine, or parts of the routine, to confirm exactly which movements the gymnast made. Alyssa, a New Zealand gymnastics judge who has used the system while judging at several international competitions, explained:

It's quite a big screen, obviously. You have two screens; over here you get a list of the competitors, so you can click on the competitor to bring up the screen. And then you get, well, it's like a DVD player, you can go forwards, backwards, slow motion, whatever you want to do, it will do first six second session, second six session, etc. Especially in bar, you don't want to watch the whole minute routine so you hit the last six seconds or the first six seconds because you want to obviously see a turn. So you can choose whereabouts. It's quite easy to use. Then you obviously get the replay here. Then here you get the judges scores.

Unlike in cricket and tennis, where all umpires have similar roles, in artistic gymnastics there are two roles that a judge can hold. First, a judge may be responsible for judging what is termed 'difficulty', which means they determine how many movements a gymnast performed during their routine and decide whether the gymnasts should receive the marks for demonstrating these skills. Second, a judge may judge what is termed 'execution'. Execution judges deduct marks from a score of ten for any errors in performance. A gymnast's final score is then calculated by adding the difficulty and execution scores together.

Startnummer	Score	Videozeitpunkt

1A drawing of the IRCOS screen by Alyssa

When it was implemented, the IRCOS system was designed to be used only by the difficulty judges and not by the execution judges. Difficulty is the area of gymnastics where objective evaluation is a possibility. When judging difficulty, the judge is determining whether the gymnast performed a skill or not. As in ice skating, it is 'a matter of verifiable empirical fact whether skaters performed the required jumps and do so without falling or stumbling' (Dixon, [2003](#), p. 105). In gymnastics each skill has very particular guidelines describing whether it has been performed correctly. For example, on rings any holds must be held for between one and

three seconds to be counted. Thus, whether a gymnast performed this is easily confirmable through watching a video and timing the hold. Yet, as described in the previous section, human judges can make mistakes.

In contrast, as discussed in relation to cricket, it is often argued that technology is more accurate than a human (see, for example, Mahmood et al., [2012](#)). This assumed reliability of technology led to the International Gymnastics Federation (FIG) greeting IRCOS with enormous enthusiasm. IRCOS was expected to have the ability to avoid mistakes of the sort that occurred in the Olympic Games in 2004 where the wrong gymnast received the gold medal owing to a judging error. It allows the difficulty judges the chance to check that they have made correct judgements, and it allows coaches to protest and use the video footage as evidence of perceived incorrect judgements. After each routine the difficulty judges are immediately able to view either parts or the whole of the routine again on a laptop to confirm they have made the correct judgement. If a coach or gymnast disagrees with their difficulty score, they can issue a protest and the routine will be reviewed by other judges to ensure the mark is 'correct'.

As with Hawk-Eye, part of the reason that IRCOS is effective is because it is a hybrid system that utilises both a human and technology in order to make a decision. Its hybrid nature allows accountability because there is an inscription created in the form of a video that allows the routine to be circulated among other judges. As a result, the score can be checked and confirmed, yet explanations can still be provided. However, in order for this to occur, the judge must enrol the technology; the video must become an assemblage with the judge. Interviews with judges revealed that there were variations in how often judges made use of the replay system. Stuart, a judge of men's gymnastics, described his experience of using the system at international competitions:

Roslyn: So how often did they use it at Worlds (World Championships)?

Stuart: Quite a bit, I suppose.

Roslyn: Every routine, every tenth routine?

Stuart: In rings, if you don't hold a skill for a second it doesn't count, if you hold it for a second it does count. So, if it's not going to be counted, they'd probably look at it then. If it's between one and two seconds, they won't look at it because they can see it's counted,

that's their job. And generally if you say it's '1001' (counting) they'll give it credit without looking at the video. But if it's really short, that's where they'll look at the video to get the proof ... And probably looked it 20–30 per cent at the time. At a guess.

Stuart's description suggests the men's judges perceived the system to be a useful tool and enrolled it regularly. Stuart believed it assisted with ensuring accurate judgements. Alyssa's comments, from women's gymnastics, were quite different:

Alyssa: I didn't use it to make any judgements at all. But we used it on vault to confirm a decision we'd made ... both times we were right.

Roslyn: So it wasn't used that often?

Alyssa: No. They used it a few times on bars just to check the completion of something ... And I don't know if they used it at all on beam ... But on floor we used it later to confirm what we thought.

Alyssa described how the system was only enrolled occasionally to confirm a judgement they had already made. However, she was clear in saying that she did not require the system and that she was capable of doing her job without the system. Unlike Stuart, Alyssa did not suggest the assemblage was particularly worthwhile.

The quotes from the judges reveal that, even when international sporting bodies enrol technologies with the intention of improving judging performance, it is a mistake to assume that the judges or referees will enrol the device. Both Stuart and Alyssa emphasised that, in their view, their own knowledge meant that they did not need to enrol IRCOS. This reflects the argument that was raised earlier in the book with the French kayakers: that it is a mistake for sporting bodies to assume that a piece of technology will be utilised purely because their own empirical evidence suggests it will be an improvement. Just as the athletes trusted their own knowledge of kayaking, which made them suspicious of the newly designed kayak, the judges here similarly trusted their own training, which meant that IRCOS was not utilised fully.

Conclusion

Through examining officiating technologies in cricket, tennis and gymnastics this chapter has demonstrated how acknowledging that sport exists as an actor-network can be

significant for sporting bodies. The officiating technologies examined in this chapter were introduced into their respective sports with the goal of improving umpiring and judging standards. In all three cases the particular technologies included an aspect of video replay that meant the performances of the athletes could be repeatedly seen and examined in detail by suitably qualified umpires or judges. All three sports also chose to implement hybrid systems, which exist as a technology and human working together in order to produce the most effective outcome, with literature arguing that both technology or humans on their own can be problematic.

In all three cases, following the network revealed unexpected consequences that were not foreseen by the respective sporting bodies. In cricket the use of Hawk-Eye revealed the respective skill-sets of various umpires, which in turn necessitated the inclusion of rotating systems for umpires within matches. Perhaps more significantly, Hawk-Eye was argued to affect player performance strongly. This last point is particularly interesting, with performance enhancement being touted as one of the primary reasons for adopting technology in sport. This chapter, along with Butryn's (2003) work, demonstrates how officiating technologies can have a negative effect on sporting performance. In cricket, the delay in waiting for the outcome from Hawk-Eye can have a detrimental effect on performance, while in tennis, players who do not use their permission to challenge calls are not maximising their performance. But the potential negative effects do not seem to be considered by sporting bodies when considering adopting new officiating technologies. The effect on the audience in taking time away from the match is considered, but not player performance. Instead, this is generally considered the realm of the sports scientist or coaching team rather than the responsibility of an international sporting body. This separation could be viewed as logical if player performance is seen as a 'micro' factor while officiating systems are considered as 'macro'. Yet as the ANT perspective argues and as this chapter demonstrates, the micro and macro levels cannot be considered in isolation, and it is problematic for international sporting bodies to do so. The role of international sporting bodies is to regulate their sports and provide the best competitive opportunities for their athletes, so any new initiative should be considered in the light of the effect it could have on all aspects of the sport, and particularly on athlete

performance. More extensive research examining the effects of new officiating and media technologies on athlete performance would be helpful in addressing this issue.

Note

1Paul Hamm received the individual all-around gold medal, which should have gone to Yang Tae-Young from Korea. The FIG and IOC investigated the situation and discovered that three judges had accepted bribe money and consequently marked Yang down. These three judges were banned for life from judging at any further gymnastics competitions. Paul Hamm was asked by the FIG to return his gold medal in the spirit of fairness but declined to do so (Grandi, [2004](#)).

7

Translating performances: the production of sports media broadcasts

When René Magritte painted a picture of a pipe and wrote beneath it 'This is not a pipe', he was drawing attention to the difference between representation and reality. The painting was, of course, an image of a pipe, as opposed to the pipe itself, and Magritte was asking viewers to keep the distinction between the two in mind. In any televised coverage of sport the same distinction is in place. A television image of a football game is not the actual game; it is a representation or depiction of the game. While we rarely refer to sports television producers as artists, their role is exactly the same. Like Magritte, they produce images that show a particular depiction of reality.

Within the study of art, art historians, theorists and philosophers have studied and written intensively on representations. The meaning of representations is discussed at length, and this forms a significant core of the discipline. But alongside the art historians are others who specialise in the study of artistic technique. These technicians are less interested in the meaning behind the representations themselves, and instead turn their attention to how the art work was produced. They are experts in brushes, paint and canvases, rather than in Madonnas or landscapes.

In the study of mediated sport there are plenty of equivalents of the first form of art historians. Many sociologists or advocates of cultural studies have examined intensively the representations produced by sports media. They have identified particular depictions of different genders, races, ethnicities, nationalities and many other factors. But unlike in the study of art, there are very few technicians who examine the exact methods by which sports media are produced. Some of these techniques may be learnt in broadcasting school, or on the job, but within academic literature the topic seems to be almost entirely missing.

Latour ([1992](#)) is famous for describing non-humans as the 'missing masses' in the study of society. While more recently authors have argued that the increased number of studies examining technology, animals and other non-humans means that non-humans are no longer missing (see Sayes, [2014](#)), they remain missing in the study of sports media. There is little attention to the exact technologies utilised by sports producers and how the assemblage of humans (such as commentators) and technologies (such as digital overlays) work together to produce the actor-network that is the sports media broadcast.

The goal of this chapter is to begin to remedy this deficiency. The chapter draws attention not to sports media representations but to the processes by which these representations are produced. It considers how humans and technologies assemble together to produce what we view to be a seamless television broadcast.

One of the most interesting aspects of a television broadcast is its global accessibility. A broadcast makes one game in a single location visible to countless people who are physically distant from where the game is happening. Broadcasts can also cross borders, with numerous countries often drawing on the exact same footage, subject of course to the inscriptions outlining each broadcaster's media rights. In this chapter the global nature of sporting coverage is considered through Collier and Ong's ([2005](#)) concept of a global assemblage. Following this, I examine China Central Television's production of the 2008 Beijing Olympic coverage, and the history of the broadcasting of the America's Cup.

Global assemblages

One of the central questions within this chapter is: how are global assemblages created? The term 'global assemblage' stems from Latour's ([1987](#)) term 'immutable mobile'. This in turn refers to the relatively stable configuration of an actor-network which can be displaced yet still holds its shape. The displacement refers to the way a certain set of ideas, or way of doing things, can be moved or used in any part of the world, while the idea of holding shape refers to the concept that it is stable enough to remain the same regardless of its movement (Law and Mol, [2001](#)). Cooren et al. ([2007](#), p. 157) explain the value of the concept:

By immutable mobile, Latour means an entity that can travel from one point to the other without suffering from distortion, loss, or corruption. The beauty of this concept is that Latour shows how much energy needs to be spent and how much technology has to be mobilized to sustain the immutability of a mobile, whether this mobile be information about the geographical position of an island, the data related to the location of an oilfield, or the statistics that go into an economic projection. In all these cases, information needs to be transported from one point to the other (it needs to be mobile) but scientists and technologists have to find ways to maintain the integrity of some of its crucial aspects (they have to render it, to some extent, immutable). Unless they do it loses credibility.

This account demonstrates the value of the concept in relation to sports media coverage. A broadcast of a sports game can remain the same regardless of how many places in the world it is transmitted to, and how many televisions display it. The global movement of the coverage does not distort or change it in any way.

Earlier in this book, in [Chapter 4](#), there was a discussion of how the graph acts as an immutable mobile, since it is a form that contains particular information that is not distorted when the graph is moved from point to point. The concept essentially relates to the idea that an actor-network can stabilise through a non-human actant in order to allow its transportation. Within television coverage of sport, it is a particular network of non-humans, including satellites and television screens, that allows this transportation, as well as inscriptions in the form of agreements between countries and broadcasters.

Collier and Ong ([2005](#)) extended the notion of an immutable mobile to the concept of a 'global assemblage' as a way to focus on actor-networks that have global reach, and which retain their form despite moving across international borders. The immutable mobile does not necessarily have to have a global form; it is often something that contains physically linked components and may only move short distances, whereas a global assemblage includes international components and is moved around internationally.

In terms of sport, broadcasts of some games or matches act as global assemblages. Broadcasts consist of an edited video recording of the match that is specifically designed to hold its shape or form while being globally distributed. As Cooren et al. ([2007](#)) describe in the account above, a fundamental aspect of the immutable mobile (or global assemblage) is the centrality of the technology in ensuring that the form of the entity is

retained. In sport, distribution takes place either through traditional media broadcasting technologies such as television or, more recently, through online forms such as YouTube or other internet video sites. These technologies facilitate the movement of the sports form. The edited recordings work as global assemblages in that the audience receiving them generally understands and accepts them as depicting the match (Law and Mol, [2001](#)). Therefore, it could be argued that the sports media relationship results in the stability of a global assemblage.

So the questions this chapter sets out to answer are: how did these global assemblages come into being? What is necessary for an actor-network to stabilise into a global assemblage? These questions will be answered by examining two different cases. In the first case, the broadcasting of the Olympic Games is already stabilised as a global assemblage. Therefore the goal in this case is about understanding how the games retain their distinct form when confronted with changes in technology. In contrast, the case of broadcasting of the America's Cup was chosen because of the complexity of the technology that was required in order to mobilise the sport, with the question of whether it has achieved stability in the form of a global assemblage still in doubt. However, before examining the cases, the chapter provides a brief overview of the history of technology in sports broadcasting.

Technological developments in sports broadcasting

Stead ([2008](#), p. 340) describes how sports media companies employ professionals to produce a sports media package that 'aims to attract, interest and excite their audience'. Therefore it is understandable that sports media produce a 'distorted' version of sport and not an objective and neutral presentation. Stead describes a number of techniques that media companies use to present sport in a more interesting way, such as commentary, expert analysis, an emphasis on the spectacular and presenting athletes in very particular ways. While these may seem simple, Whannel ([1992](#)) argued that these techniques developed in tandem with the technologies that facilitated their use. Similarly, Turner ([2007](#)) argues that the relationship between sports broadcasters and sports organisations has intensified owing to technological developments in the field of sports broadcasting.

Whannel (1992) describes how television broadcasting was only possible through the production of satellites that became sufficiently efficient in the 1950s to beam live coverage around the world. In essence, satellite technology needed to stabilise as a global assemblage to allow the production of television coverage. With satellites in place, it became possible to broadcast sport worldwide. The focus then turned to the production of a more realistic screen image, with the 1950s and 1960s characterised by improvements in camera and microphone technology, the most famous of which was the introduction of colour television in the 1960s. Ross (2008) describes how the Canadian Broadcasting Corporation used instant replay for the first time in 1955 when broadcasting *Hockey Night*. Replays were further developed in the 1960s, with both the action replay and the subsequent slow-motion replay becoming commonplace. Replays altered the coverage of events significantly, with replays not only being played during matches but also allowing for extended panel-style discussion both before and after a match. In the 1970s the focus shifted to utilising electronic devices to edit images. For example, a new amplifier allowed the production of a 'tighter' image, meaning that any unimportant or unattractive parts of the image could be removed (Whannel, 1992, p. 61). Clear camera shots from a variety of angles, replays and commentary have all come to be understood as a normal part of the sports broadcasting experience.

In terms of the technologies available to viewers, Todreas (1999, cited in Turner 2007) argues that there have been three distinct eras of broadcasting development. First, the 1950s to 1975 included limited broadcasters and heavy regulation. During this era viewers had very little viewing choice. A second era emerged in the 1980s, with the advent of cable, or pay-TV, which provided viewers with a greater range of options. The third era emerged in the 1990s with the advent of digital technologies, which increased yet further the range of options available to the viewer through websites and online content. Similarly, in examining the changes that have occurred through moving to digital technology, Bull (2005) notes the way the movement from the Walkman or Discman to the MP3 player has revolutionised listening to music through the far wider range of options now available to listeners. Listeners now have a choice of thousands of songs on a single device, plus a range of methods for listening to them. However, it is not the user experience that is the focus of this chapter but

media production. The following case study details the introduction of digital technology into broadcasting. The move from analogue to digital technology arguably created a range of new possibilities, but also some risks and problems.

Case study: the broadcasting of the 2008 Beijing Olympic Games

The summer Olympic Games could be argued to be one of the most famous examples of a global assemblage. As a ritualised event, it includes specific features such as the torch relay, the parade of athletes and victory ceremonies that include the playing of the winner's national anthem (Roche, [2000](#)). These aspects are now understood as stable aspects of the Olympic Games that occur at every Olympiad despite it moving to entirely different international venues every four years.

However, Horne and Whannel ([2012](#)) point out that a significant aspect of the actor-network of the Olympic Games is the televised aspect. The Olympic Games are produced as a television event, with television taking precedence, rather than it being merely a live event that happens to be recorded and then shown on television. Horne and Whannel ([2012](#), p. 149) use a controversial example from the 2008 Olympic Games to illustrate the vital place of television within the actor-network of the Olympic Games: the 'digitally enhanced' fireworks that were part of the opening ceremony:

Part of the firework display was 'real' and live, but other parts appeared to have been pre-recorded and used to enhance the television image ... While there clearly were real fireworks, the full display could not be properly seen either from inside the stadium or from immediately outside it ... Only on television could the whole production, complete with digital augmentation, be properly perceived.

The example of the fireworks illustrates the importance of the television coverage as part of the actor-network of the Olympic Games. If the television coverage was not important, there would be no need to digitally enhance the fireworks in this way. Therefore, the production of the television coverage forms a vital part of the global assemblage that is understood to be the Olympic Games. For most people who watch the games, it is their entire experience of the Olympic Games. With this in mind, the following case study details the work involved in producing the television coverage of the 2008 Beijing Olympic Games.

This case uses the work of Liang (2013). This writer does not describe himself as working from an ANT perspective, but his arguments resonate strongly with the ANT point of view. Like Latour, Liang (2013, p. 475) argues that both the 'material and social' are important, indicating an intention to pay equal attention to both the human and non-human within his study. His work is unique in focusing on the actual work that occurs at the production level, which is why it is so relevant in understanding the question of how a global assemblage comes to be created. As discussed earlier, among those examining sports media it is more common to discuss cultural meaning than to examine the work performed in production, so Liang's (2013) work is an important exception to this rule.

To explain why there is so little work examining media production processes, Couldry (2008) argues that media have become black-boxed as benign and natural rather than institutionalised. This is understandable since in the early days of media coverage the media were the only way in which people who were not at an event could access any news about what was happening. However, today, the media instead aim to attract viewers in order to maximise commercial gain. Couldry (2008) notes that the black-boxing process has ensured that the networks that make up the media have become hidden from view. With this in mind, Liang's (2013) work is useful for unpacking the black box that has become 'media coverage'.

Liang's focus is not only the production of the coverage but also the introduction of digital broadcasting technology as a mode of broadcasting. As described above, the move from analogue to digital has been identified as a significant shift in broadcasting and in society (see, for example, Bull, 2005; Turner, 2007). In the case of the Olympic Games, the role of the broadcasters was to ensure that television coverage was produced that mirrored the kinds of broadcast that had featured at previous games, thereby ensuring the continued production of the global assemblage known as the Olympic Games. As outlined below, Liang (2013) identifies that digital technology opened up a range of potential new broadcasting methods. However, equally, it is noted that the anti-programme of 'limited time' meant that the full potential of the technology was not utilised during the Olympic Games despite the large resources allocated to it.

Time is again identified as a scarce resource in this case (Woodward, [2013](#)), as in many other cases described in this book. In this case, Liang's ([2013](#)) description of the broadcasters' reasons for not using all the potential provided by digital technology is identical to the reasons why elite athletes do not easily enrol technologies. In both cases, the anti-programme of 'limited time' forms a significant barrier, with both groups aware that they have time to utilise only a limited actor network.

Liang argues that the move to digital broadcasting in China, as adopted by the national broadcaster, China Central Television (CCTV), brought about a complete change in the way that broadcasting took place. He explains how in the previous era of video tapes the processes of production and broadcasting took place independently, out of necessity. The physical tape needed to be completed by the first group before being edited by the second group. As the tape existed as a physical object, it needed to be physically passed from one group to the other. In contrast, by the 2008 Olympic Games the improvements in the digital platforms meant that the two processes could be integrated. Liang ([2013](#), p. 473) states:

With a crucial material link in the process (the videotape) being removed, TV content came to be stored, edited, produced, and broadcast purely via digital files. TV making henceforth transformed from a 'material' era to an 'immaterial' era.

Here Liang interprets the digital era as no longer requiring a physical object as the vehicle for circulating the images, but because of his focus on the 'material' he notes how the participants in his study were still very aware of working with particular technologies despite the 'immaterial' nature of the digital age. For example, he describes how there were concerns about remembering to save footage to the correct part of the server in order to allow it to be edited. In this example, although the digital server does not technically physically exist, broadcasting personnel clearly treated the server as a significant actant in the production of the broadcast. They acknowledged the need to use the server correctly in order for it to act as an intermediary rather than as a mediator.

This example suggests that the transition from analogue to digital increased the complexity of the actor-network that produced and broadcasted sport. In the analogue era the tape presented a finished product from the production team. It was

highly stabilised and immutable, not subject to accidental deletion or alteration. In contrast, digital files are far more ephemeral. They needed to assemble with the correct part of the server in order for them to work, but also remained subject to accidental deletion or loss in a way that was not possible with a physical tape.

One feature that Liang (2013) described as occurring as a result of the move to digital was the creation of a new device called the Express Video Service. Prior to the digital era, a physical copy of the video tape had to exist in order for editing to commence. As a result, it was not possible for editing to take place until the event was concluded. In contrast, the Express Video Service featured 'real-time recording, playback, and editing functions in an online environment' (p. 479), which meant that editors could access the live stream of the event at any time and could commence editing while the event was still running. Liang (2013, p. 475) recognises the symmetry of the human users and the technologies in producing this outcome:

In this case, the agency of users (the organizational customers) helped reconfigure the material features of the network technology, while the technology people helped users realize their creative goals by tapping into the technological affordance and added new features to the prototype.

In this description Liang points out that the various actors hold different roles and therefore have different understandings, and one aspect of moving into the digital areas was to bring these different groups together. The digital platform acted to allow users to perform different actions, and because of the immediacy provided by the platform, the 'technology people' were able to instantly respond to users' needs and consequently improve the digital platform. The digital technology, 'technology people' and users all contributed equally to the improvement of the prototype.

As previously discussed, one of the largest changes in moving from analogue to digital was the way that, with the digital platform, production and broadcasting could be undertaken simultaneously. This technological shift resulted in two groups working together who had not done so before, and Liang (2013, p. 478) found through interviews that bringing them together was perceived as generating new forms of creativity, as one interviewee (a broadcaster) described:

The sports people have the best minds. They often come up with ideas how a new technology might help realize a certain vision. Conversely, I would float my ideas and see if they could help improve the television production process. We would then toy with the

ideas and try to find a proper channel, such as the Football World Cup, to turn these ideas into technological reality.

The scenario contrasts greatly with the cases described in [Chapter 5](#), where sports coaches and scientists were not able to work seamlessly together because they brought different understandings to the scenario, even though their goal might be the same one, of producing a more effective athlete.

However, despite the apparent willingness to work together, Liang ([2013](#)) argued that the resultant Olympic coverage was not as creative as it could have been owing to a lack of familiarity with the technology, and the processes involved in working with the technology. Essentially, the limited time available and the impossibility of practising the coverage of an event the size of the Olympic Games acted as anti-programmes towards the best possible production. Again the actant 'time' proved significant. While a large number of resources were utilised, such as allocating an individual support technician to every media maker, the lack of familiarity with the new technology meant that the media makers did not feel they performed as well as they could have. For example, Liang ([2013](#), p. 482) described a revealing scenario that occurred after the games:

The International Olympic Committee (IOC) hosted its Golden Rings Awards to honour the best Olympic programs by TV rights holders. CCTV's feature team was asked to submit one program to compete for the award. I was surprised to learn that the producer submitted an entry that was broadcast in the run-up to the Games and not during the Games. The producer later explained that he could not recall any outstanding feature during the Games that merited a submission. The extraordinary pressure during the Games constrained the creativity of media makers.

A further reason for the pressure felt by the media makers was the belief that the introduction of digital technologies introduced a higher degree of risk. This was described in an interview with an engineer:

If the system works well, everything is fine and more efficient. But should there be a breakdown, it will result in a catastrophe. Unlike the tape era, when a glitch on one single machine would only have a local impact, this time a problem at the systematic level would have a systematic impact. That's the downside of a complex, interconnected system. (Liang, [2013](#), p. 480)

The argument made by this engineer is the same as that made by Latour ([1999a](#)): that any point in an actor-network can affect

any other point and potentially generate unexpected outcomes. In this case the technology of the video tape acted to limit the size of the actor-network, since the circulation of the data on the tape could be achieved only through the circulation of the physical tape. By contrast, the immediacy of the circulation offered by digital technology meant that the actor-network suddenly increased in size. While on the one hand, new, novel and creative solutions were then able to be generated, on the other, greater risk also resulted through mistakes also being able to circulate rapidly through the actor-network.

Liang's ([2013](#)) study of the broadcasting of the 2008 Olympic Games highlights the way that the technologies used for production and broadcasting have a significant impact on the way that footage is generated. His findings fill a significant gap in the literature, in examining the processes that took place within broadcasting and the role of technology within this environment. Further work in this area would be beneficial in order to understand the role that changing technology plays in the media broadcasting of sport. When watching televised sport, we cannot fail to be aware of the immense number of technologies involved in production, such as cameras, headsets, cables, microphones etc., so it is surprising that so little attention has been directed at these elements.

Moving to image enhancement

While the previous case examined the introduction of digital technology in the production of a single mega-event, the following case examines how computer-based broadcasting enhancements have influenced a particular sports event over a number of years: the America's Cup. First, however, the background to computer-based technologies is discussed.

Owens ([2005](#)) documents how a range of different computer-based technologies have been introduced into sports broadcasting that have been met with various degrees of interest. Some of these have become ubiquitous within sport, while others have not been so successful. For example, one of the more ubiquitous is the virtual field-of-play lines that are now commonplace within sporting coverage. These consist of virtual lines 'drawn' on the field that demonstrate where particular play zones are, or similar. Such lines have also been extended into showing where an athlete is in relation to a world record and have been used in sports such as athletics and

swimming. Virtual field-of-play lines add to the excitement of the viewer by presenting additional information in an easy-to-understand manner. But not all enhancements have been so successful. For example, Owens ([2005](#)) describes how an enhancement introduced into ice hockey, which made the puck easier to see by making it glow, was not greeted with enthusiasm by fans. As a result, it was only used for three years in television coverage of hockey before it was removed.

Virtual field-of-play lines and a glowing puck are small examples of two technologies that have been introduced into sports coverage with the goal of making the coverage more accessible and popular with viewers. In order to understand how technologies such as enhancements develop over time, it is necessary to examine the step-by-step process of their historical development. Latour (1991) demonstrates this process through the examine of the Kodak camera. He describes the different actor-networks that made up the camera at different stages of its existence. Parts of the actor-network included small physical technologies that could be replaced or upgraded, such as gelatin, replaced by soluble gelatin, but also included what would traditionally be considered much larger actants, such as the existence of a mass market for cameras. Latour demonstrates how the camera existed and exists in a continual state of flux as it changes based on the make-up of the actor-network. Related to this argument is the question of when the actor-network stabilises and becomes an immutable mobile or global assemblage. In the following case, the America's Cup is examined through the same method in order to track the efforts made by broadcasters to turn the event into a global assemblage.

Case study: the broadcasting of the America's Cup, 1983–2013

The America's Cup is a high-profile sailing event that began in 1851. The format involves different countries issuing challenges to win the cup, but the USA continued to win the cup until 1983, when it was won by Australia (Andrews, [1992](#); Bentley, [2013](#)). Unlike the case of the Olympic Games, the America's Cup is not a widely popular international event, despite the desire of those running the event to make it so. Therefore, where the case of the Olympic Games was about producing a consistent broadcast despite a change in technology, the case of the America's Cup is about the efforts of those involved in the cup to produce an event that may one

day reach the status of the Olympic Games or FIFA World Cup, in becoming a global assemblage. Therefore in this case study the development of the America's Cup in terms of broadcasting is followed from 1983 to 2013. It is more difficult to argue that the actor-network that makes up the America's Cup is a global assemblage, for two reasons. First, an unusual quirk of the America's Cup is the way the winner of a race is entitled to choose the venue and rules for the next cup. Therefore, the format of the event is unstable, with great variation between cups. Second, despite the efforts of those involved in the America's Cup, it fails to attract any significant global attention. Sports journalist Tripp Mickle ([2012](#)) speculates that there are several reasons for the lack of global interest. First, he suggests that the expense of the yachts means it is beyond the means of most sailors to compete, resulting in fewer than twenty yachts competing, often from the same wealthy countries with some history of sailing success. Second, he suggests that the race is not globally popular as sailing does not work easily as a spectator sport. The rules of sailing are complicated and difficult for the layperson to understand, and, in terms of viewing, it is difficult to make out the position of the boats relative to each other or to the race course. Additionally, the timing of races is determined by wind and weather conditions, making it difficult to ascertain precisely when races will be held. For example, in the 2013 America's Cup, numerous races were cancelled or postponed because of wind conditions, leaving spectators in doubt about when the next race would occur.

Despite these difficulties, since Australia's victory in 1983, which brought the race to the attention of many new viewers, broadcasters have recognised the potential for the America's Cup to become a globally popular event. Since that time broadcasters have sought ways to increase the global popularity of the sport. In essence, they have attempted to transform sailing into a global assemblage. Therefore, with this goal in mind, the following now documents how the sport has experienced significant change over the last thirty years both in terms of operation and broadcasting. It begins by providing a brief history of broadcasting the cup, then considers the question of whether the cup has become a global assemblage. To date, there has been very little academic work examining the America's Cup, so the discussion below draws upon a variety of media releases, journalistic articles, websites, blogs and policy documents as well as one academic article.

A brief history of broadcasting the America's Cup

ESPN describes its 1983 coverage of the America's Cup as a pinnacle moment in its being treated as a serious television network. ESPN made a last-minute decision to televise the final race when the series was tied 3–3, and despite the coverage coming from a single camera in a helicopter, which resulted in the boats appearing as simply two tiny dots in the ocean, the ratings recorded a weekday afternoon record (Stewart, [1992](#)). Such an indication was a strong one that interest in sailing was out there, motivating broadcasters to improve the coverage to attract more viewers.

The following event in 1987 included a far larger pool of nations and subsequently attracted greater media attention (John and Jackson, 2011). Therefore, from 1987 onwards, broadcasters began to turn their attention to how to present sailing most effectively to a wider audience. The first development, included in 1987, was the use of on-board cameras that were placed on boats near the challenging yachts. However, on-board cameras were only partially effective because the boat with the camera had to be in precisely the right place at the right time in order to record the action, something that was not always possible, leading to a very unstable actor-network. Further, on-board cameras did not show the tactics and nuances, or explain the rules, so the footage was not particularly useful. Gladwell ([2009](#), para. 4) describes how a potential solution was trialled in 1987, 'consisting of the yachts being "shot" using accurate survey equipment located on hills around the race course, and the output used to produce a GPS track of the yachts'. However, while the system appeared to have promise, it did not work effectively, so again the broadcasting of the cup did not stabilise to include GPS technology at this time.

In 1991 a team of graphics and GPS specialists came together and produced a workable system that overcame the anti-programmes identified above (Gladwell, [2009](#); Stewart, [1992](#)). The graphics team produced computer-generated graphics of the boats using techniques from the film industry. These were then linked to a GPS black box which was placed in the boat, allowing the boats to send and receive real-time data that allowed the plotting of their exact position (Gladwell, [2009](#)). Therefore, the coverage included computer-game-like animations of the boats that demonstrated their

relative positions to each other and the course. Additionally, the 1992 cup coverage included cameras that allowed steady aerial filming from a helicopter that produced live overhead viewing of the position of the boats (Bentley, [2013](#)). These developments significantly improved the presentation of sailing for television, as viewers were now able to understand the exact positions of the boats in relation to the race.

There was, however, still one anti-programme yet to be overcome, and that was the inability to see both the boats and their relative positions simultaneously. In 1992 the coverage was only able to switch back and forth between the aerial view and the animated view, without a link between the two (Bentley, [2013](#)). The simultaneous-viewing problem was not solved until 2010, when the same team of technicians came back together in order to take the next step in improving television coverage of the race. This time the improvements to the coverage were directly linked to other changes that took place in the America's Cup format. The 2010 America's Cup was won by *Oracle USA*, owned by Larry Ellison, but the victory followed years of court battles over the rules which led to sponsors and competitors pulling out of the race (Mickle, [2012](#)).

Larry Ellison proved to be highly determined to turn the America's Cup into a global assemblage. As mentioned briefly earlier, one of the unusual quirks of the America's Cup actor-network is the lack of an overall organising body. Rather than having an international overseeing body, such as FIFA for football, the America's Cup allows the winner of a race to choose the venue and rules for the next cup. Consequently, Larry Ellison, of *Oracle USA*, planned significant changes for 2013 with the goal of increasing global spectator interest in the sport (Mickle, [2012](#)).

Ellison introduced a number of changes to the cup. Perhaps the most controversial was the change in boat design. While unique boat technology has always been a hallmark of the America's Cup, highlighted by the 'winged keel' that won Australia its historic race in 1983, the changes introduced for 2013 were particularly significant (Bentley, [2013](#)). Ellison allowed the racing of carbon-fibre catamarans that used wing sails rather than soft sails. This style of boat is able to travel very fast, up to 50 miles per hour, therefore arguably making races more exciting (Mahler, [2013](#)). Further, it is able to sail in

a wider variety of wind conditions, making weather delays less likely (Mickle, [2012](#)). However, there were a number of problems with the new boats. First, the boats were so expensive to build that there were only four challengers (competing teams) for the cup, as opposed to ten or more as in previous years. Second, the boats are far more difficult and potentially dangerous to sail than previous styles. For example, in 2013 a capsized catamaran killed British Olympic gold medallist Andrew Simpson. As a result, the actor-network for racing expanded to include new safety gear such as crash helmets (Mahler, [2013](#)).

This technological development is particularly interesting through the contrast with other sports in which governing bodies must carefully weigh up the value of new technological developments in terms of fairness, safety and other relevant rules. This was illustrated very effectively in the case of the polyurethane swimsuits. Even though the faster times had the potential to make swimming more exciting, FINA chose to ban these swimsuits on the grounds that they felt they were unfair and in breach of the rules. By contrast, the actor-network that makes up the America's Cup has no such governing body to consider whether changes in regulations are fair and the best thing for the sport. Consequently, changing the sport in order to increase viewer interest is far easier. It provides an interesting case study as a corporate model of sport.

The other revolution came in the broadcasting of the cup. Ellison chose the seas around the city of San Francisco as a venue partly because of its suitability as an ideal backdrop for a television broadcast (Bentley, [2013](#)), but, more importantly, there were some significant technological improvements to the broadcasting of the 2013 America's Cup. The first was the introduction of Liveline, a system that combined overlays with real-time live footage. In a media interview, one of the main developers of the technology, Stan Honey, explained:

People wanted to see the real boats and crew sail, handling and puffs on the water, and at the same time wanted to have aids to interpretation such as lay lines, mark circles and advantage lines showing who's ahead and behind. (Bentley, [2013](#), para. 33)

In order to achieve the simultaneous viewing of the positions of the boats and the actions of those on the boats, the broadcast coverage included lines drawn on the ocean to show the

boundaries of the course, the start and finish lines, wind direction, current lines and other course markers on top of the live footage of the boats (Bentley, [2013](#); Mickle, [2012](#)). The footage also included the boat speed and the distance between any two boats, leaving viewers in no doubt of which boat was ahead. Liveline's goal was explicitly to make sailing attractive and easy for the uneducated spectator to understand (Fisher, [2012](#)).

Liveline was also utilised by umpires, who watched the race on screen and not live (ACEA, [2012](#)), although this part of the actor-network is not the focus of this chapter. In attempting to produce coverage that the layperson understood, the graphic overlays acted as intermediaries by translating the occurrences within the race into a form that viewers could understand.

To produce the graphic overlays, the actor-network was extended further to include a variety of new actants. Three helicopters equipped with cameras, precise GPS and navigational recorders filmed every race, with all their data being sent to the main control centre. Each boat was fitted with GPS units, microphones and three cameras, which also transmitted data to the control centre. At the control centre about sixty people, including commentators, were employed to use the data derived from the helicopters and the boats and to produce a streamlined television production (Fisher, [2012](#)). Therefore, the television coverage may have briefly stabilised into a form that the layperson could understand, but it required a much more extensive actor-network in order to produce this effect. The control centre also acted as an oligopticon, with data from numerous physical locations all sent to one central point, but only as long as the connections between the various locations held. However, unlike WADA, who used data in order to police athletes, the data was used to produce effective television coverage. The more information that was able to be fed to the control centre about the exact details of the race, the more data the producers had to work with in order to produce more effective coverage. This perhaps reflects a similar perspective to that used by the producers of reality television, where maximum surveillance of the participants is undertaken in order to produce the most interesting coverage.

The results of the broadcasts

The actor-network was effective for producing the graphic overlays as desired, but it is difficult to ascertain whether the resultant coverage was effective as a television product that was desirable to watch. On one hand, within the US market, the 2013 America's Cup produced higher ratings than all previous cups put together. However, the rating was still not high, particularly in comparison with other popular American sports such as American football and baseball. Further, there is an argument that the popularity of the cup was not due to Ellison's changes or the graphics work, but rather to the incredible comeback by *Oracle USA*, who were down by seven races only to clinch the series over *Emirates Team New Zealand* 9–8. In New Zealand the ratings can be argued to have been very impressive, with a quarter of the population tuning in to the races, but this is unsurprising given that New Zealand has the largest number of sailors per capita in the world (Daniels, [2013](#); Noonan, [2013](#)).

The rating numbers fall far short of the Olympic Games, with its undoubted global interest. It appears that the America's Cup is still struggling to find the global form that would allow it to reach international popularity. Daniels ([2013](#)) argues that, despite the changes introduced by Ellison, and the excitement of the final races between *Oracle USA* and *Emirates Team New Zealand*, the event has too many anti-programmes at work for it to attain global popularity. The first is cost. With the cost of building and maintaining the yachts estimated at between US \$100 and \$200 million, Daniels suggests that it is simply impossible to obtain sponsorship to offset such large costs. The television ratings are not high enough to generate that level of sponsorship. He also suggests that it is difficult to generate interest since it is not a sport that people can participate in on their own, unlike the popular sports of football or baseball. What Daniels argues is that, while other sports events have become global assemblages through having an actor-network that includes utilising sponsorship and television rights to cover the costs of the event, because of through global interest in the sport, the America's Cup has not yet found a similar workable form. Therefore, it will not be surprising if the cup sees further changes in years to come as sailing enthusiasts attempt to continue to reconfigure the America's Cup in order to reach this level of stabilisation and global interest.

Conclusion

For many sports or sporting events the relationship between sport and the media is an important one. Broadcasting rights and sponsorship provided by the media can provide significant income and allow sport to function. However, as Couldry (2004) points out, the workings that occur to produce sports television coverage are often concealed from view. Therefore, one of the goals of this chapter was to examine the processes that produce television coverage, paying particular attention to the technologies within these processes, with the aim of understanding how the actor-network stabilises to produce sport as a global assemblage.

This chapter has only scratched the surface of this particular area of study. While a few of the technologies that affect the production and broadcasting of sports coverage have been identified and discussed, a large amount of work still needs to be done to examine the range of other technologies that affect sports broadcasting and how these assemble with other human and non-human actants in order to produce sporting coverage. Ethnographic studies that examine how sports coverage comes into being would be of benefit to complement the variety of work that exists on media representation. While representation is an important area of study, examining media products without acknowledging the technologies that contribute to producing them misses half the story. In the study of sports media, technologies are still the 'missing masses' (Latour, 1992).

As this chapter has shown, the capacities of technology profoundly affect how broadcasts appear. In Liang's (2013) study of the broadcasting of the Olympic Games, the assembling of the production and broadcasting teams led to more creative coverage than when they operated independently. At the same time, these teams were aware that they were not working to the full potential of the technologies they were using, owing to the anti-programme lack of time. Similarly, in the broadcasting of the America's Cup broadcasters knew exactly what would improve the coverage for viewers as far back as 1987, but it was not until 2010 that the technology existed that would allow the coverage to take that form. These examples show how the availability of technologies, their actor-networks and their abilities act to influence profoundly the form that sports broadcasting takes.

Technologies act, and the realm of sports media requires more studies that acknowledge their role in the production of sports coverage.

These two cases also highlighted the issue of stability, and the concept of the global assemblage was employed to discuss this. In the case of the Olympic Games, sports coverage has been and is a stabilising entity. The existence of, and desire for, global coverage of the games has worked to ensure the continued funding of and interest in the Olympic Games. The effect of this arrangement is that broadcasters are not motivated to change or improve Olympic coverage profoundly, but prefer to keep it recognisable as Olympic coverage while still incorporating the latest technology. Consequently, digital technology was not introduced into the games in order to counter an anti-programme, but simply to continue the effective coverage that already existed.

In contrast, the coverage of the America's Cup has not yet reached a stabilised form, so broadcasters are strongly motivated to introduce new technologies and enhancements in order to increase ratings. The America's Cup is a particularly unusual case since the rules are not governed by a global body. Instead, Larry Ellison is able to direct the cup with an unusual amount of power. Despite his efforts, the America's Cup has not yet managed to become a stable global assemblage.

Conclusion

In today's world, we are offered a constantly expanding range of interconnected technologies to use at work, at home and in leisure activities. The realm of sport is no exception, where new technologies or enhancements are available to athletes, coaches, scientists, umpires, governing bodies and broadcasters. However, in a world where time has become a precious commodity and numerous options are always on offer, functionality is no longer enough to drive their use. Instead, as this book has shown, each assemblage must grapple with a unique set of understandings and connections in order to determine the best actor-network to serve their particular purpose. As each chapter shows, there are multiple explanations and factors at play in the use of technology that cannot be reduced to singular explanations such as performance enhancement or commercialisation. Instead,

technologies were shown to exist within actor-networks where any point in the network can affect another point, leading to multiple actants affecting the enrolment or non-enrolment of technology in sport.

This book shows how at times these networks stabilise with particular actants being enrolled, such as in the case in doping, where the actor-network of doping includes a particular understanding of doping as censured. In other cases the path of the network comes to an end as a particular assemblage or actant is no longer enrolled, such as in the case where in 2010 FINA no longer allowed the wearing of swimsuits with particular technological qualities. This book found different and varied forms of enrolment and translation, and it paid equal attention to the impact of human and non-human actants in the creation of sport.

Sport as a socio-technical actor-network

Introna (2009) emphasises that in today's world we are increasingly connected to technologies to the point where we cannot separate ourselves from them. The notion of sport and technologies existing as actor-networks which, once assembled, can stabilise to produce particular transformative effects has been a constant theme throughout this book. For example, the book explored how athletes assemble with polyurethane swimsuits to produce swimmers capable of unusually fast times, judges and umpires combine with video-replay technologies to improve the accuracy of their decisions and how footballers assemble with GPS units to transform into trackable units, able to have their heart rate and other bodily statistics surveyed and measured at all times.

The book followed these assemblages through the larger actor-networks that make up sports, where the connections between assemblages were found to generate unexpected consequences. In cricket I found that the new assemblage of umpire and video replay potentially affected player performance. In tennis the same assemblage combined with rules around player challenges to produce yet another aspect of the tennis that a player could choose to include in their training regime, or not.

Indeed, this book included examples of many cases where enrolment did not occur and the actor-network did not

expand to include a new technological device or enhancement. The evidence provided by scientists to show that a new enhanced boat was functionally capable of improving performance was not enough to convince kayakers to alter their actor-networks to incorporate the new boats. Or, in other words, the goal of performance enhancement did not translate directly into enrolment. Similarly, functionality was an insufficient reason for Michael Phelps and Rebecca Adlington to choose to assemble with any swimsuits not made by their sponsor Speedo, indicating the conflicting pressures athletes can experience between retaining sponsorship and achieving success.

At the same time, the different actor-networks that make up athletes' bodies mean that all technologies do not have the same effects on all bodies. TCHEs have had their functionality called into question by athletes who have found that the unexpected effects of them on other already working parts of their actor-network affected their performance negatively, rather than improving it. Other athletes' actor-networks already include a large capacity for carrying oxygen, making the addition of a TCHE superfluous.

Some of the above examples demonstrate how introducing new technologies into an actor-network can have unexpected effects on different parts of the network, such as Hawk-Eye impacting player performance. These examples have implications for sports policy-makers who intend to enrol new pieces of technology. Through viewing these cases as actor-networks, we can see how introducing a new piece of technology may also result in the need for restructuring or further resourcing. For example, in the case of the GPS units used in the AFL, further resourcing was found to be necessary in the form of data analysts and alternatives for stadiums with roofs that blocked GPS signals.

Describing sport as socio-technical answers ANT critics such as Elder-Vass ([2008](#)), who argue that because people have emergent properties, they cannot be treated as equal to non-humans. But he perhaps misses a crucial point in that he continues to treat people and things as separate, when the very essence of ANT is that things and people cannot be separated (Introna, [2009](#); Latour, [2005](#); Law, [1992](#); McLean and Hassard, [2004](#)). As described above, ANT argues that, once a network assembles, it is transformed into a new actant with

different properties from what existed previously. Therefore, the ANT theorist views the world as made up of these assemblages of humans and non-humans that often stabilise only briefly, and in particular ways.

As part of acknowledging the role of non-humans, ANT also notes the impact of different viewpoints in the enrolment processes. Indeed, identifying the links between the viewpoints of the different parties and the enrolment process is one of ANT's most significant contributions. Many theoretical approaches focus on the identification of the viewpoints held by particular groups. ANT is not interested in what makes up these points of view per se, but provides a process for identifying the impact these different understandings have on the acting taking place. In [Chapter 5](#), the important point was that the contrasting points of view, exemplified by the bio-medical model in comparison with the sport ethic, led to a non-enrolment, or a lack of action, between the athletes and mainstream medical practitioners, rather than the points of view themselves being the focus.

Technology as an actant

One point of contention with ANT is whether humans and non-humans can both hold agency (Collins and Yearley, [1992](#); McLean and Hassard, [2004](#)). Collins and Yearley ([1992](#)) argue that ANT tends too much towards technological determinism in overstating the significance of non-humans as actants. This book has shown how, in the case of sport, non-humans can act through the concepts of mediators and intermediaries. For example, in the case of GPS as used in AFL, this book found that GPS units acted as intermediaries because of the useful nature of the data provided to coaches, but acted as mediators through not necessarily providing entirely accurate data.

Along with treating humans and non-humans as equal actants in the creation of sport, the question also arises of whether to treat all human actants equally. McLean and Hassard ([2004](#)) note that one criticism of ANT is that it focuses on 'heroes' or central powerful figures, because of the perception that they are important and powerful and therefore have a greater influence on the network. Yet arguably, if this book was to be described as focusing on any particular type of figure, it would be that it focuses on the activities of relatively 'minor humans'. While there is some discussion of various

successful athletes, there is perhaps more discussion of the humans who are normally somewhat hidden from view. For example, [Chapter 7](#) examines the media makers and broadcasters who produce the media coverage of sport, who are a group that receive little attention in the literature. But, as Law (1992) points out, an ANT perspective is actually interested not in the 'great person', but rather in the workings that make up the success of that person. This book is therefore more focused on the various technologies that in some cases have contributed to the success of some 'great' athletes or events.

Power

This book reveals that the power structure in sport is continually shifting. Following who is responsible for enrolling or translating various actants into the actor-network reveals where the power lies. For example, in [Chapter 4](#), the examination of the doping actor-network revealed how several very different regimes – the IOC, WADA and East Germany – employed a range of components in order to minimise or eradicate doping. Through inscriptions and surveillance, enacted through paper, websites and drug testing, these organisations were able to retain control of doping and treat it as either a punishable or approved act. At the same time, power was also distributed throughout the network. For example, in East Germany the obviously powerful actors – high-level officials – enrolled doping as a method to produce success. However, athletes were also found to be powerful since they were the ones who represented East Germany, leading to a vast extension of the actor-network motivated by the perceived need to monitor the actions of travelling athletes. More recently, athletes have been empowered greatly owing to their ability to enrol the international human rights courts to intercede on their behalf and fight for compensation. Similarly, in the case of Hawk-Eye in cricket, as described in [Chapter 6](#), while umpires have the power to interpret the replays shown by Hawk-Eye, high-level officials also have the power to utilise it to monitor the umpires' skills.

At a societal level, I found the concept of the oligopticon to be useful as a way of examining how organisations enact power. The idea of the oligopticon as a central point of command that works through networked connections encompasses Foucault's (1977) theory of institutions using a

central point of surveillance to ensure the correct behaviour, along with Deleuze's (1992) notion that we have moved away from institutional surveillance through physical forms to a flatter, more dispersed, networked arrangement. For example, in the case of WADA, there are two committees who run the organisation, but these committees are only able to remain in control as long as their connections to various parts of the network, such as drug testers, police organisations and the athlete passport programme, remain intact.

Stability

One of the interests of ANT theorists is in identifying how some actor-networks come to stabilise while others unravel or remain stable for only short periods of time. [Chapter 7](#) examined two contrasting cases. The chapter argued that the Olympic Games can be considered a stable actor-network since it entails a number of features that make them immediately identifiable as the Olympic Games. This network is so stable that it is argued to be immutable and a global assemblage, in that the same form is able to remain intact even though the games move internationally. By contrast, the case of the America's Cup found that this sporting event is extremely unstable because the rules change with each cup and there is a constant search to find a globally appealing form. The chapter argued that in both these cases technology plays a role in facilitating stability. In the case of the Olympic Games, broadcasting technology ensures that a stable television event called the Olympic Games occurs, while in the America's Cup broadcasting technology is employed in order to attempt to emulate this level of stability.

Latour's (1991) argument that stabilisation occurs through non-humans was also illustrated in the case of doping through a discussion of inscriptions. The actor-network of doping includes a range of non-human and human actants that ensure that doping remains a condemned yet policed practice, particularly through the presence of inscriptions. For example, WADA's Anti-Doping Code acts as an inscription that transforms a variety of substances and practices from being allowed by athletes to being banned, with banning including a distinct set of surveillance practices to identify the use of the substances. As such, it is the inscriptions that produce 'banned' substances, and when combined with the internet, inscriptions allow the free circulation of this information. The circulation of

inscriptions thus stabilises anti-doping practices in ensuring that all athletes have access to the necessary information about which substances and practices have been transformed into 'banned' ones.

Local and global

In focusing on following the networks, and acknowledging processes such as circulation, ANT essentially rejects any boundary between what is often termed the local and global, or micro and macro (Latour, [1995](#), [1999a](#); Law, [1992](#)). Several of the cases examined in this book illustrate the ANT argument that a network can be global, while also being 'continuously local' (Latour, [1996](#), p. 67). For example, in the case of the swimsuit, factors that may be termed 'global' such as international sponsorship arrangements were found to influence the enrolment of particular suits, but at the same time it was found that, at the apparent 'micro' level, different bodies assembled very differently with the swimsuits, producing varied results. Yet these two factors were also strongly connected through the way that the ability for a body to assemble well with the swimsuit and record fast times affected the kind of sponsorship agreement that might be offered. These examples demonstrate how identifying an actant as local or global is not a useful exercise in an ANT study, since following the network extensively always leads to interconnections between the local and global.

Ending the network

This book is an incomplete description of the use of technology in a range of sports. It is incomplete because, as Law ([1992](#)) argues, it is impossible to describe every detail of a world. All that can be hoped for is a set of accounts that maps the moments when sport and technologies intersect. This book therefore contains different accounts from different parts of sport, during training, competition and broadcasting, that examine the range of reasons and ways that technologies are enrolled, or not enrolled, into sporting practice.

Lee and Stenner ([1999](#)) and Strathern ([1996](#)) note how a network has no specific end. There is no closure of the components of a network, and therefore the researcher is left uncertain where to end her research. Latour's ([2005](#)) answer to this is to stop when the participants stop or when the

demands of the inscription being written are completed. This book describes times when the participants have been very definite in arguing and agreeing that a certain point is the end of the network. However, the book could have continued by looking at a range of other cases and examples, with the networks being followed much further. But, as Strathern ([1996](#)) notes, the creation of any network must exclude, and at this point the demands of the inscription are completed. The goal of this book has been to provide a range of accounts of sport and technology and to provide readers with some methodological and theoretical ideas for examining our increasingly complex socio-technical world.

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