Conceptual Problems with Performance Enhancing Technology in Sport

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The majority of – usually moral – problems inherent in elite sport, such as whether athletes should be able to take particular drugs, wear particular clothing, or utilise particular tools, arguably stem from a conceptual one based on faulty logic and competing values. Sport is a human enterprise that represents a multitude of human compulsions, desires and needs; the urge to be competitive, to co-operate, to excel, to develop, to play, to love and be loved, and to find meaning in one's existence. From the perspective of an amateur athlete, this pluralism is possible. When one is involved in athletics at the lower echelons, the values that one holds in relation to sport are fluid and flexible; they are prioritised according to a myriad of other influences that are contingent to a particular situation. As such, the reasons that the general population participate in athletic activities and the values they consequently ascribe to it are complex and wide-ranging and thus fall into the sociological realm. The philosophical problem with value in sport is found at the highest level, the professional platform, where discordant values are espoused, particularly the value of ever increasing quantifiable performance. The athletic events at the Olympic Games are the archetypal manifestation of this *Citius*, *Altius*, *Fortius* (faster, higher, stronger) aphorism and yet when taken to its logical conclusion becomes evidently absurd.

This chapter seeks to lay out some of the contradictions and conceptual problems inherent in elite athletic performance and consider the practical implications that will inevitably occur with likely developments in technology. In particular, it will highlight the flawed logic of quantifiable progress that is intertwined with athletic performance in addition to considering recent controversial developments in technology and their effects on sport. It will conclude with an indication of the types of issues that will be faced in sport as this conceptual problem, inherent in elite sport, comes increasing to the fore.

doi:10.1017/S1358246113000234 ©The Royal Institute of Philosophy and the contributors 2013

https://doi.org/10.1017/S1358246113000234 Published online by Cambridge University Press

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The paradox at the centre of elite sport is one which holds both an incessant drive for record breaking performances as well a desire to preserve the integrity of the human. This is exemplified by Ted Butryn in his paper, 'Cyborg Horizons', when he says,

> Gold medals are to be earned by decidedly (and recognisably) human competitors, while the Olympic motto itself drives athletes to become increasingly and unabashedly "post-human", and to ultimately transgress boundaries between animals–humans–machines.[1]

It is a paradox whereby we continually strive to surpass limits and break records and yet at the same time attempt to maintain an image of the natural athlete; the ancient Greek ideal. Yet in this current technological age, when we look closely at this picture of a Greek hero we realise how much of a diminishing illusion it is. The sports technology industry is worth billions of dollars and is driven by the incessant human desire to improve sporting performance and demonstrate sporting superiority. This technology spans footwear and clothing, sophisticated video analysis, nutritional and ergogenic aids as well other innovations in tools, implements and playing surfaces. The paradox is that whilst technology is embraced in aspiration to the Olympic motto of faster, higher, stronger, it is also often rejected for being antithetical to it.

As highlighted in the quote by Butryn, our assessment of what we deem to be acceptable technological use is directly affected by our moral evaluation of what athletics ought to look like. The sporting arena, above all others, holds a unique place in our attempts to try to maintain a delicate balance between a belief that it ought to be a test of the natural human capability and at the same time, an arena whereby we are able to surpass those limits. In it we wish to remain human but at the same time demonstrate super-human performance.

Caution ought to be maintained however, since the term 'post-human' can arguably be misleading. It suggests that there is a human essence, or a set of necessary and sufficient characteristics, that can be identified; yet which has eluded those who have attempted to determine what these might be. What the term does do, however, is indicate our conceptual confusion that arises with technological innovation. Donna Haraway, in *The Cyborg Manifesto,* first argued that we were living in a post-human

[1] Ted Butryn, 'Cyborg Horizons: Sport and the Ethics of Self-Technologization' in A. Miah & S. Eassom (eds) *Sport Technology: History, Philosophy and Policy*. *Research in Philosophy and Technology*, **21**, (Series Ed: Carl Mitcham) (Oxford: Elsevier Science Ltd, 2002) 117.

https://doi.org/10.1017/S1358246113000234 Published online by Cambridge University Press

age in the late 1970s.[2] She pointed to many aspects of technology which form a necessary part of the modern life, such as, pace-makers, processed foods, intensive care units, artificial hip joints, heart-rate monitors and synthetic clothing. Since the time Haraway made her claims there have been three decades of technological innovation. Today, arguably technology has an even more endemic hold over our lives.

Similarly, Raymond Kurzweil in his 2005 book *The Singularity is Near: When Humans Transcend Biology* has argued that our knowledge of, and our ability to manipulate, the physical environment will reach a tipping point in the next twenty to thirty years.[3] According to Kurzweil, there will be little distinction between human and non-human at the advanced technological level as artificial intelligence will seem (or be) as human as our own – and machines will easily pass the Turing Test – and we will have the ability to correct, alter and transform our biology at will. At this point we will have the knowledge to be able to maintain absolute control over our existence and physical manifestation. If Kurzweil's claim is demonstrated correct, it will have profound implications for sport, particularly the fundamental value of measuring athletic performance, since the notion of 'natural human' will have significantly altered in form. That doesn't necessarily mean that sport won't survive if Kurzweil's prediction becomes reality[4] but it does mean that aspiring to the higher, faster, stronger motto as showcased by the Olympics will become nonsensical.

1. Defining technology

Before considering the value of athletic performance however, I will start with a brief discussion of the term 'technology'. The standard definition is 'the application of scientific knowledge for practical purposes'[5] with most dictionaries giving a more narrow definition focusing upon the human use of material objects, such as tools and

[2] Donna Haraway, 'A Cyborg Manifesto: Science, Technology, and Socialist-Feminism in the Late Twentieth Century' in *Simians, Cyborgs and Women: The Reinvention of Nature*. (New York: Routledge, 1991) 149–181.

[3] Raymond Kurzweil. *The Singularity is Near* (London: Penguin, 2006)

[4] This is demonstrated by Bernard Suits (1978) in his conception of utopia which argues game-playing as the ideal of existence.

[5] 'technology' in the *Oxford Dictionary of English*. Edited by Angus Stevenson. Oxford University Press, 2010. *Oxford Reference Online*. Oxford University Press. University of Gloucestershire. 10 July 2012

https://doi.org/10.1017/S1358246113000234 Published online by Cambridge University Press

machines. Broader definitions include methods of organising and the use of systems or techniques. Its etymology stems from the Greek word meaning 'systematic treatment' with 'techne' referring to a skill or craft and 'logia' referring to the discourse or study of.[6] However, the definition that best encompasses the broad scope that technology covers is:

> The whole range of means by which humans act on their environments or seek to transcend the limits of their natural capacities.[7]

This type of definition resonates with Heidegger's 'technological attitude' in that it highlights the uniquely human way that we perceive and categorise the world.[8] The human condition enables a reflection upon the past and a projection into possible futures. We are able to imagine what might have been and what might be. For Heidegger, this attitude enforces our instrumental conception of the world and can be considered as a mode of existence.[9] It is the way that we navigate through the world; overcoming barriers by identifying solutions through manipulating our environment. In essence, it is an approach that conceptualises a problem, for instance, 'how I can hit the ball further?' and then transfers the knowledge we hold about specific aspects of the world, in this case, knowledge about the properties of materials, in order to provide a solution.

This technological attitude can also be seen to provide a basis for Kurzweil's arguments concerning technological advancement.

<http://www.oxfordreference.com/views/ENTRY.html?subview=Main&entry=t140.e0848700>

[6] 'technology' in the *Oxford Dictionary of Word Origins*. by Julia Cresswell. *Oxford Reference Online*. Oxford University Press. University of Gloucestershire. 5 October 2010 <http://www.oxfordreference.com/views/ENTRY.html?subview=Main&entry=t292.e4936>

[7] 'technology' in the *Dictionary of the Social Sciences*, Craig Calhoun, (ed.) Oxford University Press, 2002. *Oxford Reference Online*. Oxford University Press. University of Gloucestershire. 5 October 2010 <http://www.oxfordreference.com/views/ENTRY.html?subview=Main&entry=t104.e1667>

[8] Heidegger actually calls the way we conceive and relate to the world 'enframing' but the term 'technological attitude' is a helpful indication of what this means. Martin Heidegger, (trans. & intro. William Lovitt). *The Question Concerning Technology and Other Essays* (New York: Harper Row, 1977) 12.

[9] Martin Heidegger, (translated by J.Glenn Gray and F. Wieck) *What is Called Thinking?* (New York: Harper and Row, 1968) 5.

https://doi.org/10.1017/S1358246113000234 Published online by Cambridge University Press

Kurzweil argues that technology develops at an exponential rate. This is most effectively demonstrated in Moore's Law whereby the number of transistors that can fit on a computer chip doubles every two years. This leads to the exponential growth in computing power and explains why the average mobile phone is now more powerful than the computers that enabled men to reach the moon.[10] This law seems to have held relatively well since the development of transistors in the early twentieth century but Kurzweil goes further in applying it to technological innovation throughout human evolution. Kurzweil argues that the mistake most of us make when considering the development of technology, is to view it in a linear rather than exponential way.

> My models show that we are doubling the paradigm–shift rate every decade. Thus the 20th century was gradually speeding up to the rate of progress at the end of the century; its achievements, therefore, were equivalent to about twenty years of progress at the rate in 2000. We'll make another twenty years of progress in just fourteen years (by 2014), and then do the same again in only seven years. To express this another way, we won't experience one hundred years of technological advancement in the 21st century; we will witness on the order of 20,000 years of progress (again, when measured by the rate of progress in 2000), or about 1,000 times greater than what was achieved in the 20th century.[11]

The question then is, if Kurzweil's thesis is correct and this inductive premise holds true for the near future, how will it affect sport, athletic endeavour and the values we place upon it? Sport is in essence, a technological enterprise. It is an evolution from play and recreation because it imposes arbitrary rules that limit the means to reach an arbitrary end. Bernard Suits' definition of a game-playing, within which sport is contained, is,

> [T]he attempt to achieve a specific state of affairs [prelusory goal], using only means permitted by rules [lusory means], where the rules prohibit use of more efficient in favour of less efficient means [constitutive rules], and where the rules are accepted just because they make possible such activity [lusory attitude].[12]

[10] M. Kaku, *Physics of the Future: How science will shape human destiny and our daily lives by 2100*. (New York: Doubleday, 2011) 22.

[11] Raymond Kurzweil. *The Singularity is Near*, (London: Penguin, 2006) 11.

[12] Bernard Suits, *The Grasshopper: Games, Life and Utopia*. (Toronto: University of Toronto Press, 1978) 41.

https://doi.org/10.1017/S1358246113000234 Published online by Cambridge University Press

The goal here might be to reach a finish line (which incidentally might be the same as the starting line), or to put a ball in a net; and the rules and means might dictate that this is done by following a designated track or by passing the ball in a particular way to a team-mate. But above all, it requires a particular attitude that accepts these rules (and the subsequent means) in order to allow the game to exist at all. If one does not hold this lusory attitude then one could quite easily reach the goal more efficiently, i.e. cutting across the infield of a track in athletics, or getting a ladder and carrying the ball up to the net in basketball. This is why sport is so peculiar, and so peculiarly human; we deliberately put obstacles in our way to make an activity more difficult to achieve. To return to our earlier definition of technology, it is the way in which we seek to overcome obstacles and solve problems that are placed in our path, despite the fact that the obstacles are ones of our own making. It is by design an inefficient activity. The paradox concerning technology is that this desire to solve problems is then used to make a necessarily inefficient activity more efficient.

2. Technology and the idea of progress

At an elite level, today even the most prosaic athletic sport – that of running for instance – is a highly technological affair, as Pam Sailor's demonstrates in her paper 'More than a pair of running shoes'.[13] The account given of Paula Radcliffe as she prepares to race is highly reminiscent of Haraway's cyborg:

> The sunglasses Radcliffe wears are to prevent tension that is caused by squinting into the sun. Even the smallest bit of tension in the face could filter down to the lower body. The sunglasses also hide her emotion from competitors and help break the dust kicking up from the street and the wind… Radcliffe also wears a strip on her nose to aid her breathing; she has exercise induced asthma… [A]n elastic titanium necklace… is designed to restore equilibrium and improve blood flow… [She was] one of the first marathoners to wear knee-high compression socks. Hers are skin-coloured and they, too, are designed to increase blood flow. To keep the blood flowing to her fingers, Radcliffe

[13] Pam Sailors, 'More than a pair of running shoes' *Journal of the Philosophy of Sport* **36** (2009), 207–126.

https://doi.org/10.1017/S1358246113000234 Published online by Cambridge University Press

> wears gloves. White gloves. She is, after all, the British aristocrat of the race.[14]

Despite technological innovation, sport is a fairly conservative sphere though increasingly driven by what Robert Nisbet calls the 'great idea of progress'.[15] This is based upon the desire for perfection and the drive to eradicate problems and achieve ultimate control over our environment. Technology allows us both to overcome perceived limitations and difficulties, and (we believe) enables us to measure this progress against previous attempts in an exact and objective way. This is seen none more clearly than in the sport record. In the case of sports measured by time, we are now able to calculate performances to a tenth of a thousand of a second.

This focus on quantifiable performance has been the subject of a detailed critique by philosophers such as Sigmund Loland. Loland argues that the notion of ever-continuing quantifiable performance and the value we place upon it highlights fallacious reasoning. He says,

> The logic of quantifiable progress has in a common-sense manner become a normative ideal in sports. For example, without new records, important events like the Olympic Games and the World Championships are considered failures both by the media and the public. This logic seems also to be an ideal for a series of current developments in sports. Through the quest for standardisation and objectivity, scientific and technological know-how is applied to control the uncontrollable, to eliminate chance, and to measure performance improvement in an increasingly more accurate way.[16]

This application of technological know-how has shaved nearly a tenth off the men's 100m sprint record in less than 100 years. Women have improved by over 20%. In swimming, the progression has been even more marked, with most disciplines showing a 20 – 25% improvement for both men and women, with the women's 100m and 200m freestyle showing a 35% improvement in less than a century. Similar

[14] Liz Robbins, *A Race Like No Other: 26.2 Miles Through the Streets of New York*. (New York: HarperCollins 2008) 140–141.

[15] Robert Nisbet, *History of the Idea of Progress* (New Jersey: Transaction, 1994)

[16] Sigmund Loland, 'The Logic of Progress and the Art of Moderation in Competitive Sports' in *Values in Sport*, C. Tannjo and C. Tamburrini (eds) (London: E & FN Spon, 2000) 42.

https://doi.org/10.1017/S1358246113000234 Published online by Cambridge University Press

progression has been seen in other linearly measured sports of jumping and throwing.

Improvements in technique, skill and athleticism have also been seen in both aesthetic sports and team games. The level of technical difficulty has increased in gymnastics and diving, balls are hit harder in hockey, kicked further in rugby, and with more precision and spin in football. Much of this change has occurred alongside developments in technology. The increased power and speed in hockey has been brought about to a large extent with changes in playing surface (from grass to water based synthetic turf) and lighter, rounder sticks. Gymnasts and divers are able to perfect their moves with improved safety harnesses and assisted by three-dimensional video analysis.

Improvements in these types of aesthetic sports and complex games are not too problematic from a logical perspective. Changes in technology result in changes in the game itself. In most cases, improvements in technology have enabled a greater aesthetic pleasure, particularly for the sporting spectator. The modern game of hockey is very different to the game of the 1970s; no longer are players hacking at balls stuck in a grass divet. However, the logical and conceptual problems that come with our expectation for ever-improving progress, is manifested in linear sports that involve measuring and quantifying progress via the standard measurements of distance, weight and time. In order to demonstrate improvements in quantifiably measurable performance, technology will inevitably begin to make a more marked influence on our physical being. As Loland points out,

> The quest for infinite quantifiable progress will sooner or later lead towards pressing moral dilemmas that challenge our very idea of what a human being is all about. The core problem of this logic is that it builds on the impossible demand for unlimited progress within limited systems. Enough is never enough![17]

3. Genetic technology in sport

For Loland, the real concern is with technologies that have a direct effect on our biological make-up. Perhaps the application of genetic technology is where we will really see, what can be called, the 'post-human' athlete. There are already areas of genetic research which

[17] Op. cit. note xvi, 43–44.

https://doi.org/10.1017/S1358246113000234 Published online by Cambridge University Press

could have a marked effect upon sporting performance including the ability to increase muscle mass, and the ability to increase oxygen uptake. Experiments conducted on mice and monkeys, for instance, have utilised the follistatin gene to block myostatin, a protein that inhibits muscle growth. The effect of which is that the muscular stature of these animals is significantly increased. This is the case even without high intensity exercise. If these results are replicated in human subjects it would affect how, and how much, athletes developed muscle. One needs to be cautious however, in concluding the effects upon sporting performance. Even in activities that depend primarily on strength, muscle mass needs to be balanced with surrounding tissue, such as ligaments, tendons, cartilage and bones. Simply adding a particular gene that increases muscle mass isn't necessarily going to lead to better performances, and may well have the unintended consequence of reducing performance through more frequent injury.

Another application of genetic technology that might have an equally significant effect upon sport is by affecting the use of oxygen in the blood stream. Athletes that carry a greater amount of red blood cells can use oxygen more efficiently and can work harder for longer. Many athletes already take advantage of high-altitude training or oxygen chambers (or indeed blood doping[18]) in order to 'artificially' force the body to use oxygen more effectively. This process has been replicated through gene transfer, whereby genetically modified mice have shown significantly enhanced endurance capabilities.[19] Again, although this technology could have discernible effects on sporting performance, particularly in long-distance or endurance events, it may result in unintended consequences. As shown in the world of elite cycling in the second half of the twentieth century, increasing the red blood cell count places additional (and excessive) demand on the heart.

Nevertheless, despite these two areas where genetic technologies may have a potential application to sport, speculation needs to be restrained. The concern that we would see genetically modified athletes

[18] This practice entails the blood being removed from the body to be reinserted at a later date once the body has replenished its lost blood cells. The effect is an increased number of red blood cells which then are able to hold an increased amount of oxygen.

[19] P. Hakimi, J. Yang, G. Casadesus, G. *et al.* 'Overexpression of the Cytosolic Form of Phosphoenolpyruvate Carboxykinase (GTP) in Skeletal Muscle Repatterns Energy Metabolism in the Mouse', *The Journal of Biological Chemistry*, **282** (2007) 32844–32855.

https://doi.org/10.1017/S1358246113000234 Published online by Cambridge University Press

first appeared in the late 1990's and early 2000's. This was at the height of publicity on the human genome project when scientists, policy makers and ethicists first met to discuss how to deal with this prospect. The solution, it was decided, was to treat genetic technology as a form of doping, alongside steroid use, THG, amphetamines, and blood doping and therefore it would come under the jurisdiction of the World Anti–Doping Agency (WADA).[20] Despite fears that genetically modified ('Frankenstein'[21]) athletes would be competing at the Sydney, Greece, and Beijing Olympics, there is no evidence to suggest that this has yet become a reality and speculation about these types of athletes seems to have died down.

4. Prosthetic technology in sport

The more pressing and likely technology to affect linear-type sports such as athletics is the development of synthetic technologies, particularly in the area of prosthetics. Oscar Pistorius, the South African 'blade runner', is currently the best known amputee athlete who has competed in able-bodied events. Pistorius's disputes with athletics authorities over his eligibility to compete in able-bodied competitions highlights the conceptual problems about the value and meaning of athletic performance, and focuses particularly on notions of 'fairness' and 'performance enhancement'. The question surrounding Pistorius is whether his specially designed prosthetic legs ('Cheetahs') provide him with an unfair advantage over other athletes. The notion of unfair advantage is a difficult one to assess but in this case, the authorities wished to establish whether these prosthetic limbs were akin to wearing jet-powered roller skates, for example. Since the 200m running race is a test of the competitors' ability to run, the conceptual problem is concerned with the definition of 'running'; and moreover whether this includes the use of prosthesis.

In order to answer this question, Pistorius was subjected to tests that measured a range of movements that were deemed inherent to running, including forces, energy consumption and wind resistance. The IAAF's (International Association of Athletics Federations)

[20] WADA Press Release. 'Wada Conference Sheds Light On The Potential Of Gene Doping' 1005 Lausanne, Switzerland, 20th March 2002.

[21] The fears manifested in such language are explored more in Emily Ryall 'The language of genetic technology: metaphor and media representation', *Continuum*, **22** (3) (2008). 363–373.

https://doi.org/10.1017/S1358246113000234 Published online by Cambridge University Press

initial conclusion was that Pistorius's prosthetic limbs did constitute an unfair advantage over abled-bodied competitors for the reason that the biomechanical differences meant that his 'Cheetahs' produced more recoil spring and less drag than 'natural human' legs, so the wearer expends less energy than an athlete with 'natural' legs. Since the IAAF's rules of running at the time had nothing to say about prosthetic limbs, they were amended to prohibit, 'any technical device that incorporates springs, wheels or any other element that provides a user with an advantage over another athlete not using such a device', a category which subsequently included Pistorius's prosthetics.[22] This judgement was subsequently overturned by the Court of Arbitration for Sport (CAS) on the grounds that insufficient variables had been tested. Indeed, the CAS questioned the validity of the testing procedure since,

> [T]he IAAF's officials must have known that, by excluding the start and the acceleration phase, the results would create a distorted view of Mr Pistorius' advantages and/or disadvantages by not considering the effect of the device on the performance of Mr Pistorius over the entire race.[23]

It was concluded that although the recoil spring from his prosthetics gave him an advantage over latter stages of the race this was offset by the fact that Pistorius was required to expend more energy in the initial acceleration stages and when running a bend.

As noted by the CAS, the fact that 'at least some IAAF officials had determined that they did not want Mr Pistorius to be acknowledged as eligible to compete in international IAAF-sanctioned events, regardless of the results that properly conducted scientific studies might demonstrate'[24] indicates the strong resistance the authorities have towards the use of prosthetic technology and the impact it might have upon sport. Despite the ban being overturned, the IAAF continued to press South Africa not to select Pistorius for the 4×400 relay but this time changed their argument from one of fairness to one of harm. They maintained that it could risk the

[22] IAAF ruling 144.2 It has since been further amended to 'the use of any technology or appliance that provides the user with an advantage which he would not have obtained using the equipment specified in the Rules.'

[23] Arbitration CAS 2008/A/1480 Pistorius v/ IAAF, award of 16 May 2008. 7. <www.jurisprudence.tas-cas.org/sites/CaseLaw/.../1480.pdf> July 2012.

[24] Op. cit. note xxiii. 8

https://doi.org/10.1017/S1358246113000234 Published online by Cambridge University Press

safety of both Oscar and other athletes if he ran in the main pack since his running style differed to other athletes and his prosthetics could cause an accident. Subsequently, Pistorius was initially prevented from running in the 2011 World Championships, despite being selected for the relay team, due to health and safety concerns. Again, the IAAF later rescinded their view and Pistorius was allowed to compete in the London 2012 Olympics.

As has been considered in greater detail by authors such as Jones,[25] Van Hilvoorde & Landeweerd,[26] Edwards[27] and Lenk,[28] there are several arguments that are raised here from both ethical and conceptual standpoints. That the IAAF has appealed to many of these arguments is indication of their conservative attitude and their desire to preserve a particular purist conception of athletics which hides problematic cases such as Oscar Pistorius and Caster Semenya.[29] Arguably if a competitor doesn't fit the conception of the 'normal, natural' human athlete (and for Semenya, this must be a 'natural feminine' athlete) then they are accused of possessing an unfair advantage. In the case of Pistorius, this was his prosthetic blades, with Semenya, it was her masculine appearance.

It is not in dispute that prosthetic technologies are performance enhancing, since they allow the athlete to compete at all. This highlights the problem with assessing what constitutes *unfair* performance enhancement and raises different questions about the value of sport and what we really wish to test. If we value equality of opportunity then, to use a sporting metaphor, how much should we 'level the playing field'? Do we compensate for inequalities in physical

[25] Carwyn Jones and Cassie Wilson 'Defining advantage and athletic performance: The case of Oscar Pistorius', *European Journal of Sports Science* **9**(2) 2009. 125–131.

Carwyn Jones 'Oscar Pistorius, the Paralympics and issues of fair competition' in D. Lampman & S. Spickard Prettyman (eds), *Learning culture through sport* (Lanham, MD: Rowman & Littlefield Education 2011)

[26] I. Van Hilvoorde and L. Landeweerd 'Disability or extraordinary talent: Francesco Lentini (three legs) versus Oscar Pistorius (no legs)', *Sport, Ethics and Philosophy*, **2** (2008) 97–111.

[27] S. D. Edwards 'Should Oscar Pistorius be excluded from the 2008 Olympic Games?' *Sport, Ethics and Philosophy*, **2** (2008) 112–114.

[28] C. Lenk, 'Is enhancement in sport really unfair? Arguments on the concept of competition and equality of opportunities' *Sport, Ethics and Philosophy*, **1** 2007. 218–228.

[29] S. M. Crincoli, 'You Can Only Race if You Can't Win? The Curious Cases of Oscar Pistorius & Caster Semenya' *Texas Review of Entertainment and Sports Law* **12** (2) (2011) 133–188.

https://doi.org/10.1017/S1358246113000234 Published online by Cambridge University Press

ability? If Pistorius should be compensated for the misfortune he received as a child in suffering dual amputation of the legs then should others too be compensated for poor rolls of the dice of life, such as having 'poor' genes, being born in an impoverished country, having no access to facilities or coaches, or being generally uncoordinated, ill-motivated and unambitious?

5. Therapy, enhancement and societal norms

The problems faced by the sporting authorities regarding fairness in performance enhancement will undoubtedly increase if Kurzweil's prediction is correct and as technology is further embedded into our daily lives and our physical being. It may be that it becomes the norm in society to replace biological parts with more reliable synthetic ones, and not simply for therapeutic reasons. Indeed, these cases illustrate how the distinction between therapy and enhancement is conceptually problematic. For instance, baseball pitchers have received elbow surgery to replace damaged tendons and in some cases this has resulted in a stronger throwing action than was the case prior to the injury. This has led other athletes (and often parents of aspiring athletes) to request the surgery without any medical necessity.[30] Similarly, the cost and effectiveness of laser eye surgery has become affordable to much of the general population and many top sports players have reportedly received it, with the most high profile example, professional golfer, Tiger Woods. As these technological enhancements become a societal norm, it raises difficult questions for the sporting authorities as to which performance enhancements are acceptable and which are not. Furthermore, it will be more difficult to prohibit technology that becomes an intrinsic part of the body than technology that is external to the body which can be easily removed or separated, such as the LZR swimming costume. It is not clear how the authorities will deal with cases such as an archer or shooter who has had her eyesight enhanced through surgery. They will need to assess whether it constitutes an unfair advantage over other competitors who have not received such surgery. If the authorities, as in the parallel case of testosterone levels in female athletes, determine that the eyesight is beyond that of 'normal' human levels, and ban these athletes from competing, then this will undoubtedly prove controversial. Moreover, the authorities

[30] Whether the faster pitching action is a result of the surgery itself or attention to a reconditioning programme and other factors is disputed.

https://doi.org/10.1017/S1358246113000234 Published online by Cambridge University Press

might find that they are increasingly re-evaluating these levels as this technology becomes more endemic in society. This difficulty in assessing what is within the range for the abilities of a 'normal' human might become increasingly pronounced if access to technology is not equitable (as is currently the case) and the gap between the 'normal' athlete of the richer nations and the 'normal' athlete of the poorer ones continues to grow.

Ultimately, the concern over performance enhancing technologies stems from questions about the value of sporting performance. There is a real desire to test the athlete not the sport scientist, engineer or pharmacist. Yet, this begs the question as to what *is* the athlete that we wish to test, and how is it possible to separate the 'natural human' from the technology. As Haraway noted decades previously, technology is so deeply embedded into our very being it has become conceptually impossible to set it apart from the modern man. Performance enhancement in sport cannot wholly be rejected since it runs alongside the notion of progress. Arguably, it is our tendency to hold a technological attitude which forms the basis for our tacit expectation that progress is both valuable and inevitable. In sport, one of the clearest measurements of this progress is through quantifiable and measurable performance exemplified in linear sports that are based upon time, weight and distance.

However, an analysis of the effect of particular technologies upon sport demonstrates that sports governing bodies will be faced, and with an increasingly greater frequency, with questions about the fundamental values of athletic performance, particularly at the elite level. If we accept a definition of sport as the 'voluntary attempt to overcome unnecessary obstacles through physical skill'[31] it is apparent that it must contain inefficiency at its core. Therefore, the inherent paradox is that it ultimately runs against the technological attitude and the notion of progress.

6. Conclusion

So one might ask, what should sport be about if it is incongruent with a technological drive? Suits' definition of game-playing perhaps provides us with an indication of the answer; this being his notion of lusory attitude. This attitude is one that accepts that sport is an

[31] Suits maintained that sport was a sub-set of game-playing but with the additional criteria of physical skill and stability (to set it apart from 'fads' or 'crazes' such as hula-hoop).

https://doi.org/10.1017/S1358246113000234 Published online by Cambridge University Press

arbitrary enterprise that enables us to enhance our lives in a much broader way and is encompassed by the values set out in the Olympic charter such as respect, courage, friendship, determination, excellence, equality and inspiration. In contrast, the values of the Olympic motto of *citius*, *altius*, *fortius* pursued by many of those involved in elite sport renders the lusory attitude unnecessary.

In conclusion, which technology is and isn't accepted in sport on the grounds of fairness will undoubtedly change as it has done throughout sporting history. One can point to many examples of historical shifts in perception, one of the most notable being the notion of organised and structured training. In the late 19th and early 20th century, serious and dedicated training and practicing before a competition was seen as bad sportsmanship, whereas today the development of professional sport means that those who do not train are now considered uncommitted, lazy, foolish or arrogant. The same could also be said with the use of coaches, nutritionalists, and psychologists. All these performance aids are an accepted part of modern sport. Similarly, altitude chambers, nutritional supplements, video and biomechanical analysis, breathable and cooling clothing materials, and asthma inhalers are all accepted technologies. And, for the time being, prosthetic technologies are too despite the IAAF's unease. Generally, decisions made about the acceptability of performance enhancing aids are reflective of the complex power and political relations between the athletics governing bodies, corporate and commercial company interests, the press and the public. But what is clear is the contradictory logic behind elite athletic performance will become more prominent and more problematic as technology progresses, particularly with innovations in prosthetic, bionic and genetic technology. The value of those linear sports that are considered the principal Olympic events, such as the men's 100m sprint, will increasingly be called into question as further inequities develop and it becomes evident that the notion of the 'natural human' athlete no longer makes sense. But that does not consequently mean that sport *qua* sport will become obsolete – indeed we will see new sports develop and flourish through the use of technological advancements. The sports that are likely to remain most intact with on-going developments in technology are the ones that are least affected by technological changes; sports that maintain those values that ultimately determine our humanness; sports that require traits such as creativity, inspiration, self-affirmation, and the lusory attitude.

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https://doi.org/10.1017/S1358246113000234 Published online by Cambridge University Press