Genetic Modification in Sports

A LEGAL AND ETHICAL VIEW ON REGULATING THE FUTURE OF PERFORMANCE ENHANCEMENT.

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PREFACE

The Master thesis that lies before you is the result of a research that started in June 2012. This thesis is the conclusion of my Master program Law & Technology at Tilburg Law School, Tilburg University.

I have been blessed with the opportunity to write a thesis on the subject that interested me the most. Sport has always been a big part of my life and the topic of genetic modification drew my attention while attending the lectures of "European and International Regulation on Biotechnology" at Tilburg University. Eventually I chose not to discuss somatic cell modification and genetic selection, since these two topics require different ethical questions to be answered than the subtopic of genetic modification that I did choose to discuss: genomics.

Further, I would like to say a word of thanks:

Firstly I would like to thank my thesis supervisor, dr. Anton Vedder, Tilburg Institute for Law, Technology and Society (TILT). He took the time to meet with me once per month to comment on every single chapter of this thesis separately and gave me detailed instructions on how to bring my project to a successful conclusion. All our meetings where fruitful and gave me the confidence to continue working on this thesis with the same enthusiasm and positive energy that I had since day one.

I also want to thank prof. dr. Bert-Jaap Koops for serving as the second reader of my thesis. He told me the subject has his keen interest and that he would like to serve as a second reader almost immediately after I asked him.

Third, I would like to thank my fellow students for their moral support and sincere interest in both the development and subject of my thesis. Every time I thought I was slacking or felt like I was not going to be able to complete my thesis in time, they jokingly remembered me of the fact that most of the time I was ahead of schedule and should not complain at all. On the same note I want to thank my friends and acquaintances for their sincere interest and the discussions we had on the subject of this thesis. As the sporty people that we are, sharing the same interest in sports, it was interesting to see the differences in our opinions on the subject.

Last, but definitely not least, I would like to say a word of thanks to my parents for giving me the opportunity to study at Tilburg University. They gave me the financial and motivational support needed to succeed in reaching my Master degree. Let me not forget about my brother, who, although sometimes somewhat reluctantly, helped to create calm and quiet surroundings by keeping the volume to a low whenever I needed to concentrate on the writing of this thesis.

Today marks the beginning of a new chapter, not a chapter on paper, but of life. It marks the end of an era called “education” (although one never stops learning), and the beginning of an era of work, a career, in which I will continue to challenge myself and develop further into whatever the future may hold.

I truly hope you will enjoy reading this thesis as much as I enjoyed writing it.

"I do not wish to hear spoken the word doping. Rather, one must say 'treating yourself,' and speak of treatments that are not appropriate for ordinary mortals. You cannot compete in the Tour de France on mineral water alone."

Jacques Anquetil†, the first cyclist to win the Tour de France for a total of five times.

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1. INTRODUCTION

1.1. BACKGROUND

Since the beginning of time, the people who have strived for sporting glory have also sought for shortcuts to reach the highest achievements possible. The passion for sports transcends race, gender, physical (dis)ability and geographic barriers and that what drives the appeal of sports often pushes athletes to do whatever it takes to be the very best.[1]

Using substances to improve performances in athletic competition is as old as competitive sport itself.[2] Ancient Greek athletes would use special diets and stimulating potions to enhance their performance. Substances as strychnine, caffeine, cocaine and alcohol were used to stimulate the endurance of athletes in the 19th century. The winner of the 1904 Olympic Games marathon, Thomas Hincks, had raw egg, injections of strychnine and doses of brandy administered to him during the race. And by the 1920s it became clear that it was necessary to do something about the drug use in sports.[3]

The International Amateur Athletic Federation (IAAF) was the first International Sport Federation (IF) to ban doping, which is the use of prohibited substances or methods, by doing so in 1928. The ban wasn't very effective, since no testing took place to reinforce it. The invention of synthetic hormones in the 1930s and their use, which began in the 1950s, further worsened the doping problems.[4]

The 'Union Cycliste Internationale' (International Cycling Union, UCI) and the 'Federation Internationale de Football Association' (FIFA) were among the first IFs that introduced doping tests, in 1966.[5] The year after, the International Olympic Committee (IOC) set up its Medical Commission, which published the first list of banned substances[6], which led to the first drug testing and disqualification at the 1968 Summer Olympic Games in Mexico: the Swede Hans-

[1] Custer 2007, p. 181
[2] World Anti-Doping Agency, A Brief History of Anti-Doping http://www.wada-ama.org/en/About-WADA/History/A-Brief-History-of-Anti-Doping/ (visited June 25, 2012)
[3] *Id.*
[4] *Id.*
[5] *Id.*
[6] *Id.*

Gunnar Liljenwall tested positive for excessive alcohol[7], a forbidden substance because the use of it may endanger the athlete and/or the other contestants.[8]

The use of anabolic steroids was becoming widespread by the beginning of the 1970s, especially in strength events, because these could not be detected yet. In 1974, a reliable test was introduced and anabolic steroids were added to the IOC's list of prohibited substances in 1976.[9] With this introduction of a dependable testing method, disqualifications due to drug use (notably in strength-related sports) increased dramatically by the end of the 1970s.[10]

Anti-doping work was complicated when a scandal of government-sponsored doping emerged in the 1980s, when athletes of some countries got there doping substantiated by the former German Democratic Republic.[11] Later that decade, the world was shook by the most famous doping case of the 1980s: Ben Johnson was stripped of his 100-metre gold medal after he tested positive for an anabolic steroid known as stanozolol. This case would focus the world's attention on the problem of doping to an unprecedented degree.[12]

In a more recent case, the 1998 Tour de France "marked the eruption of a major scandal in cycling".[13] Willy Voet, a soigneur[14] of the Festina cycling team, was arrested by French customs for the possession of illegal quantities of prescription drugs and narcotics. This led to raids of the Festina hotel rooms, where more doping products were discovered. The Festina team argued that the use of doping was widespread at the elite level of cycling.[15] This scandal highlighted the need for an independent and international anti-doping agency, which was established on November 10, 1999: the World Anti-Doping Agency (WADA).[16]

Another recent case is that of Claudia Pechstein, who has been banned for two years because of the use of blood doping. She was accused of using a synthetic version of recombinant human erythropoietin (rHuEPO), which increased the amount of red blood cells produced by the bone

[7] http://www.reference.com/browse/wiki/Hans-Gunnar_Liljenwall (visited June 25, 2012)
[8] http://www.dopingautoriteit.nl/wat_is_doping/dopingcategorieen/alcohol, own translation. (visited August 5 2012)
[9] World Anti-Doping Agency, A Brief History of Anti-Doping
[10] *Id.*
[11] *Id.*
[12] *Id.*
[13] Custer 2007, p. 184; World Anti-Doping Agency, A Brief History of Anti-Doping
[14] A soigneur is a non-riding member of a bicycling team whose role is to provide support for the riders, which could include transportation and organization of supplies, preparation of food, post-ride massages, and personal encouragement.
[15] Custer 2007, p. 184
[16] World Anti-Doping Agency, A Brief History of Anti-Doping

marrow, increasing the oxygen-carrying capacity of blood.[17] This shows how the use of performance enhancing technologies by athletes develops further and further.

By now the WADA and its World Anti-Doping Code have developed to nearly a standard for doping rules and regulation[18], and many different kinds of doping techniques and technologies that have been used by athletes, have been discovered by anti-doping agencies.[19] The last decades, concerns have risen about the use of so called 'gene doping'[20], a technology that uses gene therapy techniques to increase the body's production of performance-enhancing proteins.[21] Genetic science is still in its early stages of development and there are scientists that regard the genetic modification of athletes as nonsense and completely lacking scientific possibility[22], but given the social and financial incentives to win, the athletic field may be one of the first places where genetic modification becomes a reality[23], when its time comes.

For now, WADA and other world anti-doping authorities have universally condemned genetic modification in sport, mainly in the name of protecting the well-being of the athlete.[24] The strict ban on genetic enhancement in sports applied by these authorities is an appropriate and necessary measure for the time being, given the hazards and unpredictable consequences of gene therapy and genetic enhancement.[25] But what if that all changes?

1.2. RESEARCH QUESTION

As discussed above, WADA labeled genetic modification as 'gene doping' and added it as such to the Prohibited List[26], which clearly connotes a negative attitude towards it.[27] Although this is a necessary ban to protect the well-being of the athlete for the time being[28], the point of discussion is if this is the correct choice to continue with in the future. To feed to that discussion, I have stated the following research question:

[17] McArdle 2011, pp. 53-56
[18] Vieweg 2004, p. 37
[19] Custer 2007, p. 185
[20] By labeling it 'gene doping', they have already created a negative atmosphere around the use of genetic modification in sports.
[21] Fore 2010, p. 77
[22] Miah 2004, p. 5
[23] Fore 2010, p. 78
[24] *Id.*
[25] *Id.*
[26] Proscription M.3, the 2012 Prohibited List. http://www.wada-ama.org/Documents/World_Anti-Doping_Program/WADP-Prohibited-list/2012/WADA_Prohibited_List_2012_EN.pdf (visited June 28, 2012)
[27] Custer 2007, p.197
[28] Fore 2010, p. 78

What should our future response to the development of genetic modification in sports be, from a legal and ethical perspective?

By answering this question, I attempt to add to the discussion about the future development and possible acceptance of genetic modification in sport. By outlining a legal ethical perspective on the subject, I will try to create a viewpoint that can be used to base the arguments in this discussion upon. The reason for looking at genetic modification is that it is a developing field which could possibly be used by athletes to achieve a higher potential in their field of sport.

The difficulty of this topic of discussion and the research question lead to multiple sub-questions that need to be answered, to be able to give a complete answer to the research question. These sub-questions are as follows:

1. *What is considered 'sport' in light of this research? (Definition)*
2. *What is the definition of 'doping'?*
3. *How do you define 'genetic modification'?*
4. *How could genetic modification be applied in sport?*
5. *Which regulation is relevant for the situation?*
6. *What kind of legal and ethical arguments should be taken in consideration?*
7. *What kind of regulatory responses to the development of genetic modification in sport could be considered?*

Definitions are given to clarify what is meant by these certain words in light of this thesis. This leaves less room for interpretation, which prevents possible misunderstanding of these definitions and thus the context of them in this thesis.

By describing the relevant regulation I will sketch the legal playing field of genetic modification and doping at the moment. Describing existing regulation on the subject will give the possibility to argue if this kind of legislation is a possible solution to uphold in the future or if regulatory changes should be made. This description will not only include regulation created for anti-doping purposes, but also other rights of athletes that are possibly affected. Including these other rights may provide different legal ethical arguments than just the ones that are aimed at the regulation on genetic modification in sport. I will discuss these legal ethical arguments in order to create a possible view on the development of genetic modification in sport.

Taking the above into consideration, I will discuss possible regulatory responses to the development of genetic modification in sport.

In this thesis I will only discuss the use of genetic modification on grown, adult athletes (as discussed in the preface: genomics). I also chose to limit the thesis to the elite level in sports. As already has been stated in section 1.1, the athletic field may be one of the first places where genetic modification shall be used, because of the financial ability.[29] However, since genetic modification will cost a lot of money, at least at first, this financial ability will likely not be present at the amateur level. Therefore I chose to limit the reach of this thesis to sport at the elite level.

1.3. METHODOLOGY

How does one answer a question that is mostly based on possible future developments? One may do so by researching the possibilities given by experts. After all, they are the people that deal with the developing technology of genetic modification every single day.

The questions in this thesis shall be answered by firstly giving clear definitions. This shall be done by doing literature research: browsing through articles, reading books about the subjects and looking at the definitions in relevant regulation. This way there will be no doubt about the comprehensiveness of the definitions. Where possible, a small list of requirements that need to be met to fall within the definition will be given. Then, I will explain how genetic modification can be used in sport. This will be based on both literature research as well as expert interviews with scientists in reports and literature. These expert interviews give a clear look at the current state of the art, while literature may not be able to do this since it may be based on outdated data. The relevant regulation shall be discussed based upon literature research. I will point out why the regulation is relevant to the subject and thus the effects of the regulation on the use of genetic modification in sports shall be made clear. Discussing relevant regulation is done because it can give insight on what a possible reaction to the use of genetic modification in sports can be (the regulation *as is*), as well as lead to a ground on which to base other arguments concerning the future regulatory reaction on the use of genetic modification in sports upon. Following that, I will do an analysis from an ethical viewpoint on genetic modification in sport, based on both literature research, including reports on the subject. Legal and ethical arguments will be based on literature research, but expert insights may give an additional viewing on how genetic modification is perceived in the world of sport itself, by for example athletes and the people around them, these can also be found in the literature used. In this way, ethical considerations will be discussed. Literature research will also be used to discuss ethical arguments on the development of genetic modification in sport. These ethical arguments may not always be in agreement with current social opinions, but can give important viewpoints to

[29] Fore 2010, p. 78

think about. Finally, the possible responses that will be suggested are based purely on literature research. Real-life scientific events will be discussed to provide examples of the development of genetic modification, especially the examples that could be relevant to the 'world of sport'. There will also be some discussion about cases based on performance enhancing substances to give an example of the reaction of the 'world of sport' to these kinds of developments.

1.4. AIM

The aim of this thesis is to create a basis for the discussion on whether or not genetic modification should be allowed when it comes to sport. Answering the question how we should respond to the development of genetic modification in sport gives a foundation for arguments in this discussion to be based upon. By giving possible responses to the development of genetic modification in sport, this thesis aims to give a ground where future regulation on the subject of genetic modification in sport should be based upon.

1.5. THESIS STRUCTURE

This first chapter gives a little background on the subject, as well as some practical information about the thesis, how the research shall be done, and, not to forget, the motives behind it. Chapter 1 could therefore be seen as an introduction.

In Chapter 2, an overview of the relevant definitions as used in the rest of this thesis will be given. First I will give the definition of sport as used in this thesis. Then I will discuss the definition of doping and if genetic modification in sports is considered doping or not. After that, I will define genetic modification and explain how genetic modification can be used in sport.

Chapter 3 will discuss the relevant regulation on the topic. I will state the regulation that is applicable to the use of doping, both with international and national contexts, and I will give concrete examples by using court cases. I will also point out that there are other rights of athletes that need to be considered when it comes to doping, apart from the "doping regulation" that will be discussed earlier in this chapter.

After that, arguments on both the ethical and legal aspects of genetic modification in sport will be given in Chapter 4. There will be different ethical questions and thoughts about the use of

genetic modification in sport and the current legal regime on the subject, and these should be addressed in order to reach an acceptable solution to the problem.

Some possible responses to the use of genetic modification in sport shall be discussed in Chapter 5. I will base these responses on the considered legal ethical perspectives in the earlier chapter. By setting out these responses I will fully answer the research question.

Finally, Chapter 6 will conclude the thesis with a summary of the research findings.

2. SPORT, DOPING AND GENETIC MODIFICATION

2.1. THE DEFINITION OF SPORT

What exactly is sport? We probably all have an idea about what sport is, but when it has to be explained, it's hard to do so. What kind of requirements should be fulfilled for an activity to be considered as sport? In order to reach a conclusion on the research question, I will first have to define what sport is in the context of this thesis.

Professor van Staveren states in his Opinion entitled "Sports legislation at national level appropriate?" that "sport will be difficult to define in such a way that the field in which the law has effect is clearly delineated. This in itself is already an impediment to just rules."[30] And it seems that there are powerful arguments against attempting any definition of sport, since the extreme complexity of sport and the overlapping features of different sports do not make it easy to create a clear definition.[31]

However, in light of this thesis we will need to have a certain definition to make clear what we are speaking about. Although this definition is not comprehensive or universally applicable, the definition of sport will be:

> *"A form of a mainly physical activity which aims at obtaining results in competition according to a certain set of rules and customs."*

I will clarify the requirements given by this definition to create a clear view on why I choose these requirements to regard to the chosen definition as sport.

- Physical activity: Article 2 of the European Sports Charter of the Council of Europe defines sport as "all forms of physical activity which, through casual or organized participation, aim at expressing or improving fitness and mental well-being, forming social relationships or obtaining results in competition at all levels."[32] Physical activity is an important requirement in light of this thesis, because the examples of the expected possible use of genetic modification in sports that are given are all affecting physical performances (see section 2.3.3.). For this reason the definition will be narrowed down to just physical activity. By naming physical activity as a requirement in the definition of sport, for example, one of the most ancient and widespread games, chess, is ruled out.

[30] Soek 2007, p. 151
[31] Allison 1988, p. 4
[32] The European Sports Charter of the Council of Europe can be found at: https://wcd.coe.int/ViewDoc.jsp?Ref=Rec(92)13&Sector=secCM&Language=lanEnglish&Ver=rev&BackColorInternet=9999CC&BackColorIntranet=FFBB55&BackColorLogged=FFAC75 (visited July 14, 2012)

- Competition: The Oxford English Dictionary defines sport as "an activity involving physical exertion and skill, esp. (particularly in modern use) one regulated by set rules or customs in which an individual or team competes against another or others"[33], which gives sport an objective of competition. On top of that the World Anti-Doping Code (the Code), that is compiled by the WADA, says that "anti-doping rules are […] sport rules governing the conditions under which sport is played"[34], wherefrom I conclude the Code to apply only to practitioners that practice sport in the competitive context. Since WADA and its Code are nearly a standard for doping rules and violation[35], and the prohibition of Genetic Modification is present in the Code at this moment[36], this prohibition only applies to activities that have a form of competition. Because of this, I added the requirement of competition to the definition.
- Set of rules and customs: Of course, in order to make sure that any form of competition runs smoothly, it is necessary to state and clarify rules and customs to which athletes shall comply, because rules in sport define the field and mode of play plus it is in the essence of sport that the competitors obey to the rules of fair play.[37] This way, there shall be "equity in the conditions or opportunities afforded to *an athlete*"[38], which is the definition of fair play. Therefore, including a requirement of rules and to the definition of sport, in conjunction with the requirement of competition, is vital.

2.2. DOPING

2.2.1. DEFINITION OF DOPING

The word "doping" in itself provokes discomfort[39], it is a word that clearly implies a negative attitude against any practice labeled as such.[40] But what is the actual definition of doping? What do we mean when we refer to this practice?

[33] The Oxford English Dictionary http://www.oed.com/view/Entry/187476?rskey=e6laBs&result=1&isAdvanced=false#eid under 4.a. (visited 14 July, 2012)
[34] World Anti-Doping Code, p. 17, available at: http://www.wada-ama.org/Documents/World_Anti-Doping_Program/WADP-The-Code/WADA_Anti-Doping_CODE_2009_EN.pdf (visited July 15, 2012)
[35] Vieweg 2004, p. 37
[36] Forbidden metod M3 on the 2012 Prohibited List.
[37] Bahrke 2002, foreword.
[38] Oxford English Dictionary, cursive added http://www.oed.com/view/Entry/67704?redirectedFrom=fair+play#eid4659098, under c. (visited July 15, 2012)
[39] Hilvoorde, Vos & de Wert 2007, p. 173
[40] Fore 2010, p. 85

According to the Oxford English Dictionary, "to dope" has its origin in the US and can be defined as "to administer dope to (a person, a horse); to stupefy with a drug; to drug".[41] The American Oxford Dictionaries narrow this further down to "administer drugs to (a racehorse, greyhound, or athlete) *in order to inhibit or enhance sporting performance.*"[42] So according to the definitions given by these dictionaries, three criteria can be stated: (1)there must be some use of a drug, (2)which is administered to an animal or athlete, (3) to inhibit or enhance sporting performance.

However, for the specific purposes of this thesis, a lexicographic definition is not enough. Since this thesis is about the ethical and legal aspect of genetic modification in sport, an inquiry of the definition as given in the laws is necessary. Unfortunately, there is no common legal definition of the term "doping" as yet. The different international sports organizations all have their own definition of "doping", with ever so often small variations.[43] I will use some of these differences to create a definition of doping for the use of this thesis.

Since the World Anti-Doping Code (WADC) of the World Anti-Doping Agency (WADA) is nearly a standard for doping regulation[44], I will discuss the definition of doping given in this code first. Article 1 of the WADC defines doping as follows[45]:

> *Article 1: Definition of Doping*
> *Doping is defined as the occurrence of one or more of the anti-doping rule violations set forth in Article 2.1 through 2.8 of the Code.*

Article 1 WADC does not give clear criteria to define "doping", but gives an abstract definition by referring to a list of forbidden practices that constitute anti-doping rule violations.[46] Articles 2.1 through 2.8 follow with different kinds of anti-doping violations, listing for example the use of forbidden methods and substances as well as failing a drug test.[47] These articles will be elaborated in section 3.1.1.

The International Olympic Committee (IOC) has been using a similar abstract definition of doping. Before the 2012 London Olympics, the IOC has released a new version of "The

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[41] Oxford English Dictionary http://www.oed.com/view/Entry/56853?redirectedFrom=doping#eid6141076, under 1.a. (visited August 1, 2012)
[42] The Oxford Dictionaries http://oxforddictionaries.com/definition/english/dope?q=doping#dope__9, under "verb" 1, (visited August 1, 2012)
[43] Vieweg 2004, p. 37
[44] Vieweg 2004, p. 38
[45] Article 1 WADC, available at http://www.wada-ama.org/Documents/World_Anti-Doping_Program/WADP-The-Code/WADA_Anti-Doping_CODE_2009_EN.pdf (visited August 1, 2012)
[46] Vieweg 2004, pp. 38-39
[47]Article 2.1-2.8 WADC

International Olympic Committee Anti-Doping Rules", which are "applicable to the Games of the XXX Olympiad, London 2012" (the Rules).[48] In the Rules, doping is defined in the Articles 1 and 2.

> *Article 1: Application of the Code – Definition of Doping – Breach of the Rules*
> *1.1 The Commission of an anti-doping rule violation is a breach of these Rules.*
> *1.2 Subject to the specific following provisions of the Rules below, the provisions of the Code and of the International Standards apply mutatis mutandis in relation to the London Olympic Games.*
>
> *Article 2: Anti-Doping Rule Violations*
> *Article 2 of the Code applies to determine anti-doping rule violations, with the following amendments:*
> *(A)Possession of Prohibited Substances and Methods*
> *[…]*

As you can see, the IOC "defines" doping as "the commission of an anti-doping rule violation" and refers to the list of anti-doping rule violations stated in the WADC (the Code), while adding the "Possession of Prohibited Substances and Methods", which are explained in Article 3 of the Rules.[49] Again, clear criteria are not given, yet referring to a list of anti-doping rule violations takes place.

These abstract definitions are the ones I will keep in mind while writing this thesis. Doping shall be considered "The use of prohibited substances or methods that are listed as anti-doping rules violations in the WADC or the Rules"

[48] Front page of The International Olympic Committee Anti-Doping Rules applicable to the games of the XXX Olympiad, London 2012. Available at: http://www.olympic.org/Documents/Games_London_2012/Anti-doping/IOC_Anti-Doping_Rules_London%20_2012-eng.pdf (visited August 3, 2012)
[49] Article 1, 2 and 3 IOC Anti-Doping Rules

2.2.2. GENETIC MODIFICATION IN SPORT: DOPING OR NOT?

Let's have a quick look at genetic modification in sport and doping. Can genetic modification be arrayed under "The use of prohibited substances or methods that are listed as anti-doping rules violations in the WADC or the Rules"? According to Article 2.2 WADC, the "use or attempted use by an athlete of a Prohibited Substance or a Prohibited Method" is considered an anti-doping rules violation.[50] The list of Prohibited Methods includes gene doping: [51]

> *M3. Gene Doping*
> *The following, with the potential to enhance sport performance, are prohibited:*
> *1. The transfer of nucleic acids or nucleic acid sequences;*
> *2. The use of normal or genetically modified cells.*

By labeling genetic modification as gene doping, the official negative attitude towards the practice is shown[52], and thus it is considered a form of doping, so it is prohibited.

2.3.GENETIC MODIFICATION

In this section I will explain how genetic modification takes place. But before that is even possible, we first have to set clear what it is that is modified, *genes.*

2.3.1. GENES

During the nineteenth century, the basic rule of genetics and inheritance where identified by an Austrian (nowadays Czech Republic) monk named Gregor Mendel (1822-1884). He studied pea plants and this study eventually revealed how molecular biology works. [53]

Mendel's work was forgotten until the beginning of the twentieth century, when it was "rediscovered" by several scientists. It was found that the rules that Mendel worked out based on his research on pea plants were equally important to humans in determining human disease, which they were applied to by Sir Archibald Garrod, an English clinician. [54] More by intuition than from demonstration, Garrod understood that there were medical conditions that resulted from defects in the chemical factors that determined the mechanics in the human body that are used for the production or metabolism of chemical modules. Therefore he used the term 'inborn

[50] Article 2.2 WADC
[51] The World Anti-Doping Code, the 2012 Prohibited List, International Standard. Available at: http://www.wada-ama.org/Documents/World_Anti-Doping_Program/WADP-Prohibited-list/2012/WADA_Prohibited_List_2012_EN.pdf (visited August 3, 2012)
[52] Fore 2010, p. 85
[53] Miah 2004, p. 43
[54] Schneider & Friedmann 2006, pp. 11-12

errors of metabolism' as a description of these processes that led to the emergence of hereditary human conditions.[55]

The phrase Garrod used to describe above named processes, 'inborn errors of metabolism', is filled with prescience and insight. 'Inborn' reflects Garrod's understanding that it was the human equivalent of the genetic determinants that Mendel discovered about fifty years before. He understood that this human equivalent underlay human disease as those of a pea plant determine whether or not a pea is wrinkled.[56] Choosing the world's 'errors' shows that Garrod realized that the factors discovered by Mendel exist in an altered form in hereditary diseases, making them responsible for the production of deviant physical properties in humans.[57] Finally, the word 'metabolism' reflects that Garrod understood function of these factors, whether they functioned normally or abnormally, was to drive metabolism inside the human body.[58]

In 1944, Oswald Avery was the first to discover the genetic material that would be called deoxyribonucleic acid, more commonly known as DNA.[59] He and his team discovered that it was "possible to permanently and heritably change the infectivity properties of a strain of the bacterium pneumococcus[60] by introducing DNA from a different strain"[61] The experiments conducted by Avery and his team led to the belief that genes were composed of just one particular form of DNA, and that the properties of all living things and their future generations were determined by the information in this molecule.[62]

Although Avery made his discovery in 1944, it took until 1953 before a full description of DNA was published by Francis Crick and James Watson. This publication caused a change in the way that human biology was understood, and made way for a new discipline of molecular biology.[63] They described that 'a gene is a piece of information coded on a segment of DNA', and 'it consists of a unique order of nucleotide bases'[64]. A nucleotide base is described as 'a member of a class of organic compounds in which the molecular structure comprises a nitrogen-containing unit (base) linked to a sugar and a phosphate group'.[65] There are four standard types of nucleotide bases:

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[55] *Id.*
[56] Schneider & Friedmann 2006, p. 12
[57] *Id.*
[58] *Id.*
[59] Miah 2004, pp. 43-44
[60] According to Encyclopedia Britannica, Pneumococcus is a bacterium in the family Streptococcaceae that causes human diseases such as pneumonia, sinusitis, otitis media, and meningitis. http://www.britannica.com/EBchecked/topic/465467/pneumococcus (visited July 4, 2012)
[61] Schneider & Friedmann 2006, p. 14
[62] *Id.*
[63] Miah 2004, p. 44
[64] *Id.*
[65] Encyclopedia Britannica http://www.britannica.com/EBchecked/topic/421985/nucleotide (visited July 4, 2012)

adenine (A), thymine (T), guanine (G), and cytosine (C).[66] These four bases encode a number of different proteins, with current estimates at 5 proteins per gene (as mentioned above, genes consist of a unique order of these nucleotide bases), and can be found in all living organisms.[67]

Genetic information –the genetic code- is made up by the sequence of previously mentioned bases in different orders and combinations along the backbone. Occurrence in various orders is what makes the 'four-letter alphabet' of bases communicate subtle instructions to our body and once we understand the code it creates, it is possible to explain how specific functions in the body operate and why dysfunctions might occur.[68]

Thanks to the advances since 1953, we have been able to map the characterization of the human genome in its totality. Because of all these advances we now know three things: (1)the genetic information of all living organisms is contained in a sequence of four standard types of nucleotide bases; (2)normal variations among individuals of a species can be accounted for by many naturally occurring differences in this sequence; (3)some differences that occur in the sequence of genes, both naturally or induced by environmental influences, are the cause of severe disorganization of the normal metabolic, cellular functions to cause disease.[69]

The human DNA consists of forty-six chromosomes, which makes twenty-three base pairs, and in the human body there are around 25,000[70] different genes. These genes are, as described above, responsible for encoding a number of biological compounds we call proteins. Gene expression also takes place in the human body, which basically is a process by which a gene is transcribed into messenger ribonucleic acid (mRNA), which has the function of transmitting information from DNA to the cytoplasm[71], by which the chemical process in the cell is controlled.[72]

2.3.2. HOW DOES GENETIC MODIFICATION WORK?

Genetic modification is the technique of inserting well-functioning genes into cells in order to correct a genetic error in those cells, or to introduce a new function to the cells.[73] This technique used to be called 'gene therapy', but the preferred terminology at the moment is 'genetic transfer

[66] Miah 2004, p. 43
[67] *Id.*
[68] *Id.*
[69] Schneider & Friedmann 2006, p. 14
[70] According to Encyclopedia Britannica
http://www.britannica.com/EBchecked/topic/1377262/human-genome
[71] According to Encyclopedia Britannica, cytoplasm is the semifluid substance of a cell that is external to the nuclear membrane and internal to the cellular membrane, and is sometimes described as the nonnuclear content of protoplasm.
http://www.britannica.com/EBchecked/topic/148950/cytoplasm (visited July 4, 2012)
[72] Miah 2004, p. 43
[73] *Id.*

technology', because it is not clear that modifications will have a therapeutic intervention in all cases.[74]

Genetic modification can take place in various ways and has made progression since the science has become more refined. For some time it was believed that the best way of introducing new genes into cells might be to simply blast them in using a biolistic or particle gun. This method involves mixing DNA with tiny metal particles, and then fires it into a tissue culture of cells or into an organism itself. It has been noted that this method has not been very effective, as it may damage the cells and it is not very successful at promoting the update of foreign DNA.[75] It is also possible to transmit the genetic material by injecting it in the organism. This ensures a better uptake of the foreign DNA.[76] Another vectorless method involves electroporation. In this method, the cells that are to be genetically engineered are placed in a solution of the foreign DNA and the integration of the new genetic material into the host cells is then stimulated by applying a high-voltage electric field.[77]

A completely different method is by using some kind of vehicle, named a vector, to transfer the genetic material into human cells and tissues.[78] "A vector is an organism that carries genetic material from one species (the donor species), and finally injecting the species (carrying the new genetic material) into the host."[79] To make this even more efficient, DNA can be wrapped into a virus particle, while the dangerous parts of the virus have been disabled through genetic modification. This way the harmful virus genes are removed and replaced by the donor gene.[80] After injection with the viral vector, the virus will begin infecting the cells with the new DNA, and in that way it will be transferred throughout the organism.[81] These vectors have been constructed from different kind of viruses, including potentially dangerous viruses like the human immunodeficiency virus (HIV), herpes viruses, pox viruses or cancer-causing mouse leukemia viruses. In all cases, the dangerous genes of these viruses were removed or deactivated, which gave the virus only one function: act as a 'Trojan horse' and sneak the foreign genes into the organism's cells.[82]

[74] Miah 2004, p. 45
[75] *Id.*
[76] *Id.*
[77] *Id.*
[78] Schneider & Friedmann 2006, p. 20
[79] Miah 2004, p. 45
[80] Schneider & Friedmann 2006, p. 20
[81] Miah 2004, p. 45
[82] Schneider & Friedmann 2006, pp. 20-22

There are different ways of using a vector to insert the foreign genes. Retroviruses[83] can be delivered 'ex vivo' (outside the body) as well as 'in vivo' (inside the body).[84] 'Ex vivo' entails reintroducing genetically corrected cells into the patient.[85] The cells that do not function properly are taken from the patient, they are transformed in culture with the missing gene carried in a suitable gene transfer vector, and then the corrected cells are put back into the patient.[86] The use of the patients own cells have the advantage of avoiding rejection by the patient's body, which could be possible if the cells were from another donor.[87]

When using 'in vivo' gene transfer, the retroviruses are injected directly into the organism. However, this could be problematic, because retroviruses have the habit to insert themselves at random, which often causes cancers to form. Because of their random insertion, the retroviruses used for gene transfer are hard to control.[88] On top of that, retroviruses only infect dividing cells, and since there are many genetic disorders that are not cause of mutations in dividing cells, there is only limited success achieved when using retroviruses 'in vivo'.[89]

More successful is the method of 'in vivo' gene delivery while using adenoviruses[90], which involves inserting functional copies of a gene. These kinds of viruses have a more efficient insertion rate, but the rapid uptake it causes tends to decrease quickly with time and it can often be the cause of a seditious response in the host cells.[91] At the moment, retroviruses are considered to be most effective for 'ex vivo' gene transfer, and adenoviruses are the most effective for 'in vivo' gene transfer.[92]

2.3.3. GENETIC MODIFICATION IN SPORT

Now that it's been outlined how genetic modification works, it can be discussed how genetic modification can be used in sport.

The discovery of performance-related genes and their protein products happen at a rapid pace. In 2005, there were an estimated 187 genes known that were associated with performance and

[83] According to Encyclopedia Britannica, retroviruses are viruses that, unlike most other viruses, carry their genetic blueprint in the form of RNA.
http://www.britannica.com/EBchecked/topic/500146/retrovirus (visited July 5, 2012)
[84] Miah 2004, p. 45
[85] Schneider & Friedmann 2006, p. 22
[86] Miah 2004, p. 45
[87] Schneider & Friedmann 2006, p. 22
[88] Miah 2004, p. 45
[89] *Id.*
[90] According to Encyclopedia Britannica, the adenovirus is any virus belonging to the family Adenoviridae, a group of viruses which are known to cause e.g. a sore throat and fever in humans.
http://www.britannica.com/EBchecked/topic/5760/adenovirus (visited July 6, 2012)
[91] Miah 2004, p. 46
[92] *Id.*

fitness,[93] and as research progresses, more performance related genes and their proteins shall be added to that amount.[94]

Athletes have always looked for a way to improve their performance, which makes it likely that the arrival of genetic modification will not be overlooked; creating the idea that sport could be one of the earliest areas where genetic modification could be attempted.[95] Then, the genes that are associated with performance and fitness would be the topic of this genetic modification. Because of the development of tools for gene transfer being applied successfully in cases of life-threatening diseases, the temptation to apply the same technology on people that do not have a disease but simply want to augment or improve their 'normal' human functions increases.[96]

One of the candidates for genetic modification is the gene coding for the production of the erythropoietin (EPO) hormone.[97] EPO is produced by the kidneys and the hormone guides the production of red blood cells, and more blood cells means a better oxygen intake. This enhancement would give endurance-athletes the possibility to strain themselves for a longer period without tiring.[98] The research on identifying the effects of inserting EPO into a virus and inserting it into the body to improve endurance is already taking place, and with positive effects: "by inserting the gene into a virus strand, it was subsequently transported throughout the body and did, indeed, have the effect of increasing the level of red blood cells that were being pumped around the body".[99]

In an experiment done in 2003 by scientists of Stanford University, California, EPO was introduced into a virus vector and the vector was used to infect human skin cells that were being grown in the laboratory. These genetically modified cells were transplanted into mice (thus an 'ex vivo' gene transfer) to do research on its effect. The EPO gene was altered, so it would only express in the presence of a certain type of steroid. The mice that did not yet receive the inducing steroid kept perfectly normal levels of EPO and red blood cells, but when the steroid was applied in the form of a topical cream, the genetically modified cells responded by increasing the production of EPO leading to an increased production of red blood cells by the bone marrow.[100] However, other groups that introduced the EPO gene via a virus vector in monkeys, have studies that show that a high percentage of monkeys have developed life-

[93] Rankinen et al. 2006, pp. 1881: Speaking of 165 autosomal entries, 5 X-chromosome assignments, and 17 mitochondrial DNA markers.
[94] Solomon et al. 2009, p. 251
[95] Schneider & Friedmann 2006, p. 37
[96] Schneider & Friedmann pp. 37-38
[97] Schneider & Friedmann p. 38
[98] Fore 2010, p. 79
[99] Miah 2004, p. 49
[100] Schneider & Friedmann pp. 44-45

threatening anemias, presumably because of an immune response to the vector itself. This shows that the EPO gene transfer technology has not yet developed well enough to be used to improve the normal human traits.[101]

Another example is the research of Professor Lee Sweeney and his team, who studied "in vivo" gene transfer in mice using insulin-like growth factor 1 (IGF-1), which is a protein that stimulates muscle growth.[102] It has been proven that injecting IGF-1 or the gene that encodes it into skeletal muscle causes the muscle to become hypertrophic[103], which means that each individual muscle cell becomes larger, resulting in bigger and stronger muscles.[104] Because of the hypertrophy, the muscle is able to contract with greater force, the recovery of the muscle takes less time, and repairing an injured muscle happens quicker.[105] Sweeney actually researched a synthetic form of IGF-1 and its possibility to repair muscle tissue, but its application to mice demonstrated an enhancing effect[106], resulting in so called 'Schwarzenegger mice'.[107] An additional benefit of using IGF-1 as genetic modification is that when injecting the gene in a specific muscle, the effect is localized.[108] Figure 1 illustrates the "in vivo" gene transfer of EPO and IGF-1 as described above.

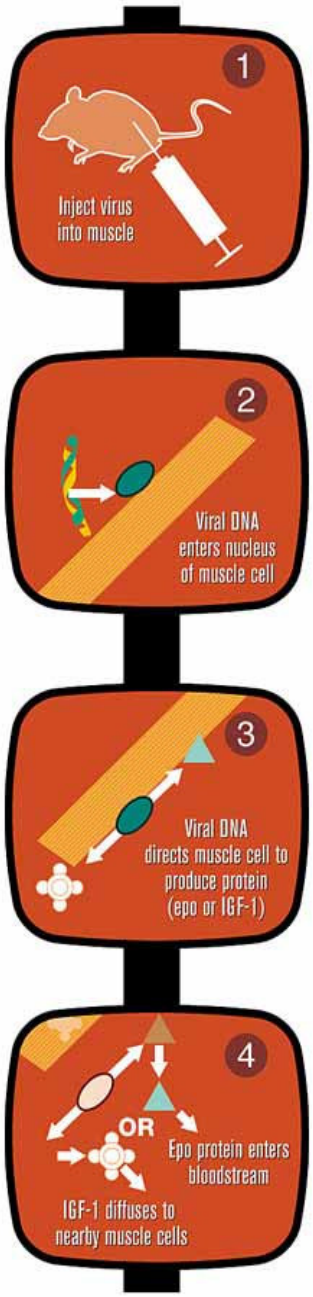

FIGURE 1

While IGF-1 stimulates muscle growth, there's another gene that counters the growth-stimulatory properties of IGF-1 and other growth factors. The myostatin gene is one of those genes. By inactivating the myostatin gene, the balanced state of growth that should be reached by the myostatin gene counteracting to the IGF-1 gene is shifted, resulting to an unbalanced state, which increases the effect of the IGF-1 produced by the body itself (thus, without even using the IGF-1 "in vivo" gene

[101] Schneider & Friedmann p. 45
[102] Fore 2010, p. 79
[103] Schneider & Friedmann, p. 42
[104] Encyclopedia Britannica http://www.britannica.com/EBchecked/topic/275628/human-disease/63209/Metabolic-control#toc63210 (visited July 12, 2012)
[105] Schneider & Friedmann, p. 42
[106] Miah 2004, p. 49
[107] Schneider & Friedmann, p. 43
[108] Aschwanden 2000

transfer as described above). Research on mice that had the myostatin gene inactivated showed that the mice had bigger, stronger muscles than those of normal mice, a similar result as Professor Lee Sweeney and his team reached with their IGF-1 research.[109] A side effect of inactivating or inhibiting the myostatin gene is that it could reduce body fat, which is another attractive benefit to athletes.[110]

Finally, genetic modification might create the possibility to alter the metabolism of particular muscles.[111] Muscle tissue contains different kind of muscle cells that each have a different rate of burning energy and thus effecting both muscle function and athletic performance.[112] A distinction is made between two different types of muscle fibers: Type I, slow twitch muscle fibers (red fibers) and Type II, fast twitch muscle fibers (white fibers).[113] Type I, or slow twitch muscle fibers, are more resistant to fatigue than Type II, or fast twitch muscle fibers. This is probably because of the higher content of mitochondria[114], which gives Type I muscle fibers the ability to efficiently convert fat to energy. Type II muscle fibers contain fewer mitochondria and are therefore dependent on energy production from glucose.[115] Research done by Professor Ronald Evans and a group of scientist showed that mice that are expressing an excessive amount of the PPAR delta gene, had an increased number of slow-twitch fibers. As a result, these mice had a reduced amount of body fat and were utilizing their energy more efficient during endurance exercising. Therefore, they were called "marathon mice".[116]

These are three examples done on mice that show how genetic modification could have a possible application to sports and the results might be game-changing. Already, there are more examples of research on genetic modification that could be interesting for use in sports. Although it is not yet clear whether genetic modification could be used to safely engineer the human genome with enhancing results, as findings from research done on mice do not have to

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[109] Schneider & Friedmann, p. 43
[110] Fore 2010, p. 80
[111] *Id.*
[112] Schneider & Friedmann 2006, p. 45
[113] According to information on Encyclopedia Britannica:
http://www.britannica.com/EBchecked/topic/638973/weight-training#ref857026 (visited July 13, 2012) and
http://www.britannica.com/EBchecked/topic/371756/meat-processing/50324/Myoglobin-content#ref501721 (visited July 13, 2012)
[114] According to Encyclopedia Britannica, a mitochodrion is a membrane-bound organelle found in the cytoplasm of almost all eukaryotic cells (cells with clearly defined nuclei), the primary function of which is to generate large quantities of energy in the form of adenosine triphosphate (ATP), which is a type of energy carrying molecule.
http://www.britannica.com/EBchecked/topic/386130/mitochondrion (visited July 13, 2012)
[115] Schneider & Friedmann 2006, p. 46; According to Encyclopedia Britannica, glucose is one of a group of carbohydrates known as simple sugars.
http://www.britannica.com/EBchecked/topic/235853/glucose (visited July 13, 2012)
[116] Schneider & Friedmann 2006, p. 46

translate well to human functioning,[117] the outlined researches do raise expectations. In context of the expectation that the use of genetic modification of an athlete could one day be possible, it is explainable that international sport organizations such as the WADA take this matter seriously.[118] Even though, with the current technology, any genetic modification undertaken with the purpose of enhancing athletes would be unsafe and would lack full disclosure and informed consent, since there is still much that we do not know.[119]

[117] Hendricks 2010
[118] Miah 2004, p. 51
[119] Schneider & Friedmann 2006, pp. 46-47

3. RELEVANT REGULATION

3.1.INTERNATIONAL REGULATION

In this section I will discuss the relevant regulation on an international level, starting with the World Anti-Doping Code. After that, I will briefly discuss the Strasbourg Anti-Doping Convention of 1989.

3.1.1. WORLD ANTI-DOPING CODE

The World-Anti Doping Agency was created as an independent organization to promote, coordinate, and monitor the global efforts of doping prevention in athletic competition. One of its duties was to draft the World Anti-Doping Code (WADC)[120] implemented in 2004[121], which has become the international standard for the regulation on testing, adjudication and punishment of athletes and support staff found guilty of engaging or assisting in doping.[122] Associated with the WADC, WADA publishes a "List of Prohibited Substances and Methods" (the List) every year.[123]

The WADC and the accompanying List can be considered to have a special status. Since the WADA is an independent, private organization the WADA cannot be seen as a treaty or any other kind of law, it is private regulation. Because of the hierarchical structure between WADA (as the international anti-doping organization) and the national anti-doping organizations, the definitions of doping (and what is considered an anti-doping rule violation) are transferred from WADA to the rules stated by the national anti-doping organizations.[124] Therefore, as mentioned in the introductory chapter, the WADC has become a standard for doping rules and regulations.[125] The relationship between WADA and the national anti-doping organizations as well as the transferring of rules from WADA to the national anti-doping organizations are organized by civil law, which will be further explained in section 3.1.1.3.

The latest issue of the WADC has been released in 2009 and gives the following definition of doping:[126]

[120] Solomon et. al 2009, p. 254
[121] Custer 2007, p. 191
[122] Solomon et. al 2009, p. 254
[123] Custer 2007, p. 193
[124] Vieweg 2004, p. 37
[125] Vieweg 2004, p. 38
[126] The World Anti-Doping Code can be found at: http://wada-ama.org/Documents/World_Anti-Doping_Program/WADP-The-Code/WADA_Anti-Doping_CODE_2009_EN.pdf (visited August 28, 2012)

"Article 1: Definition of Doping
Doping is defined as the occurrence of one or more of the anti-doping rule violations set forth in Article 2.1 through Article 2.8 of the Code."

Article 2 WADC states the anti-doping rule violations, as is mentioned in Article 1 WADC. According to Article 2, athletes or other persons that the WADC applies on are held responsible for "knowing what constitutes an anti-doping rule violation and the substances and methods which have been included in the Prohibited List".[127] The paragraphs of Article 2 sets what is constituted as anti-doping rule violations.

Paragraph 2.1 states that an Athlete is personally responsible for the presence of a prohibited substance or its metabolites or products to mark the presence of such a substance in the sample that is taken from the athlete. The demonstration of intent, fault, negligence or knowing use by the athlete is not necessary for the presence to be listed as an anti-doping rule violation.

The use or attempted use of a prohibited substance or method by an athlete is listed as an anti-doping rule violation in paragraph 2.2. It is seen as the athlete's personal duty to ensure that there are no prohibited substances in his or her body, and again the demonstration of intent, fault, negligence or knowing use is seen as unnecessary.

If an athlete refuses or fails to submit a sample after he has been notified to do so and this is without compelling justification, this is also seen as an anti-doping rule violation under paragraph 2.3. The same goes for any other way of evading sample collection.

Paragraph 2.4 lists the "violation of applicable requirements regarding athlete availability for out-of-competition testing". This includes the failure to file required whereabouts information and missed tests which are declared. If any combination of three of these facts takes place within an eighteen month period, it is constituted as an anti-doping rule violation.

The tampering or an attempt to tamper within any part of doping control is prohibited in paragraph 2.5. According to the comments on this paragraph, it is meant to prohibit conduct which "subverts the doping control process" but which is or cannot be included in the definition of "prohibited methods". Examples given are "the altering identification numbers on a doping control form during testing, breaking the B bottle at the time of B sample analysis or providing fraudulent information to an Anti-Doping Organization."[128]

[127] Article 2 WADC
[128] WADC p. 23

Possession of prohibited substances or methods is listed as an anti-doping rule violation under paragraph 2.6. This paragraph does not only apply to athletes in-competition, but also to those out-of competition as well as supporting personnel of an athlete in- or out-of-competition.

Paragraph 2.7 forbids the trafficking or attempted trafficking of a forbidden substance or method.

The last paragraph of Article 2, paragraph 2.8, lists the "administration or attempted administration to any athlete in-competition of any prohibited method or prohibited substance".[129] This also applies to the administration or attempted administration of a prohibited substance or method that is prohibited out-of-competition to an athlete out-of-competition. Finally, paragraph 2.8 also lists the assistance, encouragement, aiding, abetting, covering up or any other type of complicity that involves an anti-doping rule violation or an attempted anti-doping rule violation as an anti-doping rule violation.

In light of this thesis it is important to mention that the "List of Prohibited Substances and Methods" mentioned above has been amended to include gene doping as a prohibited method. The following proscription can be found in the 2012 Prohibited List:[130]

> *"M3. Gene Doping*
> *The following, with the potential to enhance sport performance, are prohibited:*
> *1. The transfer of nucleic acids or nucleic acid sequences;*
> *2. The use of normal or genetically modified cells."*

3.1.1.1. SANCTIONS

Article 10 WADC contains the sanctions that are put on individuals who commit an anti-doping rule violation. There are two types of sanctions: Disqualification (art. 10.1 WADC) and Ineligibility (art. 10.2 WADC). *Disqualification* takes place when an anti-doping rule violation is detected during an event. The possibility of *ineligibility* will be imposed after the event, and has effect on all future events of competition for the length of the ineligibility. In other words, an athlete will not be able to take part in the competition as long as the ineligibility applies. The standard sanction for a first anti-doping rule violation is a two years ineligibility for violation of Article 2.1 (Presence of Prohibited Substance or its Metabolites or Markers), 2.2 (Use or Attempted Use of Prohibited Substance or Prohibited Method) or 2.6 (Possession of Prohibited

[129] Art. 2.8 WADC
[130] The 2012 Prohibited List can be found at: http://wada-ama.org/Documents/World_Anti-Doping_Program/WADP-Prohibited-/2012/WADA_Prohibited_List_2012_EN.pdf (visited August 28, 2012)

Substances and Prohibited Methods) of the WADC.[131] For violating Article 2.3 (Refusing or Failing to Submit to Sample Collection) and 2.5 (Tampering with Doping Control) the period of ineligibility will be two years too.[132] However, the violations of Article 2.7 (Trafficking or Attempted Trafficking) and 2.8 (Administration or Attempted Administration of Prohibited Substance or Prohibited Method) lead to an ineligibility with the minimum length of four years up to a lifetime.[133] The least ineligibility is given for violating Article 2.4 (Whereabouts Filing Failures and/or Missed Tests). The minimum period in this case is one year, and the maximum is up to two years, based on the athlete's degree of fault.[134]

The Articles 10.4 (Specified Substances under Specific Circumstances) and 10.5 (Exceptional Circumstances) WADC state the possibilities of elimination or reduction of the period of Ineligibility. On the other hand, Article 10.6 WADC states "Aggravating Circumstances which may *Increase* the period of ineligibility".

Article 10.7 deals with multiple anti-doping violations. If an athlete has been convicted of a second anti-doping rule violation, the length of ineligibility shall be determined according to the following table: [135]

Second Violation / First Violation	RS	FFMT	NSF	St	AS	TRA
RS	1-4	2-4	2-4	4-6	8-10	10-life
FFMT	1-4	4-8	4-8	6-8	10-life	life
NSF	1-4	4-8	4-8	6-8	10-life	life
St	2-4	6-8	6-8	8-life	life	life
AS	4-5	10-life	10-life	life	life	life
TRA	8-life	life	life	life	life	life

The numbers in this table stand for the range wherein the length of the ineligibility shall be determined, with "life" being a lifetime ban. The abbreviations stand of the following definitions:[136]

RS Reduced sanction for Specific Substance under Article 10.4

FFMT Filing Failures and/or Missed Tests under Article 10.3.3

NSF Reduced sanction for No Significant Fault or Negligence under Article 10.5.2

[131] Article 10.2 WADC
[132] Article 10.3.1 WADC
[133] Article 10.3.2 WADC
[134] Article 10.3.3 WADC
[135] Source: World Anti-Doping Code, p. 66
[136] World Anti-Doping Code, p. 67

St Standard sanction under Articles 10.2 or 10.3.1

AS Aggravated sanction under Article 10.6

TRA Trafficking or Attempted Trafficking and administration or Attempted administration under Article 10.3.2

For example, if an athlete's first violation was a Standard sanction under Articles 10.2 or 10.3.1 (St) and his second violation is a Filing Failure under Article 10.3.3, the length of the ineligibility for his second sanction will be 6-8 years, instead of the 1-2 years that would been given if the Article 10.3.3 offence was his first offence. Article 10.7.2 WADC states that a second anti-doping violation could establish entitlement to suspension or reduction according to Article 10.5.3 or 10.5.4 WADC.

When an athlete is condemned to a third anti-doping rule violation, the result will be a lifetime period of ineligibility, except when the third anti-doping rule violation qualifies for elimination or reduction of the period of ineligibility under Article 10.4 or if it involves an Article 2.4 (Filing Failures and/or Missed Tests) violation. In these cases, the period of ineligibility will have a minimum of eight years and a maximum of a lifetime.[137]

3.1.1.2. STRICT LIABILITY

As the wording of the anti-doping rule violations mentioned in the WADC indicates, strict liability is used in doping cases, because liability is not limited to actual intention of the athlete to use doping substances or methods.[138] For example, article 2.1 WADC states that "Presence of a Prohibited Substance or its Metabolites or Markers in an Athlete's Sample" is enough to justify a doping offence. This article does not mention the intention of an athlete to use a Prohibited Substance, given the possibility that contaminated food products or supplements could be the reason of a negative result in a doping test. It does not matter how the banned substance got into an athlete's body, the athlete is held strictly liable to the presence of the banned substance in his or her body.[139] An example in the jurisprudence is the case CAS 2002/A/376, where an athlete was stripped of his bronze medal won at the Salt Lake City Winter Olympics.[140] The athlete bought an over-the-counter medication which contained a banned substance while in Salt Lake City, not knowing that the same product back home in the UK was of a different formula that didn't contain the banned substance. Although the panel did not find the athlete guilty to intend to digest the banned substance, he was found guilty of committing a doping offense and his disqualification was upheld.

[137] Article 10.7.3 WADC
[138] McNamee Tarasti 2011, p. 16
[139] Connolly 2006, p. 180
[140] CAS 15 October 2002, nr. 2002/A/376 *(Baxter/International Olympic Committee (IOC)*

This use of strict liability can be justified "as the standards of criminal proof would be unreasonably high to establish against athletes who necessarily dope in private".[141] The Court of Arbitration for Sport (CAS or TAS: Tribunal Arbitral du Sport), created in 1983 by the International Olympic Committee (IOC) as a respond to the need for an independent international tribunal specialized in settling sport-related disputes[142], emphasizes this in its jurisprudence:[143]

> *Too literal an application of the principle "Nulla poena sine culpa"* (no punishment without guilt) *could have damaging consequences on the effectiveness of anti-doping measures. Indeed, if for each case the sports federations had to prove the intentional nature of the act (desire to dope to improve one's performance) in order to be able to give it the force of an offence, the fight against doping would become practically impossible.*

To ensure fairness for the other athletes that are taking part in the same competition, an automatic disqualification during a competition is enforced when a Prohibited Substance or use of a Prohibited Method is found.[144] This has been explained in the case CAS 94/126, which was about a doped horse. The panel considered that "the interests of the rider of a doped horse, even if he/she is totally innocent, must be weighed up against those of all the other competitors who entered the event 'clean'."[145] This same logic has been followed with human competitors in CAS 95/141: "Once a banned substance is discovered in the urine or blood of an athlete, he must automatically be disqualified from the competition in question, without any possibility for him to rebut the presumption of guilt."[146] This principle that has emerged in case law over the years has been adopted by the WADA in the WADC and has been expressed as strict liability.[147]

3.1.1.3. CIVIL (CONTRACT) LAW

It must be stated that WADA is a private foundation, which has the result that the juridical norms of the WADC are not generally binding, but rather have governance over those sport organizations that are signatories to the WADC.[148] Therefore, the WADA does not by itself enforce the WADC nor punishes athletes who committed offenses. This is done by Sports Federations (SFs), which are obliged by the WADC to apply to the obligatory articles of the WADC and follow its principles, even when these SFs have their own anti-doping regulation.[149]

[141] McNamee & Tarasti 2011, p. 16
[142] Connolly 2006, p. 163
[143] CAS 22 April 1996, nr. 95/141, point 13 (English translation in McNamee & Tarasti 2011)
[144] Connolly 2006, p. 178
[145] CAS 9 December 1998, nr. 94/126, point 7 (English translation in Connolly 2006)
[146] CAS 22 April 1996, nr. 95/141, point 15 (English translation in Connolly 2006)
[147] Connolly 2006, p. 179
[148] McNamee & Tarasti 2011, p. 12
[149] McNamee & Tarasti 2011, pp. 12-13

This results in the juridical norms of the WADC being applicable to all athletes and other people taking part in the sport under the jurisdiction of a signatory of the WADC.[150]

The procedures described in this regulation are of a disciplinary character. Every sportsman that wants to exercise his profession in sport has voluntarily committed himself to this disciplinary law by being a club member or contractually committing himself in order to be able to enter competitions.[151] SFs can be seen as private clubs. These clubs have rules and athletes that want to join have to accept these rules. There are two main types of rules that the athlete agrees to, namely the doping rules and the disciplinary processes under these rules.[152] The sanctions that are applied to violation of the rules are not a punishment in the same sense as in a criminal code, but rather disciplinary consequences which are limited to the power of a private organization. Therefore, when an athlete is accused of breaking the anti-doping rules, it is not questioned if a crime is committed, but if a violation of the rules of a private organization took place. In case of an anti-doping rule violation as mentioned in the WADC, the validity of this violation shall be set by a sports tribunal summoned by either a national or international SF[153], since, as previously mentioned, the WADA does not enforce the WADC by itself.[154]

Although doping law is, as explained above, civil law, CAS applies a requirement that is higher than the "balance of probabilities" that is the typical civil law standard. In CAS 98/211 it decided that "No doubt that the standard of proof required […] is high: less than the criminal standard, but more than the ordinary civil standard", adding the test set out of CAS OG 96/003-004: "ingredients must be established to the comfortable satisfaction of the Court having in mind the seriousness of the allegation which is made".[155]

3.1.1.4. GENETIC MODIFICATION AND THE WADC

In 2004, WADA formed a panel to advise and provide the WADA's Health, Medical and Research Committee with the current information and newest advances on genetic modification. They basically engaged the same individuals who created the genetic modification to find a way to detect genetic doping in athletes.[156] Although the WADA does not see genetic doping as a threat that already exists, they've decided that it's better to be proactive than reactive regarding

[150] McNamee & Tarasti 2011, p. 13
[151] Soek 2001, p. 58
[152] Foster 2001, p. 184
[153] McNamee & Tarasti 2011, pp. 12-13
[154] McNamee & Tarasti 2011, p. 12
[155] CAS 7 June 1999, nr. 98/211, point 26
[156] Custer 2007, p. 200

genetic modification in sport,[157] and while testing for gene doping may be difficult, WADA thinks it's solvable with improved research and technological development.[158]

The first time that gene doping showed up on the WADC was in 2004, with a vague and broad definition:[159]

> *"Gene or cell doping is defined as the non-therapeutic use of genes, genetic elements and/or cells that have the capacity to enhance athletic performance."*

In 2005, the WADA added *"modulation of gene expression"* to this definition and in 2009 a whole new definition was put in use:[160]

> *"The transfer of cells or genetic elements or the use of cells, genetic elements or pharmacological agents to modulating [sic] expression of endogenous genes[161] having the capacity to enhance athletic performance, is prohibited.*
> *Peroxisome proliferator activated receptor δ (PPARδ[162]) agonist (eg GW 1516) and PPARδ-AMP-activated protein kinase (AMPK) axis agonist (eg AICAR) are prohibited."*

The latest edition of the WADC Prohibited List has been released in 2012. This edition contains a simpler and a little broader definition of gene doping, and is of course the definition as used by the WADC today:[163]

> *The following, with the potential to enhance sport performance, are prohibited:*
> *1. The transfer of nucleic acids or nucleic acid sequences;*
> *2. The use of normal or genetically modified cells.*

This proscription shows that there's a dominant anti-modification stance,[164] which is also shown by what Richard Pound, former WADA-president stated: "To misuse this advancement (*genetic modification*) to create super athletes is not acceptable. WADA will fight gene doping as vigorously as it has traditional doping. Competitions should still be won through hard work, training and dedication."[165]

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[157] Custer 2007, p. 199
[158] Schneider 2011, p. 112
[159] Solomon et al. 2009, p. 254
[160] Solomon et al. 2009, p. 254
[161] "Endogenous" means originating from within an organism, tissue or cell.
[162] The phenotype of the PPARδ-null suggests an important role in lipid homeostasis and this protein has received attention as a downstream target of growth regulatory genes.(http://ppar.cas.psu.edu/general_information.html, visited September 3, 2012)
[163] Prohibited Method M3, The 2012 Prohibited List, International Standard, p. 6
[164] Fore 2010, p. 84
[165] Pound 2005, p. 1

3.1.2. STRASBOURG ANTI-DOPING CONVENTION 1989

The most important formal legal point of reference for national legislators is probably the Strasbourg Anti-Doping Convention (the Convention) of 1989.[166] The Convention requires governments to take the necessary steps to apply the provisions of the Convention, with the goal to reduce and eventually eliminate the use of doping in sport.[167] The justifications are listed in the preamble and are as follows:[168]

- Protection of public health and that of athletes.
- Protecting the ethical principles and educational values embodied in the Olympic Charter, in the International Charter for Sport and Physical Education of Unesco and in Resolution (76) 41 of the Committee of Ministers of the Council of Europe ("European Sport for All Charter")
- The responsibilities of the public authorities and the voluntary sports organizations to combat doping in sport, notably to ensure the proper conduct, on the basis of the principle of fair play, of sports events and to protect the health of those that take part in them.

Article 2(1) under c, shows that the scope of the Convention is narrowed down to just organized sports, as it describes sportsmen and sportswomen as "those persons who participate regularly in *organized* sports activities".[169] This would mean that in any other situation or with other purposes of use, the Convention is inapplicable. Think of gyms, aerobic-centers, and/or other clubs that are engaged in any form of physical activity outside of the realm of organized sports.[170]

By aiming solely at organized sports, the Convention becomes coercive for governments to interfere with the fight against doping that is carried out by sports federations and clubs,[171] although article 7 of the Convention simply speaks of "co-operation with sports organizations". In article 4 of the Convention it is set put what kind of measures should be used to for this "co-operation". Governments can choose to "adopt appropriate legislation, regulations or take administrative measures to restrict the availability as well as the use in sport of banned doping agents and doping methods".[172] For those that want to use administrative measures, a criterion

[166] Staveren 2002, p. 46 (own translation)
[167] Article 1 Strasbourg Anti-Doping Convention 1989, available at: http://www.coe.int/t/dg4/sport/Source/CONV_2009_135_EN.pdf (visited September 4, 2012)
[168] Preamble Strasbourg Anti-Doping Convention 1989; Staveren 2002, p. 46
[169] Article 2(1) under C Strasbourg Anti-Doping Convention 1989 (emphasis added)
[170] Staveren 2002, p. 47 (own translation)
[171] Staveren 2002, p. 46
[172] Article 4(1) Strasbourg Anti-Doping Convention 1989

should be made for the grant of public subsidies to sports organizations to make sure that these organizations apply anti-doping regulations.[173] If a sports organization takes insufficient measures to fight doping, public subsidies could be diminished or withdrawn.[174] The Convention entered into force in the Netherlands on June 1, 1995.[175]

3.2. NATIONAL REGULATION

In this section I will discuss the national regulation of the Netherlands, since this is the national regulation of my own nation and I am interested to know how the use of doping dealt with in my own country's legislation. I also think that it gives an important insight on the fact of the way doping can be dealt with in national legislation apart from the above discussed WADC.

I will not discuss the Dutch equivalent of the WADC, because the Dutch National Doping Agency has based the national anti-doping code on the WADC and for a list of forbidden substances and methods reference is made to the latest WADA Prohibited List.[176] Therefore I think it is safe to conclude that the discussion on the WADC in section 3.1 also covers the discussion on the national anti-doping code of the Netherlands.

The relationship between the Dutch law and the Strasbourg Anti-Doping Convention 1989 will be discussed in the next section.

3.2.1. THE NETHERLANDS

Based on the Strasbourg Anti-Doping Convention 1989, the government of the Netherlands decided not to create doping law, but to choose for the possibility of controlled "self-preservation."[177] For the matter of doping, a properly functioning disciplinary law is preferred over criminal law.[178] In the explanatory memorandum belonging to the ratification of the Strasbourg Anti-Doping Convention 1989, reference is made to the two legal regimes that are already limiting the availability of doping products, namely the Dutch "Opiumwet" (Opium Act) and the "Geneesmiddelenwet" (Medicines Act). It is also stated that for the use of doping products, the "Wet op de beroepen in de idividuele gezondheidszorg" (Individual Health Care

[173] Article 4(2) Strasbourg Anti-Doping Convention 1989
[174] Staveren 2002, p. 48
[175] Ministry of Foreigh Affairs: Overeenkomst ter bestrijding van doping. Available at: http://www.minbuza.nl/producten-en-diensten/verdragen/zoek-in-de-verdragenbank/1989/11/003898.html (visited September 3, 2012)
[176] Article 13.1 Nationaal Dopingreglement, available at: http://www.dopingautoriteit.nl/media/files/documenten/Nationaal_dopingreglement_2011.pdf (visited October 19, 2012)
[177] Staveren 2002, p. 48 (own translation)
[178] Bos & Doelder 2002, p. 65 (own translation)

Professions Act) is in place, as well as the medical disciplinary law and the Penal Code.[179] The use of these laws in the fight against doping will be explained one by one in the following sections.

By referring to the Penal Code, Opium Act and Medicines Act, it is clear that the Dutch government does not want to disconnect the fight against doping from the already existing, general policy of possession, dealing and the injudicious or prohibited prescription or prohibited administering of drugs.[180]

3.2.1.1. THE OPIUM ACT

The Opium Act has a double objective. On one hand it is deemed necessary that there are enough drugs available for medical and scientific purposes. But on the other hand it is necessary to counter and prevent the illegal trade in opium and other narcotics.[181] For the misuse of drugs in sport, the Opium Act is only relevant for some of the prohibited substances as listed in the WADA Prohibited List. This goes for amphetamines, cocaine (stimulants) and narcotics (i.e. heroine and morphine).[182]

Article 2 and 3 of the Opium Act prohibits import and export, preparation, manufacturing, processing selling, delivering, distribution or transportation and the possession of the prohibited substances that are covered by the acts accompanying lists I and II or that are appointed under Article 3a(5) of the Act. Acting contrary to the prohibition of Article 2 (which applies to list I) of the Opium Act can lead to an imprisonment with the maximum of six months or a fourth category fine (maximum of €19.500[183]).[184] But when Article 2 is violated intentionally, the punishment can increase to a maximum of twelve years imprisonment or a fine of the fifth category (maximum €78.000[185]).[186] If one acts contrary to Article 3 (which applies to list II) of the Opium Act, the maximum imprisonment will be one month and the fine will be of the second category (maximum €3.900[187]).[188]

[179] *Kamerstukken II* 1991/92, 22671, nr. 3, p. 9 (Explanatory Memorandum)
[180] Staveren 2002, pp 48-49
[181] Pannekeet 2008, p. 34
[182] WADA Report on Anti-Doping Legislation in the Netherlands, under II. Available at: http://www.wada-ama.org/Documents/World_Anti-Doping_Program/WADP-Legal_Library/National_Legislation/Dutch_Legislation_Concerning_Doping_Jan_2007.pdf (visited September 5, 2012)
[183] Art. 23(4) Dutch Penal Code
[184] Art. 10(1) Opium Act.
[185] Art. 23(4) Dutch Penal Code
[186] Article 10(2) to 10(5) Opium Act
[187] Art. 23(4) Dutch Penal Code
[188] Article 11(1) Opium Act

3.2.1.2. MEDICINES ACT

For the misuse of drugs in sport, the Dutch Medicines Act is relevant because it applies to anabolic androgenic steroids, erythropoietin (EPO) and growth hormone.[189] These are so called UR-medicines which are only available on prescription (UR stands for "Uitsluitend op Recept", which is Dutch for "exclusively on prescription"[190]).[191] Without a European trade license it is prohibited to market these medicines.[192] In 2001, illicit drug trafficking has been labeled as a so called "economic offense", which increases the possible punishment severely.[193] In accordance with the Economic Offences Act (Wet Economische Delicten), there's a possible maximum imprisonment of 6 years or a fine of the fifth category (maximum €78.000[194]).[195]

Thanks to the fact that illicit drug trafficking has been labeled an "economic offense", the investigative powers have been increased, but the law enforcement authorities should always consider the special position of sports. As a result, the requirements of proportionality and moderation should be followed strictly in these cases.[196] The penal approach should be reserved for the criminal traders that can be found in the "gym world", which cannot be dealt with according to disciplinary law, while economic and/or health interests are at stake.[197]

3.2.1.3. THE PENAL CODE

We cannot speak of a direct bearing of the Dutch Penal Code on doping control. However, some of the articles in the Penal Code can be applicable to the selling and/or distributing of listed banned substances.[198]

Article 174(1) of the "Wetboek van Strafrecht" (Penal Code) states that if someone sells, offers for sale, delivers or distributes goods knowing that these goods are harmful for the health of a person, and conceals this harmfulness when selling the goods, the punishment can be imprisonment up to fifteen years or a fine of the fifth category (maximum of €78.000[199]). This article could apply to the case where someone sells harmful substances used for doping to an athlete, without informing the athlete about this.[200] Section 2 of Article 174 aggravates the

[189] WADA Report on Anti-Doping Legislation in the Netherlands, under III.
[190] http://www.consumed.nl/medicijnen/groepen/2561/UR-geneesmiddelen
[191] Article 1 Medicines Act
[192] Article 40 Medicines Act
[193] Bos & Doelder 2002, p. 66 (own translation)
[194] *Id.*
[195] Article 6 Economic Offences Act.
[196] Bos & Doelder 2002, p. 66
[197] Bos & Doelder 2002, pp. 66-67 (own translation)
[198] WADA Report on Anti-Doping Legislation in the Netherlands, under IV.
[199] Art. 23(4) Dutch Penal Code
[200] WADA Report on Anti-Doping Legislation in the Netherlands, under IV.

punishment if the selling of the goods if the use of the goods results into death of the user, up to a life-long imprisonment or a temporary one with a maximum of thirty years.

Article 175(1) of the Dutch Penal Code is applicable when someone to whose fault is due that goods that are harmful to life or health are sold, delivered or distributed to a recipient or buyer who does not have knowledge of the harmful nature of these goods. An offence against this article can be punished with a maximum imprisonment of a year or a fourth category fine (maximum €19.500[201]). However, when the offence results in death, the maximum imprisonment is increased to two years.[202] This article can for example be applicable to gym-owners who know that there are anabolic steroids being sold in their gym, but who do nothing about it.[203]

Finally, most so-called doping substances are being sold on the black market, where buyers are provided with substances they did not always ask for.[204] In this case, Article 330 of the Penal Code could apply, considering the doping substances that are provided are falsified and the seller did not tell this to the customer or recipient. Article 330 punishes the selling of falsified food items, beverages and medicines without telling the buyer that the products are falsified with an imprisonment of up to three years or a fine of the fifth category.[205]

3.2.1.4. THE INDIVIDUAL HEALT CARE PROFESSIONS ACT

The Individual Health Care Professions Act (Wet op de beroepen in de individuele gezondheidszorg) lists acts that are performed by qualified people.[206] Article 35-39 of the Act sum up the actions that are reserved for people who are assigned to do so by the Act. These articles relate to specific legislation for professionals that could also be active around athletes. For example, Article 36(5) lists the persons who are qualified to give injections (which could possibly be done with steroids) and Article 36(14) lists the people who are qualified to give prescriptions for so called UR-medicines (as described in section 3.2.1.2.). Violation of this act is punishable according to Article 96. This punishment includes imprisonment for up to three months or a fine of the second category (maximum €3.900[207]).[208] If the person in question knows or has serious reason to suspect that he will cause damage or a significant risk of harm to the health of the patient, the imprisonment is increased to a maximum of six months and the fine

[201] Art. 23(4) Dutch Penal Code
[202] Article 175(2) Dutch Penal Code
[203] WADA Report on Anti-Doping Legislation in the Netherlands, under IV.
[204] WADA Report on Anti-Doping Legislation in the Netherlands, under IV.
[205] Article 330 (1) Dutch Penal Code
[206] WADA Report on Anti-Doping Legislation in the Netherlands, under V.
[207] Art. 23(4) Dutch Penal Code
[208] Article 96(1) Individual Health Care Professions Act

will be of the third category (maximum €7.800[209]).[210] The highest punishment can be imposed in accordance with Article 103. This article states that if an offender commits an Article 96(1) or 97 offence for the second time within 4 years, the maximum imprisonment will be six months and the fine will be of the third category (maximum 7.800[211]).[212] However, when an Article 96(2) offence is committed within four years of committing an Article 96(1) or 97 offence, the maximum time of imprisonment will be one year and the fine will be of the fourth category (maximum €19.500[213]).[214]

3.2.1.5. DISCIPLINARY LAW

Finally, there are the "Guidelines for professional conduct of physicians working in sports" (Richtlijnen voor artsen omtrent het sportmedisch handelen) of the VSG (Vereniging voor Sportgeneeskunde; Society for Sports Medicine).[215] In these guidelines, the issue of doping is addressed and the use of prescriptions of pharmacological classes of banned substances to athletes for doping purposes is banned explicitly.[216] Sanctioning of the violations of these guidelines is done according to the disciplinary law of the Royal Dutch Medical Association (KNMG), which is the umbrella organization of physicians in the Netherlands.[217]

3.3. CONCLUDING REMARKS ON RELEVANT LEGISLATION

In this chapter I have set out the legal framework on which the prohibition of doping is based. The major source of this prohibition is the World Anti-Doping Code as discussed in section 3.1. For the sake of my own interest I have also included a description of the Dutch legal framework, which is part of my national legislation and guidelines.

In section 3.1 about the WADC I took the liberty to describe the most important articles on the prohibition of certain substances and methods, as well as the punishments related to infringement on these anti-doping rules. I explained the strict liability stance that is used in the WADC as well as by organizations that rule in accordance with this code. On top of that I wrote an extra subsection on the position of the use of genetic modification in this regulation. The latter I will comment upon in the next chapter, since the prohibition of genetic modification

[209] Art. 23(4) Dutch Penal Code
[210] Article 96(2) Individual Health Care Professions Act
[211] Art. 23(4) Dutch Penal Code
[212] Article 103(1) Individual Health Care Professions Act
[213] Art. 23(4) Dutch Penal Code
[214] Article 103(2) Individual Health Care Professions Act
[215] Available at (Dutch):
http://www.sportgeneeskunde.com/uploads/487/423/VSG170.pdf (visited September 5, 2012)
[216] See point 9 at p. 15 and point 10 at p. 16 Guidelines for professional conduct of physicians working in sports.
[217] WADA Report on Anti-Doping Legislation in the Netherlands, under VI.

brings ethical problems. One could for example think of the fact that it would be questionable to apply the punishments as described in subsection 3.1.1.1 since of the fact that genetic modification may possibly be permanent, and a ban for a certain amount of years will not change the positive effect an athlete gets from this treatment (in contrast with doping, where the residues, and thus the positive effect of the substance used will be long gone once the suspension period expires). This is just one of the ethical considerations that will be discussed in the next chapter.

4. ETHICAL CONSIDERATIONS

Doping and drug use in sports is the dominant subject of ethical debates about the (mis)use of science in sport over the last thirty years.[218] Throughout this time, medical professionals have held the responsibility on anti-doping policy since the emergence of the International Olympic Committee's Medical Commission[219], which was responsible for the publishing of the first list of forbidden substances.[220] As a result the values of the anti-doping policy reflect the values that are consistent with the medical ethical norms.[221] Because of this, I have decided to subdivide the ethical considerations in this chapter into the "Four Principles of Biomedical Ethics" as developed by Thomas Beauchamp and James Childress: Autonomy, Beneficence, Nonmaleficence and Justice.[222] However, at the end of this chapter I would like to also take a view of the ethics on technology and sport, as it seems that the use of technology complements sports. Because of the medical influence on anti-doping policy, ethics on technology can be overlooked when discussing the use of enhancing substances and methods in sport. In my opinion, adding a short discussion on the ethics of technology and sports creates a broader and more complete view on the use of genetic modification in sport.

4.1. AUTONOMY

The term "autonomy" was first used as a reference to the self-rule or self-governance of Greek states, and has since then be used "to refer to a set of diverse notions including self-governance, liberty rights, privacy, individual choice, liberty to follow one's will, causing one's own behavior, and being one's own person."[223] The principle of autonomy has the minimal requirement of being able to "decide for the self, free from the control of others and with sufficient level of understanding as to provide for meaningful choice". It requires a person to have the capacity to think of a proceeding, and to put it into action.[224] The core idea of autonomy is that of self-governance by the individual, a type of personal ruling free of controlling interferences by others as well as personal limitations. If a person is autonomous, he can act in accordance with his "freely self-chosen and informed plan".[225]

[218] Miah 2005, p. 51
[219] Miah 2005, p. 52
[220] World Anti-Doping Agency, A Brief History of Anti-Doping http://www.wada-ama.org/en/About-WADA/History/A-Brief-History-of-Anti-Doping/ (visited June 25, 2012)
[221] Miah 2005, p. 52
[222] Lawrence 2007, pp. 35-36
[223] Beauchamp & Childress 1989, pp. 67-68
[224] Lawrence 2007, p. 35
[225] Beauchamp & Childress 1989, p. 68

Autonomy is considered the hallmark of the value structure in medicine and scientific research, a tradition which was formed in the early period of bioethics in the 1960s.[226] Within this historical context, autonomy is given an important role in the discussion about what's valuable about being human. According to Miah, "these ideas are made explicit in a wealth of legislation for individual freedoms where the capability of being moral is presupposed by the capacity of autonomy". An interesting requirement can be found in the reflection of this in European Union laws, which states that an infringement on individual autonomy can only take place when it can be shown that 'more was at stake than the fact that a majority found the ideas disturbing or even disgusting'. Genetic modification of athletes might be such an idea, but if it can be shown of more importance for the individual to be allowed to enhance themselves than it is to ensure no genetically modified athletes exist, the ethics of autonomy necessitates that athletes are allowed to use genetic modification.[227] However, this might be a conclusion drawn too quickly, as the principle of respect for autonomy does not definitively count as a valid justification to do whatever one may like.

4.1.1. UNDERMINING INDIVIDUAL AUTONOMY: COERCION

It may be argued that when genetic modification is allowed to be used by athletes, it becomes a coercive option which would be unethical because it undermines individual autonomy. This view has to do with the fact that a choice has to be made in a coercive environment. When this happens, there is no question of a freely desired choice made by an individual, since the possible options are reduced.[228] This could possibly deprive other athletes of their perceived right to compete in a 'natural', drug-free sports world.[229]

Under certain circumstances it may lead to a situation where all prospective athletes would feel coerced to use genetic modification to remain competitive at an elite level.[230] However, as Miah states, "elite sport is already the kind of activity where individuals participate under pressure".[231] He adds that "sport is already a coercive environment" and that "this is constitutive of what makes it valuable." Since genetic modification does not have to be seen as a risk to health when fully developed (as will be discussed later on in this chapter) it is not the kind of coercion that's ethically alarming.[232]

[226] *Id.*
[227] Miah 2004, p. 76
[228] Miah 2004, p. 158
[229] Custer 2007, p. 198
[230] Miah 2004, p. 158
[231] *Id.*
[232] Miah 2004, pp. 158-159

On the other hand, it could be argued that speaking of coercion in this context would be an overstatement. Although athletes will be put under pressure to emulate their colleagues that do use genetic modification, there is nothing that withholds them from not doing so.[233] If they choose to keep competing within the same competition as the genetically modified athletes, they will probably not be part of the group of habitual winners, but the fact is that in competitive activities not everyone can win. This is in agreement with the professional ethical principle that benefits and rewards should be distributed according to efforts and risks undertaken.[234] In this light it can be said that the genetically modified athlete is by definition the one who took more risk than the athlete who didn't use genetic modification (a technology as genetic modification does not have to be 100% safe, but 'safe enough', (see section 4.1.2) and thus brings additional risks), and thus it is 'fairer' for him to win.

Another argument to put coercion in perspective is that anyone that enjoys competing in sport does not necessarily have to use genetic modification. This could mean that an athletes at the elite level who decide not to use genetic modification are not able to compete with the best at an elite level anymore, but that does not take away the enjoyment of competition in itself. An athlete can always decide to start competing at a lower level, where the use of genetic modification does not (or in a lesser manner) take place.

In the next chapter I will give possible responses to the use of genetic modification in sports. One of these responses could be to introduce different competitions for athletes who used genetic modification, and thus solving the problem discussed in the last argument on coercion.

4.1.2. AUTONOMY AND INFORMED CONSENT

Autonomy underpins the rationale of informed consent, which is seen as one of medical ethics' and scientific research's most important instruments.[235] It is this informed consent which leads to ethical problems with the genetic modification of athletes.

For athletes to enter into a research procedure that involves genetic modification, it is required that the investigator gives full disclosure and that the subject (the athlete) gives informed and voluntary consent. This would include a clear description of both the harms and the benefits that may arise from the use of genetic modification.[236]

[233] Savulescu, Ter Meulen & Kahane 2011
[234] *Id.*
[235] Miah 2004, p. 75
[236] Schneider & Friedmann 2006, p. 63

However, in the case of genetic modification it is unlikely that this requirement is met.[237] Since the technology of genetic modification is still in its early stages, not all risks are known and a risk/benefit ratio would merely be a guess. With these conditions in mind, it would be impossible for an athlete to give informed and voluntary consent, which means that the procedure would be unethical.[238]

I would like to draw attention to the fact that this is a valid argument *at the moment*, but we should keep in mind that there's a possibility that genetic modification in the future will become safe enough to be used effectively,[239] meaning that the medical world considers the technique's benefits to outweigh the known risks. If this happens, it is possible for an athlete to be informed of all possible risks and benefits and the athlete will be able to give informed and voluntary consent.

4.2. BENEFICENCE AND NONMALEFICENCE

According to Beauchamp and Childress there are two type of beneficence: positive beneficence and utility. Positive beneficence requests that moral agents provide benefit, utility asks of moral agents that benefits outweigh deficits to produce a positive result.[240] The practice of benefit is challenged by autonomy. There is no possibility to act without the permission of a free moral agent if you do not have that agent's consent. Since 'good' is subjective, beneficence must overlap with autonomy: patients must be provided with enough information to be able to choose the direction of their care, which in their eyes is the greatest good.[241]

The ethical principle of nonmaleficence can be summarized in just four words: first do no harm (primum non nocere). It is considered to be the negative side of beneficence, though some people see beneficence and nonmaleficence more like two sides of the same coin.[242]

Since the ethical arguments on genetic modification in sport that will be discussed in this section contain both elements of beneficence and nonmaleficence I have decided to not give these ethical principles a separate section, but to treat them as one.

We may easily conclude that an athlete will in a certain aspect benefit from genetic modification. It is easily arguable that if genetic modification improves an athlete's performance, the athlete will possibly end up higher in rankings and will win more prize money. Therefor a number of

[237] *Id.*
[238] *Id.*
[239] Fore 2010, p. 87
[240] Lawrence 2007, p. 35
[241] Lawrence 2007, p. 36
[242] Lawrence 2007, p. 35

individuals could have both a financial and personal interest in the performance of an athlete (these persons include the athlete, but possibly also coaches, trainers and doctors) will probably go to great lengths to advance the success of an athlete, including the possibility of genetic modification.[243]

4.2.1. THE SAFETY ARGUMENT

The principle of nonmaleficence underlies the main argument given by WADA to prohibit genetic modification in sports. They argue that the use of genetic modification is causing an actual or potential health risk to the athlete, whilst their goal is to protect individuals against harm or risk to health.[244] They have even undertaken education efforts to make athletes realize that gene doping is still an imperfect science and thus dangerous.[245] Doctor Friedmann, director of the gene therapy program at the University of California and head of WADA's panel of gene doping emphasizes that "For humans, gene therapy remains very immature, experimental and highly risky. […] Such a use (the use of genetic modification in anyone other than in a patient with a serious or untreatable disease, red.) would be frivolous, dangerous and, in my mind, would constitute medical malpractice or professional misconduct."[246] Examples of these risks are the disruption of the body's balanced homeostasis and interference with the molecular feedback loops by a change in the activity of an individual gene, as well as risks carried by the vector that is used to deliver the gene, which may vary from a transient adverse reaction to death.[247]

The above mentioned safety concerns are a justification for the prohibiting of genetic modification by WADA.[248] In response to this, governments world-wide have strict protocols for the approval of studies that regard to gene therapy. Because of these strict protocols, the chance that attempts at gene doping would occur outside of the regular oversight produces is emphatically present. [249] Athletes could also end up in unsafe labs where a rogue scientist may deliver a substandard job at applying genetic modification to an athlete, in an attempt to evade oversight mechanisms and remain undetected by authorities.[250] A strict ban on genetic modification in sports is therefore appropriate for the time being.[251]

[243] Custer 2007, p. 202
[244] NeCeDo report 2004, p. 14
[245] Pound 2005, p. 1
[246] Friedmann 2005, p. 8
[247] Solomon et al. 2009, p. 252
[248] Fore 2010, p. 85
[249] Fore 2010, p. 86
[250] Custer 2007, p. 202
[251] Fore 2010, p. 78

But if in the future genetic modification becomes safe enough to employ, does the safety argument still apply?[252] When the time comes that the safety of the technology increases and an environment where an individual is at less risk of physical or mental debilitation arises, harm is no longer a sufficient basis on which to reject genetic modification.[253] After all, it is clear that sports policy does not requires sports to be completely safe, since there are many sports that are only possible by accepting a certain level of risk.[254] In the case of genetic modification, this means that we should not ask ourselves *if* genetic modification is harmful, but rather if it is *more harmful* than other legitimate methods of performance enhancement, as well as if the possible harm that comes with genetic modification is an integral or acceptable part of sport. One could argue that in the future, the possible harm of genetic modification might bring no greater risk than the risks taken by participating in some sports at all.[255] We should keep in mind that many sports, such as football, boxing, skiing and the Iron Man triathlon are inherently dangerous. [256] In these activities there's a high potential for severe injuries and the harm caused by using performance enhancing techniques "might be seen as relatively negligible by comparison."[257] A prohibition of genetic modification would then be overly paternalistic, since a certain disregard of an athlete's personal safety is required to reach achievements in these sports.[258] The harmful effects of sport in itself is clearly expressed by König, who asks himself the following question:[259]

> *"Do we hear of an unmistakable accusation of those irreversible damages, not caused by doping but by 'classical' training of numerous former high performance athletes? Who takes care of the army of nameless ones, who ruined their bodies for the rest of their lives by using 'normal' technological aids in sports?"*

We should also consider the positive effect that genetic modification may have. Genetic modification can for example be used to promote muscle growth in order to speed healing and repairing of damaged or injured muscles.[260] Maybe it could even be used preventive, to lower the risk of overstrained muscles in athletes. This would mean that we should not just look at if genetic modification in sports could be possibly harmful, as is done by those who support the safety-argument as described in this section, but also at the contrary, the positive effect that the use of genetic modification in sports may have. I will further discuss the use of genetic modification as injury repair in section 4.3.2.

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[252] *Id.*
[253] Miah 2004, p. 137
[254] Miah 2004, pp. 137-138
[255] Miah 2004, p. 138
[256] Fore 2010, p. 85
[257] Miah 2004, p. 138
[258] Fore 2010, p. 86
[259] Shogan & Ford 2000, p. 50
[260] Custer 2007, p. 188

4.2.2. THE HARM OF TESTING

Genetic doping is currently undetectable.[261] However, WADA has made it a priority to "make sure that gene doping is as detectible as any form of traditional doping" by funding projects that are researching on ways to detect gene doping.[262] The test that is most likely able to detect the use of genetic modification in athletes is a biopsy, where a slice of the muscle at the spot of DNA injection is cut from the athlete's muscle and examined.[263]

Biopsy is a technique that's way more invasive and it is very plausible that many athletes will not voluntarily consent to such an invasive test. If testing is done before competition, chances are that athletes might not recover in time to show up top fit at the competition or, when testing is done too far in advance of competition, the chances are that athletes engage in genetic doping just after testing.[264] Another problem with the biopsy is that testing cannot be done mid-competition, because the athlete will have no time to recover from the biopsy procedure.[265] This is especially problematic when athletes participate in multi-day tournaments such as the Olympics, the Tour the France or football competitions, where testing is done on a regularly basis throughout the competition. These kind of tests may otherwise harm the athlete in his or hers performance during the competition.

There is another harm that comes with the genetic screening and testing of athletes, even if it becomes possible to do so without an invasive procedure like a muscle biopsy. According to Miah, the "knowledge of one's genetic future – which is implied by the results of screening and testing – is considered by some to present potential harm to individuals." Genetic screening or testing of an athlete may lead to the conclusion that the athlete has a genetic disorder that may lead to a disease. [266] Questions have been raised about the healthiness for a patient to be aware of such a condition, especially considering the fact that there is no cure for many kinds of genetic disorders that emerge from screening or testing.[267] In such cases it is possible that the knowledge of this possible condition is detriment for the patient's health, increasing the tendency to contract the illness.[268]

[261] Custer 2007, p. 203
[262] Special Feature: Gene doping 2005, p. 5
[263] Custer 2007, p. 203
[264] *Id.*
[265] Custer 2007, p. 204
[266] Miah 2004, p. 122
[267] Miah 2004, pp. 122-123
[268] Miah 2004, p. 123

A similar argument can be raised in regard to the family members of the athlete, who might discover via the results of the screening or testing of the athlete that a certain disorder runs in their family. This knowledge may affect their health as well.[269]

With regard to the above, ethical questions arise concerning the disclosure of such genetic information. It can be considered overly legislative of individual freedoms for an athlete to disclose their (and thus possibly their families') genetic information, all in the name of ensuring fair competition.[270] The key question therefore is whether an athlete should be entitled to conceal this information in the world of sport.[271]

4.2.3. HARM TO SOCIETY

Any form of doping, not only genetic modification, may not only be harmful to the person using it, but also to another group of people: the public, in particular children. Successful athletes are admired and even considered role models by these people.[272] The struggle against the odds, their tenacity and their dedication is what we often try to emulate from athletes.[273] We place a big trust onto athletes; a trust that seems to be a societal "good" and if anything brings that trust into distribute it must be considered a form of harm.[274]

Most young people hope to gain excellence in sports as they look up to athletes as their heroes and heroines. If such an athlete becomes morally suspect, the very young may find it difficult to distinguish the athletic triumphs of their heroes and heroines from the moral or ethical flaws on these athletes.[275]

The interesting part about this is that the downfall of a 'hero' is probably not intrinsic to use of a forbidden substance or method in itself, but rather to the fact that the use of such results in breaking the rules. If a rule that forbids such usage does not exist, the severity of the fall from grace of the athlete would not be the same. For example, if there would be a revelation of a prima ballerina that uses painkillers or stimulants to achieve an excellent performance of 'Swan Lake', there wouldn't be such a problem since the use of such drugs is not forbidden for artistic achievement.[276]

In the same manner it can be argued that if genetic modification will not be considered negatively by society, there should not be a prohibition of the use in sport. As Fore states:

[269] *Id.*
[270] Macer 1990, Chapter 13; *Id.*
[271] Miah 2004, p. 124
[272] Schneider & Friedmann 2006, p. 92
[273] Schneider & Friedmann 2006, pp. 92-93
[274] Schneider & Friedmann 2006, p. 93
[275] *Id.*
[276] *Id.*

"Sports provide a unique and valuable context through which to examine the ethics and limits of genetic enhancement, but decisions regarding the use of genetics in sport must reflect broader societal attitudes toward these technologies."[277] An example can be found in society's attitude to the use of illegal drugs in sport. Since doping in sport and the more general issue of illegal drug use are closely tied, a negative stance is taken upon this subject,[278] especially since it is believed that the use of doping by athletes (as role models) may encourage young children to experiment with illegal drugs.[279]

However, this is rooted in the fact that "Don't do drugs" is considered to be an acceptable stance in our society. The question is if this also counts for "Don't alter your genes".[280] We should keep in mind that "genetic modification does not come with the same cultural baggage that underpins drug taking."[281] Therefore, genetic modification should not be considered a deviant practice. Since genetically modified athletes will not differ very much from non-modified humans, it is not acceptable to characterize these athletes as morally less valuable. As long as it is not undertaken in an environment where genetic modification is banned, there should be no negative ethical overtone associated with it.[282]

Even if athletes are genetically modified, this does not change the nature of the human, thus we can still admire the nature and personality of the athlete. As Miah describes it, "the claim of expectation disappointment is subsequent to the moral evaluation of the technology."[283] There would be no expectation disappointment when we discover athletes that have used genetic modification, if genetic modification is seen as a relative facet of sport. If genetic modification is seen as an allowed, positive aspect of being human, the athletes who use the technique to enhance themselves do not have to be seen as a negative example at all.[284] Therefore it is important to await the stance of society on the subject, before steering their stance in a certain direction by negatively labeling the use of genetic modification as "gene doping" with a prohibition beforehand.

[277] Fore 2010, p. 92
[278] *Id.*
[279] Miah 2004, p. 159
[280] Fore 2010, p. 92
[281] Miah 2004, p. 159
[282] *Id.*
[283] *Id.*
[284] *Id.*

4.3. JUSTICE

Justice is about ensuring fairness in the process. It is about respect for people's rights and the respect of morally accepted laws.[285]

4.3.1. FAIR PLAY

The broad moral concept of justice can be slimmed down to what is considered the first resource when seeking to articulate what is valuable about sports: fair play. The spirit of the concept of fair play was already present in early forms of competition, where an athlete's moral character was indicated by his will to follow the rules and being noble in defeat. The ethical principle of fairness in sport has turned into an unquestionable principle, even though it frequently happens that an athlete does not live up to the high demands of fair play.[286]

However, we should keep in mind that a sporting competition is a voluntary, cooperative endeavor and the competitors have accepted the restrictions put on their individual liberty to make this competition possible. Thus if athletes do not maintain the rules they have agreed upon, they cease to play the game: "if one is cheating, then one is not playing the game at all, which makes it impossible to win or lose in any meaningful sense."[287] The value of maintaining fair play can, according to Miah, be explained as the value of having a concern for respecting others. Incorporated herein lies the desire to be treated by others in the same way.[288]

Those who oppose the use of performance-enhancing technologies and substances are quick to argue that the use of any kind of doping is unfair.[289] Since the use of genetic modification in sport is labeled "gene doping" by the WADA,[290] we can assume that the same argument goes in the case of genetic modification. This is indeed argued by the Dutch National Doping Agency, who states that the use of gene doping may compromise the aspect of fair play "in an especially deep and potentially disastrous way for the practice of sports."[291] However, they neglect to go in depth on this argument.

It is argued that, in order to promote fair play, every athlete should start on a level playing field, free of any performance-enhancing substances or methods.[292] However, many athletes might

[285] Lawrence 2007, p. 36
[286] Miah 2004, p. 116
[287] Miah 2004, p. 117
[288] *Id.*
[289] Hilvoorde, Vos & De Wert 2007, p. 174
[290] See section 3.1.1.4
[291] Necedo report 2004, p. 15
[292] Custer 2007, p. 198

consider their genetic gift as a noticeable aspect of what gives sport value to them,[293] since this genetic gift is part of the reason they are able to compete at a high level in the first place. From this we can conclude, at least indirectly, that competition is partly about revealing who is genetically advantaged.[294] Therefore, the "level playing field" that is used as an argument against the use of genetic modification in sport, or any sort of performance-enhancing substance or method for that matter, does not exist. The playing field is never level because we are all born with different natural athletic abilities and we are raised in different environments.[295] Genetic modification could be a solution to at least the problem that is created by the genetic differences between athletes. On the other hand, if those who are already naturally gifted use genetic modification in the same way as those who are not so naturally gifted, the gap between those athletes may not decrease, but stay the same or even increase.[296]

But before one argues that genetic modification provokes unfairness because of the differences it creates, one should keep in mind that "organized sport is already inherently unfair in many respects, since it does not differentiate in genetic differences."[297] There are many sports that do not provide an opportunity for athletes that have a disproportionate genetic predisposition, at least at elite level. An example of this could be volleyball, where the net is such that an athlete must be able to reach a certain minimum height in order to be able to compete at the elite level. If someone is born with a less-than-ideal body for the sport because of a genetic predisposition, this person should still be given the opportunity to be the best in their sport of choice.[298] This does not mean that everyone should be equally entitled to win sport contests, but there should be a distinction made between those who are "failing to be good enough" and those who are "genetically prevented to be good enough".[299] Genetic modification could come as a solution to those who are otherwise "genetically prevented to be good enough." It could for example give an athlete the possibility to jump higher, making his length (in the case of volleyball) not a problem anymore.

On the other hand, the disparity of genetic differences between athletes has in some sports been minimized by creating different divisions for competitors to compete in.[300] As an example we can look at boxing, where different weight classes exist. It could be a possibility to do the same

[293] Miah 2004, p. 155
[294] *Id.*
[295] Custer 2007, p. 199
[296] *Id.*
[297] Miah 2004, p. 157
[298] *Id.*
[299] *Id.*
[300] Miah 2004, p. 155

for those athletes that have been genetically modified. I will go into more details about this in the next chapter.

As a closure of this subsection I would like to urge you to keep the following in mind: "To be genetically modified does not circumvent the test of a sport or the challenge of becoming an elite athlete."[301] Those who are willing to become an athlete at the elite level, will have to work hard, make sacrifices and give their all to reach such a high level, regardless of the use of genetic modification. Therefore we cannot simply say that the "lazy" athlete that "cheated" will come out on top, since an athlete will always have to work hard for many years to reach the elite level.

4.3.2. THE THERAPEUTIC EXEMPTION: FAIRNESS?

There is a possibility that an athlete is granted a so called Therapeutic Use Exemption (TUE) that allows an athlete to use one or more of the prohibited substances and methods. This exemption is elaborated in Article 4.4 of the Code. If an athlete is granted such a TUE, "Presence of a *Prohibited Substance* or its *Metabolites* or *Markers* (Article 2.1), *Use* or *Attempted Use* of a *Prohibited Substance* or a *Prohibited Method* (Article 2.2), *Possession* of *Prohibited Substances* and *Prohibited Methods* (Article 2.6) or Administration or *Attempted* Administration of a *Prohibited Substance* or *Prohibited Method* (Article 2.8) consistent with the provisions of an applicable therapeutic use exemption issued pursuant to the *International Standard* for Therapeutic Use Exemptions shall not be considered an anti-doping rule violation."[302]

It is of course possible that it is inevitable that treatment through gene-based methods will become available. This could possibly apply to diseases, but also to the repair of injuries, even in athletes.[303] With that we should keep in mind that if an athlete sustains an injury, this does not only threaten the health of the athlete, but also their livelihood and sport objections, with a chance of a considerable financial impact.[304] Therefore athletes need and deserve the best medical procedures and methods, including gene-based methods, and they should not be deprived of the best medicine available to all others.[305] If this would mean that an athlete will have to use therapeutic gene therapies, there might be a problem when the athlete returns to competition.[306] It might be argued that allowing an athlete who has undergone gene therapy back into competition is unfair, because we do not know if this athlete has been (unintentionally)

[301] Miah 2004, p. 158
[302] Article 4.4 World Anti-Doping Code.
[303] Schneider & Friedmann 2006, p. 48
[304] Schneider & Friedmann 2006, pp. 48-49
[305] Schneider & Friedmann 2006, p. 49
[306] Fore 2010, p. 90

enhanced to a level beyond "normal" by this treatment. (Then again, how do we decide what is "normal"?)[307]

We could compare the therapeutic exemption for gene-based therapy with other types of treatment that have enhancing characteristics and are allowed, like laser vision correction. Laser vision correction could result in a better than normal vision, which would be a positive side effect for a biathlete with a less than normal vision that undergoes such a treatment. As a result the biathlete would gain an advantage in the rifle shooting aspect of the sport. The athlete that used gene-based therapy to recover from a serious disease or illness, arguably more justified than the use of laser vision correction since one can wear glasses, should be allowed to compete in international sports competition even if the therapy had enhancing side effect, since the biathlete that has nearly super human vision because of his treatment is allowed so too.[308]

4.3.3. PROBLEMS WITH SANCTIONING

If the WADA wants to maintain the prohibition of genetic modification in sports, they're going to have a problem with regard to the existing doping regulatory framework. *If* effective and unobtrusive tests are developed, the use of genetic modification will still be a challenge to the current sanctioning mechanisms[309] as described in the Code.[310]

First, there will be a problem distinguishing between those who have used genetic modification and those who have natural-occurring genetic mutations.[311] Without irrefutable evidence that an athlete actually has been genetically modified, it is impossible to exclude the athlete from participating in competition in a fair manner. On the other hand, deciding that any athlete with genetic values of a certain level or higher is not allowed to compete would be unfair for those athletes that are born with genetic mutations, resulting in genetic values that are higher than the possible "standard" that would have to be set. This would mean that certain people would never be allowed to compete, just because they are born a certain way.

The permanent nature of genetic modification poses another problem.[312] Once an athlete used genetic modification to increase his athletic performance, the effects of the procedure are possibly present for the rest of his life.[313] As seen in Chapter 3, the Code promotes a two-year suspension for first time violators. This does not take into account the permanent nature of genetic modification. Since it would be unfair to other athletes if athletes caught on genetic

[307] Custer 2007, p. 206
[308] Custer 2007, p. 207
[309] See section 3.1.1.1 for a description on the current sanctioning mechanisms.
[310] Fore 2010, p. 89
[311] *Id.*
[312] *Id.*
[313] Custer 2007, p. 208

modification could return to competition after a ban of two years, anti-doping authorities would have to ban a caught athlete for life in compliance with the espoused zero-tolerance policy.[314] The problem with this is, as Custer so clearly states, that "such a policy would leave no room for a second chance or an opportunity to repent or come clean, unless a method was devised to reverse the effects of genetic doping."[315] This would also mean that testing for genetic modification would have to be flawless. A positive test for genetic modification of an athlete would have to be a hundred percent foolproof since a false positive test could have severe consequences[316] both for the athlete as well as the credibility of the testing agency.

Finally, it is of a concern that an attempt to ban an athlete based on his genetic composition could be seen as genetic discrimination, which is contrary to international human rights standards.[317] The United Nations Educational, Scientific and Cultural Organization stated in its "Universal Declaration on the Human Genome and Human Rights":[318]

> *"Article 2*
>
> *(A) Everyone has a right to respect for their dignity and for their rights regardless of their genetic characteristics*
> *(B) That dignity makes it imperative not to reduce individuals to their genetic characteristics and to respect their uniqueness and diversity."*
>
> *"Article 6*
>
> *No one shall be subjected to discrimination based on genetic characteristics that is intended to infringe or has the effect of infringing human rights, fundamental freedoms and human dignity."*

It is not hard to imagine that an athlete that is banned because of his use of genetic modification will claim that he was denied his "fundamental freedom" to practice his career[319] in sport at an elite level based on his genetic characteristics. The question is how the Court of Arbitration in Sport (CAS) will interpret the Universal Declaration on the Human Genome and Human Rights and thus will handle these kinds of claims.[320]

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[314] *Id.*
[315] *Id.*
[316] *Id.*
[317] Fore 2010, p. 90
[318] Available at http://portal.unesco.org/en/ev.php-URL_ID=13177&URL_DO=DO_TOPIC&URL_SECTION=201.html (visited October 8, 2012)
[319] Art. 23 Universal Declaration of Human Rights gives the right to free choice of employment.
[320] Fore 2010, pp. 90-91

Therefore we can conclude this subsection by stating that these difficulties would probably make a total ban on genetic modification in sport incompatible with the existing regulatory framework at best, and in the worst case technologically impossible.[321]

4.4. TECHNOLOGY AND SPORT

As described above, because doping policy has remained mainly the responsibility of medical professionals, the kind of values it reflects are derived from medical ethical norms.[322] These medical ethical norms have been discussed in the previous sections. However, there is limited elaboration on the so called "spirit of sport". It seems that the medical ethical values are of more influence than the sport ethical values when it comes to the anti-doping policy.[323] In order to prevent this thesis from going in the same direction, I have decided not to only discuss the medical ethical arguments, but to also look at sport ethics on the use of genetic modification in sport. These types of ethics will be discussed in this section.

According to Van Hilvoorde, Vos and de Wert "Technology and sports are, from a historical and conceptual perspective, two inseparable domains."[324] Technology has been used to improve sporting performance for a long time. Genetic modification can be seen as just another type of technology applicable to the improvement of sport performances. The desire for these technologies comes from the constitutive demand that athletes "push on until the limits of human performance are reached".[325] Pursuing some sort of enhancement and the development of technologies to achieve that enhancement have been reflected in many different ways and technological methods for more than 150 years. Enhancement is 'the very best thing sports are about'.[326]

The concern for the use of doping in sport is actually a concern for the variety of performance enhancing methods. To understand what is actually problematic about the concept cannot be done if we do not understand what is valuable about a sporting performance in itself. To reach this understanding, we need to reach a consensus on what is the real value of a sporting performance.[327]

According to Vorstenbosch, the primary goal of sports is not the absolute performance of setting increasingly faster records (it should however, in my opinion, be considered a key secondary

[321] Fore 2010, p. 91
[322] Miah 2005, p. 52
[323] *Id.*
[324] Hilvoorde, Vos & de Wert 2007, p. 175
[325] Shogan & Ford 2000, p. 50
[326] Vorstenbosch 2011, p. 56 (own translation)
[327] Miah 2005, p. 53

goal), but simply winning competitions. He believes that the most important thing is being better than the direct opponents that are in the same competition at that very moment.[328] However, to be better than the competition, an athlete must seek ways to push his body further in order to improve his competitive advantage. New methods of performance enhancing, including new technologies, are tried to reach this competitive advantage.[329]

An example of such a technology is the use of altitude chambers or altitude tents. These kinds of chambers or tents are able to simulate a high altitude, creating the possibility for an athlete that lives in a low-altitude country to acclimatize to a high altitude, for example because the athlete has to compete in a high-altitude country in the near future. This could eliminate the disadvantage that some athletes have from living in a low-altitude country.[330] This technique also gives athletes the possibility to increase the amount of red blood cells in their body, allowing the blood to transport more oxygen to the muscles, which increases performance. Therefore, it is not only used as a possibility to adapt to higher-altitude countries, but also to gain a competitive advantage in endurance.[331] It is, however, not on the list of banned substances or methods,[332] although it might give athletes an unfair advantage, since not all elite athletes may have the (financial) possibility to make use of an altitude tent.

It can be argued that the use of a technology such as altitude tents is not comparable to the use of genetic modification. Many believe that with the use of genetic modification, the athlete does not need to make any efforts or sustain any sacrifices to achieve good results.[333] We should however keep in mind that the opposite might be true. If genetic modification leads to an equalization of the physiological differences in athletes, effort, dedication and sacrifice will become more decisive for the results of sporting performance. The little difference between winning and losing will depend on the excellence of character.[334] Therefore the use of a technology such as genetic modification may make things even more interesting.

The use of technology must not be seen as an end in itself, but rather as a means to realize some other, valued end. Technology in sports must be seen as a tool a human uses to "make possible and serve the attainment of human ends".[335] Therefore, the use of technology adds value to sport. This value does not have to be the gained advantage or the enhance performance in itself, but

[328] Vorstenbosch 2011, p. 56 (own translation); on a personal note, I do not think Vorstenbosch his statement is always correct, there could be reasons that validate the goal 'setting faster records' in sport, but for the purpose of this thesis, these do not matter at the moment.
[329] Miah 2005, p. 54
[330] *Id.*
[331] See the experiment described in Stray-Gundersen, Chapman & Levine 2001
[332] See the WADA 2012 Prohibited List
[333] Tamburrini 2002, p. 263
[334] *Id.*
[335] Miah 2005, p. 55

rather the underlying reason why athletes want to improve: the human is a kind of being that wants to transcend the limitations of biology.[336] Accepting modern technologies in sport, including genetic modification, does not necessarily bring value to sport because of the performance, but rather about what we see as valuable about being human.

Because of this, it is arguable that the use of technology in sports to increase human performance contributes to the value of being human. Therefore we have to keep the sport ethics on the use of such a technology in consideration when we decide on the use of genetic modification in sports. Only using the four biomedical ethics to base the decision on genetic modification in sports is not enough and in my opinion a little short-sighted, because the relation of sports and technology is equally important, and so are its ethics.

4.5.CONCLUDING REMARKS ON ETHICS

This chapter is arguably the most important chapter of this thesis. Although it does not yet provide an answer to the research question, it does however provide the rationale where the final answer will be based upon. This fourth chapter already makes clear that I do not believe that our future response to the use of genetic modification in sports should be a complete ban on the use of it, for ethical reasons as discussed in this chapter. We cannot uphold a complete ban when the technology is so advanced that there is question of the widespread use of genetic modification through society, which portrays the acceptance of such a technology. The safety concern might be a good enough reason to uphold the ban for the time being, but it will not hold when the time comes that genetic modification is considered safe enough to be used. I have discussed why the use of genetic modification in sports would not have to be considered unreasonably fair and I also took the time to briefly discuss the relation between sport and technology, showing that such advancement seems to be inevitable. In the next chapter I will, with the ethical considerations in mind, give possible ways of dealing with the problem of genetic modification in sport. In this way I am looking to finally answer the research question.

[336] *Id.*

5. POSSIBLE RESPONSES

As already discussed in chapter 4, the use of genetic modification is, at the moment, unsafe because it is still in its infancy and needs further development. Therefore, the currently applied ban on genetic doping makes sense and must be maintained at least until the technology is safe enough to use.

When this time comes, it is questionable if a total ban should still be maintained, and even if a total ban is ethically justifiable. Depending on the acceptance of genetic modification by the public, it may be hard to maintain such a total ban on the use of genetic modification in sport.

I personally do not believe that, based on the ethical arguments discussed in the previous chapter, it will be possible to maintain such a ban for a longer period of time after the use of the technology of genetic modification will be deemed acceptable by the public. In this chapter I will do a suggestion of other possible responses to the use of genetic modification in sport, apart from the total ban of the technology as is (righteously) maintained right now.

5.1. BIOLOGICAL "WEIGH-INS"

The concern with regard to the use of genetic modification in sport of what is in the body and how it got there does not have to be the leading mindset. Instead, we can decide to focus on how much of it is present in the athlete's body. Even if it would turn out to be very difficult or even impossible to develop tests that can distinguish between the natural and artificial genetics, or tests that can decide on how the genetic material got into the body in the first place, the development of tests that can measure the results of genetic activity is more likely.[337] At the moment, it is already possible to measure the effects of drug-based doping on genetic activity. For example, the increased production of a particular protein and the expression of the gene itself can be shown by testing.[338]

The key point is that if we can use this kind of testing to decide on the level of genetic activity in an athlete's body and compare them to pre-defined "normal" values. If an athlete's values do not fit in the boundaries of these "normal" values, there are two possibilities:[339]

The first possibility would be a ban. A ban would not be particularly fair to athletes with natural mutations and, if there is no way to reverse the effect of genetic modification, is also not

[337] Fore 2010, p. 93
[338] Special Feature: Gene Doping 2005, p. 5
[339] Fore 2010, p. 93

proportionate for the athletes that used genetic modification.[340] In comparison, an athlete that is banned on drug-based doping can return from suspension and rejoin competition after a certain number of years.[341]

The second, and in light of this thesis the more favorable, possibility is to group athletes by their genetic make-up.[342] Based on the test results, it could be possible to put athletes that used genetic modification to increase their genetic activity to a certain level above the bounderies of "normal" in a separate, or even multiple separate, competitions.[343] This way one could, for example, create a "normal", "enhanced" and "super enhanced" division in competitions.[344]

A technical hurdle might be the decision on what is considered "normal" to begin with. Studies show that that "even among relatively homogenous populations of athletes, various biological parameters can vary widely."[345] Another problem is that it might be hard to link athletic performance to just a few substances. Selecting biological products to test on also requires the inescapable exclusion of others, so it could be possible that athletes will simply find new doping targets that cannot be measured at that time.[346] These are problems that should be solved before we decide to use biological "weigh-ins", or solutions like "genetically modified" competitions (discussed in section 5.2), in sports.

Biological "weigh-ins" could be a reaction to the development of the use of genetic modification in sport. However, if nothing is done with the information that results from these "weigh-ins", it would be fairly useless (except for research-purposes). Therefore reactions like the creation of extra competitions for genetically modified athletes is needed (section 5.2). Biological "weigh-ins" can thus turn out to be a handy tool, but not a solution in itself.

5.2. THE CREATION OF "GENETICALLY MODIFIED" COMPETITIONS

There are settings in where sports are about being the best, the fastest, the strongest etc. Gold medals are not awarded to those who tries the hardest or has improved the most since his last performance, but to the ones that are better than every other competitor.[347] Genetic

[340] *Id.*
[341] See section 3.1.1.1 on sanctions under the World Anti-Doping Code.
[342] Fore 2010, p. 93.
[343] Which will be elaborated in detail in the next section.
[344] Fore 2010, p. 93
[345] Fore 2010, p. 94
[346] *Id.*
[347] Fore 2010, p. 95

enhancement could be used to push boundaries, to improve results beyond the limitations of the 'normal' human body.[348]

Of course this is not the only reason that people enjoy sports, since there are many kinds of competitions and not all rely on purely objective successes.[349] For example, in the Olympics we honor the human runner that sets the best time, appreciating the fact that the excellence of human running can be "truthfully and quantitatively measured", while in the Special Olympics we look at the results of the athletes as a sort of excellence, a personal achievement instead of the absolute superior performance, even if they reach much lower scores in the same sort of competition as the non-disabled athletes.[350]

In light of the above, a separate competition for athletes that made use of genetic modification to increase their results beyond limitations of the 'normal' human body could be a possibility.[351] Given the assumptions made in this thesis, putting the genetically modified athletes in the same competition with the "natural" athletes would significantly disadvantage the "natural" athletes, and thus can be considered unacceptable.[352] Separating genetically modified athletes from 'natural' athletes would also give fans the possibility to understand under what conditions they see the athletes perform, which makes room for more accurate and meaningful comparisons among competitors, without distraction from the meaning of the respective competitions. If we create a separate competition for genetically modified athletes, we would allow these athletes to compete against one another while being judged on the same standards and would not have any effect on the image of non-enhanced athletes.[353] If all athletes in the same competition use genetic modification to improve their abilities the equality of the competition would not be compromised, it would only "change the kinds of activity and the kinds of skills being assessed. "[354]

There is the fear that if we do decide to create an extra competition for genetically modified athletes, "natural" versions of such a competition will be driven out. On the one hand we could say that this is "consumer preference". If the fans decide that they like to look at genetically modified athletes better than at "natural" athletes, we should accept the choice of the fans.[355] Ultimately this means that we should leave the decision on permissibility of genetic modification for athletes to the fans. We cannot predict what fans will prefer to see. It is possible that, if

[348] Miah 2004, p. 178
[349] Fore 2010, p. 96
[350] President's Council in Bioethics 2003, p. 133
[351] For example, Dr. William Hurlbut suggests a "Bio Olympics". Friedmann 2002
[352] Miah 2001, p. 46
[353] Fore 2010, p. 96
[354] Miah 2004, p. 93
[355] Fore 2010, p. 97

genetically modified athletes compete at a level that exceeds that of "natural athletes" by far, the interest of the fans in "natural" competitions might show a vast reduction.[356] On the other hand, based on the reactions of the public on athletes that were accused of doping[357], it might be that fans are actually tired of what in their eyes are "unearned" achievements, and they will not enjoy the genetically modified competition at all.[358]

However, it is unlikely that the creation of a new kind of competition (that of the genetically modified athletes) will lead to the repulsion of other kinds of competitions like the ones for "natural" athletes. Since the enjoyment of sport, from the point of view of the fans, does not always arise from the need to watch the absolute fastest or strongest athletes compete, it is well possible that there are fans who will stay interested in the competition between "natural" athletes as well as those who will switch to the "genetically modified" competition,[359] and let us not forget about the fans that might enjoy both forms of competition. Take boxing as an example. It was predicted that in the year 2000 "there will be only one discussion in boxing, the heavyweight, all others having vanished because of boredom or bankruptcy."[360] Nothing seems to be less true, people actually enjoy the fights between lightweight boxers as well as they enjoy the heavyweight division. It seems that fans can still appreciate the talent and work put in by these competitors in different weight divisions.[361] Therefore we may say that it is possible that the creation of a genetically modified competition does not mean that the other types of competitions will not be interesting to the fans anymore.

It is an impossible task to predict the reaction of the fans on the introduction of a genetically modified competition beforehand. As discussed, there is the possibility that fans may avoid or even protest against genetically modified athletes, but there is perhaps the same possibility that fans might actually enjoy to see genetically modified athletes perform at a higher level than "natural" athletes may ever reach. But if sporting organizations refuse to think about the idea of genetically modified competitions in advance, they might find themselves in a difficult position if the time comes where genetic modification is accepted by the public and used by athletes.[362] Therefore I believe that the introduction of genetically modified competitions should be seen as a possibility to deal with the use of genetic modification in sports.

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[356] Miah 2004, p. 178
[357] Think of, for example, Lance Armstrong, who was immersed with the wrath of the world in 2012 after witness statements were used to ban him for life and strip him of his 7 Tour de France titles on account of doping.
[358] Fore 2010, p. 97
[359] Fore 2010, p. 97
[360] Fore 2010, p. 97 quoting William O. Johnson.
[361] Fore 2010, p. 97
[362] Fore 2010, p. 98

5.3. REDEFINING SPORT ETHICS

As discussed in Chapter 4, the ethical arguments against the use of drug-based doping in sports do not irrefutably apply to the use of genetic modification in sports. It would be wrong to simply categorize genetic modification in sports as "just another form of doping", since it is a whole different kind of technology.[363] Therefore, when it comes to genetic modification in sport, we should consider changing the ethical view that we have on the use of performance enhancing technologies in sports.

To start, we should look at the involvement of technology in sports. Technology must not be seen as an end in itself, but rather as a means to realize some other, valued end.[364] The purpose of using technology such as genetic modification in sports is "the maintenance of human life and its perfection".[365] This explains the historical context of the relation between technology and sports: technology is employed to reach better performance. The technologisation of sports has led to a situation wherein technology is used to see progress, transcendence and enhancement, which are typical aspirations of the technological process as a whole.[366] This development is not incompatible with important sporting values like competition, winning and physicality, which are important values for the sport practice at an elite level. Therefore we can consider technology to be of such an importance for sport (as discussed in section 4.4) that the view of sport ethics on the use of such technology is in need of change.

The ethical value of genetic modification as such a technology is not that of a form of performance enhancement comparable to drug-based doping. Of course genetic modification may also be used for reparative purposes in sports,[367] for example when athletes need to recover from some kind of serious injury. However, the more important value of the use of genetic modification in sport is that it reflects one of the fundamental values of being human.[368] Sport ethics have been "preoccupied with identifying codes of behavior for participating in sports".[369] These codes have been limited by what is considered to be "natural".[370] However, as I have

[363] Miah 2004, p. 160
[364] Miah 2005, p. 55
[365] W.F. Hood as quoted in Miah 2005, p. 55
[366] Miah 2005, p. 56
[367] Miah 2004, p. 161
[368] Miah 2004, p. 162
[369] Shogan & Ford 2000, p. 52
[370] *Id.*

already discussed in the previous chapter, it is part of being human to try to improve human performance. Should it than not be considered "natural" to act in accordance with these feelings, as long as it is safe? If athletes believe that genetic modification is a technology that is consistent what they consider humanness, this should provide a basis for the acceptance of genetic modification in sport.[371] If this does not comply with sport ethics, maybe we should not try to change the desire of athletes, the real participants in sports, but try to change the way sport ethics looks at sports.

Changing sport ethics on the use of a technology like genetic modification is not an easy task. For those that value high performance sports as it is at the moment, there is no reason to start questioning the rules and demands of sports as they are.[372] However, in the light of increasing performance and reaching the sporting values described above, it may be needed to eventually change the view of sport ethics on the use of performance enhancing technologies as genetic modification. It appears that ethical conclusions on the use of performance enhancing technologies have already been drawn without coming to the complexity of the issue in the first place. If we really start to look at this subject more thoroughly, the prospect for achieving a coherent ethical theory on sporting values, including the value of using genetic modification in sports, shall increase.[373] Therefore, we must consider a change in sport ethics.

[371] Miah 2004, p. 160
[372] Shogan & Ford 2000, p. 53
[373] Miah 2005, p. 56

6. CONCLUSION

I've started this thesis on genetic modification in sports with the underlying thought to figure out what should be changed about the way we deal with the subject at the moment. For now, a ban on genetic modification in sports based on safety arguments is maintainable, however, in the future, when the technology of genetic modification is developed enough to be used safely, it will not. When that time comes, we should consider another response to the use of genetic modification in sports, and as I have discussed in this thesis, by then may no longer an option. We will have to respond in a different way, by for example facilitating special competitions in which genetic modified athletes can compete against each other, while "natural" athletes stay in their own competitions to not perceive negative effects of the "superior" genetically modified competitors.

Before I could formulate possible future responses to the development of genetic modification in sports, I had to discuss the ethical viewpoints on the matter. To do this, I decided to subdivide the ethical considerations into the "Four Principles of Biomedical Ethics": autonomy, beneficence, nonmaleficence and justice, and added the ethics on the relation between technology and sports to complement the discussion.

In the section on autonomy I've discussed the subject of coercion and that of informed consent. I have argued that speaking of coercion could be an overstatement, since there is nothing that withholds an athlete from not using genetic modification to enhance their performances. This may however result in the fact that they will probably not be part of the group of habitual winners. Fact remains that not everyone can win, and in accordance with the ethical principle that benefits and rewards should be distributed according to efforts and risks undertaken, it is reasonable for genetically modified athletes to win. But even for those athletes that do not want to use genetic modification, the spirit of competition and winning may remain if they compete at a lower than elite level, where the use of genetic modification will probably not or barely exist.

The problem with informed consent on the other hand is that it is not yet possible for the medical personnel to know all the risks. Without this knowledge, it will not be possible for the athlete to practice informed and voluntary consent. As I pointed out, this is a valid argument at the moment, but it will not stand when genetic modification is further developed and the risks become clear.

In section 4.2 I discussed two biomedical ethical principles, namely beneficence and nonmaleficence. In this section I discussed "the safety argument" and two types of harm, knowing the harm of testing and the harm to society. The safety argument is clear: it is not safe

to use genetic modification, because it is “very immature, experimental and highly risky”, which is, in my opinion, a justification for the prohibition of the use of genetic modification in sports. However, as with informed consent, it is a good argument at this moment. There will probably be a time when genetic modification can be used safely, and the safety argument will not prevail.

The harm of testing on the other hand is an important argument against the prohibition of the use of genetic modification. The test that is most likely able to detect the use of this technology is a muscle biopsy, which is a very invasive method of testing and it brings risks to the athlete. The athlete might for example not recover in time, and mid-competition testing becomes impossible. Another problem with genetic testing is that it might show more than what is tested for. “The knowledge of one’s genetic future” (like knowing one might develop Huntington’s disease) can present potential harm to individuals, as well as to family members of these individuals (since certain disorders may run in the family).

The harm to society is the final ethical argument discussed in this section. Athletes might be heroes to (little) children who are inspired by them. These children might have difficulties to distinguish the athletic triumphs from the moral or ethical flaws. I have argued that this downfall is not intrinsic to the use of a forbidden substance or method, but rather to the fact that such use results in breaking the rules. Without existence of such a rule, the fall from grace would not be the same. I have argued that if genetic modification will not be thought of negatively by society, there is no reason to ban the use of it in sports. It is not the same as the use of drug-based doping, from which it is considered that it may encourage young children to experiment with drugs. If society does not think negatively on genetic modification (like it does on the use of drugs), there is no reason to consider that it may encourage young children in a negative way.

In the section on justice I discussed the value of fair play, the fairness of the therapeutic exemption and possible problems that may arise with sanctioning the use of genetic modification in sport. The argument goes that using performance enhancing techniques like genetic modification does not constitute to fair play in sports, that it is in fact unfair. I do not tend to agree, because athletes do not start of at a genetically level playing field (every athlete’s genetic composition varies) and genetic modification may actually be used to solve this problem, thus creating a genetically level playing field. On top of that, genetic modification could come as a solution to those who are “genetically prevented to be good enough”, think of too short for basketball etc. These genetic problems withholding these athletes from performing at an elite level may be solved by the use of genetic modification.

The therapeutic exemption becomes a problem when treatment through gene-based methods will become available. What if an athlete catches a disease or injury that is cured with the use of

genetic modification? We do not know if the athlete will reach a level beyond "normal" by this treatment, and giving him a therapeutic exemption, and thus the right to compete again, would be unfair to other athletes who used genetic modification but were not eligible to get such an exemption.

Third, problems can arise with the sanctioning of athletes suspected of the use of genetic modification. The first problem is that it may be hard to distinguish those that have used genetic modification from those who have natural-occurring genetic mutations. It is possible that athletes who have natural-occurring genetic mutations are above the "standard" levels, resulting in punishment for something they did not do. The second problem is the permanent nature of genetic modification. While first time violators will be punished with a 2-year ban (according to the WADC), this seems not to work with athletes who used genetic modification. The permanent nature of genetic modification would require a permanent ban which would leave no room for a second chance or an opportunity to repent or come clean. Another factor of this problem is that the testing would have to be 100% flawless, since a false test would have serious consequences.

The last problem with sanctioning is that banning an athlete based on his genetic composition could be seen as genetic discrimination, which is forbidden in the "Universal Declaration on the Human Genome and Human Rights" of UNECO.

Section 4.4 discusses the relation between technology and sports. Technology and sports are two inseparable domains, since technology has been used to improve sports for a long time. Athletes try to find new kinds of technology that gives them a competitive advantage. I've discussed the example of altitude tents, which gives athletes the possibility to increase their red blood cells, which means more transport of oxygen to the muscles and thus increased performances. Technology is not an end in itself, but is used as a tool to reach some other, valued end. The use of a technology as genetic modification does not even have to bring value to sport because of the performance, but rather about what we see as valuable about being human: the kind of being that wants to transcend the limitations of biology.

After I discussed the ethical problems, I was able to think of possible future responses. The first future response that I would consider is introducing biological "weigh-ins". This way we can at least determine the level of genetic activity in an athlete's body. When an athlete's values does not fit in the range that is considered "normal", there are two possibilities: ban the athlete, or put the athlete in a group of athletes with the same kind of genetic make-up. Although not an end in itself, the biological "weigh-ins" should be used as a tool to gain information about athletes and do something with that information.

An example of grouping athletes by their genetic make-up is given in section 5.2. The creation of additional competitions could solve the problem. We can create additional competitions based on genetic make-up the same way as boxing has weight classes. The fans can then decide what competition they would like to see.

My final proposed response is a change in the way we see sport ethics. If we see technology as a tool to reach a certain end, and acknowledge the fact that technology will always be used to improve performances in sports. Genetic modification could be considered as such a technology that is used to increase performance. As discussed before, it is part of being human to try to improve human performance. If genetic modification will one day be safe enough to use, and athletes, the real practitioners of sports, are willing to use it, who are we to hold them back? Maybe then it's time for a change of the view on sports by ethics.

Of course, these kind of responses will need to be researched and developed further, as is done with the technology of genetic modification. But we should not wait with this research until it's too late. If we start researching after the technology is finished and already in use, we will bear the implications. We should start researching and developing these kind of responses right now, in line with the development of genetic modification, to be sure that we are ready when the time comes…

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