Accessibility and Fairness: Prosthetics in Sporting Competition

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Introduction

Oscar Pistorius made history in 2012 when he became the first double amputee to run in the Olympic Games, but this breakthrough for athletes with disabilities was met with as much controversy as it was celebration (Smith, 2015). Prosthetics are artificial devices that are designed to allow patients who have suffered the loss of one or more limbs to restore normal function and allow for participation in activities that may have otherwise not been possible, and this includes competing in athletic competitions, as shown in the case of Pistorius. Pistorius made a name for himself as the best paralympic sprinter in the world, winning a gold medal in the 2004 Athens Paralympic Games and setting the disabled world record in each of the 100, 200, and 400-meter races (Bidlack, 2009). After his success in the Paralympic Games, Pistorius aimed to compete in the Olympic Games in 2008, but he was initially denied the opportunity to compete by the International Association of Athletics Federations (IAAF), who ruled that he was ineligible to compete due to his prosthetics (Bidlack, 2009). Pistorius successfully appealed this decision with the Court of Arbitration for Sport (CAS), and although he did not qualify for the 2008 Beijing Olympic Games, he did compete in the 2012 London Games, achieving his goal of competing with able-bodied athletics despite his disability (Smith, 2015).

This research paper aims to investigate the following question: should athletes using prosthetic devices be allowed to compete in sporting competitions alongside able-bodied athletes? The development of the field of prosthetics over the years that now allows athletes such as Oscar Pistorius to compete in sporting competitions with able-bodied athletes shows that prosthetics can be successfully used to increase the accessibility of these competitions and remove barriers to entry for those with disabilities that may have existed in earlier time periods. However, in the case of Pistorius and others, some argue that advanced prosthetics may allow

athletes to gain an unfair advantage, as a result athletes with prosthetics should not be allowed to compete. This paper utilizes the Social Construction of Technology (SCOT) framework as a tool to analyze the various social groups involved in the discussion surrounding prosthetics in sporting competition and provide insight on how the fields of athletics and prosthetics are impacted by these social groups.

Research Question and Discourse Analysis Methodology

This paper uses the research methodology of discourse analysis in order to analyze the question of whether or not it is fair for athletes with prosthetics to compete in sporting events with able-bodied athletes. Discourse analysis is the method of interpreting data gathered through literature reviews, interviews, or other events that generate dialogue, and allows for non-traditional sources such as social media posts (Seabrook, 2022). The research conducted for this paper utilized databases such as Web of Science and PubMed using keywords such as "sports prosthetics" in order to gather journals and scholarly articles in order to investigate the scientific discourse surrounding prosthetics in athletics. First, this paper investigates the social debate regarding fairness in sports not necessarily concerning prosthetics, but instead concerning gender, sexuality, and steroid use. Next, the research collected on the current developments in the field of prosthetics is used to analyze whether or not prosthetics have become so advanced they could give an advantage to athletes using them. Finally, this paper analyzes current legal arguments surrounding the use of prosthetics in sports to attempt to determine whether or not barring athletes from entry in sporting competitions in the interest of fairness violates laws related to accessibility in these competitions, such as the Americans with Disabilities Act.

Background: Sports and Prosthetics

Sports and athletic competitions provide several benefits both in children and adults; development of motor skills, improved focus and concentration, increased self-esteem, and sports typically emphasize collaboration skills which are important in all facets of life (Du Plessis & Berteanu, 2020). Due to the physical nature of most sports, people with disabilities such as loss-of-limbs are typically unable to participate in these competitions, and as a result may miss out on the benefits provided by these activities such as increased physical and cognitive function (Garcia-Falgueras, 2015).

One alternative that has gained traction over the past several decades is the creation of separate categories of sporting competitions designed specifically for those with disabilities, such as the Paralympics (Du Plessis & Berteanu, 2020). One example of a separate competition established with people with disabilities in mind is amputee soccer, which aims to modify the sport of soccer to allow for participation using forearm crutches and one leg to control the ball (Lamberg & Pierre-Glaude, 2022). This competition does not allow for the use of prosthetics, instead attempting to alter the sport to a level where athletes with disabilities can compete without assistance by artificial limbs.

In recent history, the field of prosthetics has developed greatly, and as a result more and more patients are able to gain essentially normal motor function in areas where loss-of-limb has occurred with the use of advanced prosthetics. Recent studies show that the movement of amputees using modern prosthetics is very similar to that of control groups of able-bodied subjects (Jarvis et al., 2021). According to a recent study conducted by interviewing athletes using prosthetics, the technology has developed to a point where participants were satisfied with the ability of prosthetic feet in particular to allow for participation in regular sporting events (Poonsiri et al., 2020).

Social Construction of Technology Framework

The STS Framework utilized in this research paper in order to answer the research question stated above is the Social Construction of Technology (SCOT), which analyzes technology as a consequence of social movements, and asserts that technology is a social construct (Klein & Kleinman, 2002). The SCOT framework includes the principal ideas of interpretive flexibility, relevant social groups, closure and stabilization, and wider context, and its origins go back to an article written by Trevor Pinch and Wiebe Bijker in 1987 (Klein & Kleinman, 2002). Essentially, the SCOT framework is used to analyze technological developments as a result of the wants and needs of relevant social groups, where society pushes for certain technological advances due to their own self-interests, and the form and purpose of these technologies are flexible and can change as society's needs change.

Despite being a founder of the idea of SCOT, Trevor Pinch later on has criticized the framework as being too simple and making flawed assumptions. Namely, Pinch criticized the assertion that the SCOT framework views society as composed of relevant social groups, and that each social group is equally important in the development of technologies (Pinch, 1996). Pinch argues that the development of technologies is not equally influenced by all relevant social groups, and instead some social groups dominate over others due to a variety of factors include wealth, social status, and others (1996). These nuances should also be taken into consideration when analyzing technology through the lens of SCOT, in order to properly analyze the context surrounding how these technologies develop.

Literature surrounding the field of prosthetics is extremely limited, but despite a lack of prior research in this subject this paper uses the SCOT framework to analyze both the development of prosthetics and athletic competitions as a whole through the lens of the relevant

social groups that drive their development. These social groups include people with disabilities requiring prosthetic treatment, medical professionals, athletes, and viewers of sporting events and competitions.

Results and Discussion

In the results below, the social discourse and academic research surrounding both steroid use and transgender participation are analyzed and show that the debate on what is fair in the competitive field of sports is not entirely grounded in scientific reasoning and instead is created and developed by relevant social groups. Research is then analyzed showing the performance levels of modern prosthetics in sports and whether or not athletes like Oscar Pistorius gained an unfair advantage relative to other participants thanks to the use of prosthetics. Finally, the American with Disabilities Act is used as a legal framework to investigate the legal validity of bans prohibiting the use of prosthetics in athletic events. Based upon all the research conducted in this paper, it is concluded that unless in the future there becomes definite scientific proof that an athlete is able to perform at levels not reasonably achievable by fellow athletes, prosthetics should be allowed in sporting competitions. One major reason for this conclusion is that when discussing fairness in sports, the issue of whether or not it is fair to able-bodied athletes to have to compete against those with prosthetics is not the only perspective that should be considered, and the fairness of not allowing people with disabilities to participate in these events also must be considered.

Fairness in Sports: Steroid Use and Transgender Athletes

Before analyzing studies and social discourse surrounding the issue of prosthetics and their use in athletic competitions, the debate surrounding fairness and integrity in sports should first be investigated by overviewing some more mainstream topics, such as steroid use or

participation of transgender athletes. In most athletic competitions, use of drugs or steroids in order to enhance performance are strictly prohibited, and punishment for breaking these rules can vary but are typically some form of suspension, along with the seemingly obvious prerequisite of passing drug tests in order to prove that the athlete is "clean" again before they can begin competing again. (Farrugia, 2021). Since performance enhancing drugs potentially grant athletes with advantages over the rest of the competition who are assumed to be "clean," it is logical that organizations are concerned about their use and test their athletes consistently to ensure compliance with their drug policies (Farrugia, 2021). However, there is some empirical evidence that even brief exposure to anabolic steroids could have long-lasting performance enhancing effects, mainly by increasing muscle growth capacity so that even after athletes are clean, their muscles have higher growth potential than other athletes (Devine, 2019).

One potential parallel to this may be found in the cases of transgender athletes. In recent years there has been widespread discourse over whether or not it is fair for transgender women to compete in women's sports, with many believing that they hold an unfair advantage (Devine, 2019). In November of 2015, the International Olympic Committee produced guidelines that require transgender women declare that their gender identity is female and have a low enough testosterone concentration for a period of at least 12 months prior to competing and throughout the athlete's desired period of participation (Devine, 2019). Usually, this requirement is met with the use of hormone replacement therapy. There is some concern, however, that these requirements are not strict enough, and risk being undermined by the same problem described above about steroid use: that transgender women athletes maintain an unfair advantage over others even after undergoing hormone replacement therapy due to continuing benefits such as increased muscle capacity (Devine, 2019).

One highly public case of a transgender woman athlete competing in women's sports is Lia Thomas, who competed in NCAA men's swimming for three seasons before transitioning to a woman and undergoing hormone replacement therapy in order to compete as a woman (Sanchez, 2022). After Lia began participation in women's sports, Lia and the NCAA became the subjects of lots of attention concerning whether or not Lia gained an unfair advantage due to factors including but not limited to build, body composition, hormone levels, etc. Parents of Penn swimming team members sent a letter to the NCAA asking that Thomas be ruled ineligible due to concerns that she would "rewrite records and eliminates biological women from this sport." (Sanchez, 2022) The figures below show a sample of the hundreds or even thousands of tweets that are found in the replies of every journal article concerning Thomas and her success:

Fig. 1. Tweet criticizing organizations supporting Lia Thomas (AStrange1 – KPSS, 2021)

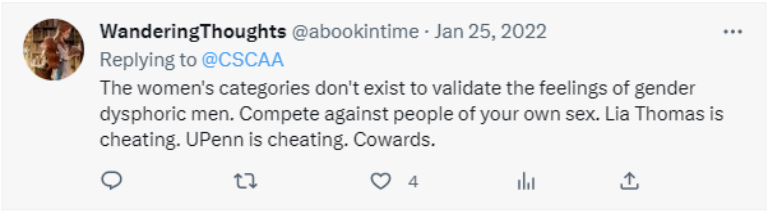

Fig. 2. Tweet stating that Lia Thomas is cheating by competing in women's sports (WanderingThoughts, 2022)

There are scientific studies and experiments aiming to determine to what extent factors such as prior steroid use or growing up as a male can impact one's ability to compete in sporting competition, but it must also be considered that whether or not it is "fair" for these athletes compete in sporting competitions is not purely based on some objective scientific definition of fairness, but instead on society's definition of fairness and integrity as it pertains to athletics. The

Social Construction of Technology (SCOT) framework states that technologies are created and developed as a result of the needs and wants of relevant social groups, and sports and athletic competitions are no different (Klein & Kleinman, 2002). As society changes and develops, so do our ideas of concepts such as fairness. Michael Phelps, known by many as the greatest swimmer of all time, has several biological advantages that give him an edge over the competition (De Bellefonds, 2020). He has hyperextended joints and his double-jointed ankles bend 15 percent more than his competitors, and he has been proven to produce half as much lactic acid as the competition, meaning that he can recover faster have an advantage when training in order to win one of his countless gold medals (Bellefonds, 2020). This isn't to say that Phelps' accomplishments should be diminished, but instead to say that our definition of what advantages are "fair" are social constructs, and are subject to change over time based on social norms.

How Good are Modern Prosthetics?

In order to analyze whether or not it would be considered fair to allow athletes to compete with the use of prosthetics, it is useful to understand what modern prosthetics are capable of when it comes to reproducing human movement and athletic ability. As relevant social groups such as people with disabilities, doctors, and medical organizations have increased the desire for capable prosthetics, the technology has evolved and become more and more adequate. A study of over 40 individuals with severe injuries requiring the use of leg prosthetics was conducted in order to determine how close to "normal" the walking ability of an individual with prosthetics is (Jarvis et al., 2021). The study shows that with current high-specification prosthetics as well as intensive rehabilitation, individuals with amputations can achieve a walking pattern that is very similar to that of able-bodied individuals (Jarvis et al., 2021). The

research does however note that due to limitations of current prosthetic designs, one cannot expect an individual to walk exactly like an able-bodied individual.

Another study investigated consumers satisfaction levels with prosthetic devices and their performance in sporting or athletic events. By performing interviews and qualitative analysis of 16 athletes, it was shown that participants were generally satisfied with the prosthetics sports feet use (Poonsiri et al., 2020). Sports performance was critical in the study, and it was shown that factors such as stability, confidence, safety, and comfort among others were all critical components in the competence of the prosthetic devices, whereas cosmetics were unimportant (Poonsiri et al., 2020). This study shows one example of interpretive flexibility, a concept of SCOT where technologies can have different meanings to different social groups, and is shown above by sports performance being the primary function discussed in the study as opposed to more standard actions typically desired from prosthetics. Main negative factors for the use of prosthetics in sports were poor support from professionals during rehabilitation, the complexity of the purchasing process, and lack of easily accessible information regarding prosthetics for use in sporting competitions (Poonsiri et al., 2020).

The two studies above show that modern prosthetics are reasonably equipped to allow for individuals to not only recreate the kinematics and dynamics of able-bodied individuals, they are also able to be used adequately in athletics and allow for individuals with loss-of-limb(s) to participate in these competitions, whereas without the use of this technology they would be otherwise unable to compete. In order to answer the research question stated at the beginning of this paper, it must be investigated if modern prosthetics are capable of providing an advantage over other athletes instead of just allowing for participation in the first place. This issue came to the forefront of social discourse in 2008 when Oscar Pistorius aimed to become the first double-

amputee to compete in the Olympic Games (Bidlack, 2009). Similar to the case of Lia Thomas described earlier, public discourse was very concerned with the threat that Pistorius posed to the fairness and integrity of the Olympics with his attempts to participate (Schoolman, 2022). However, studies show that there is insufficient evidence to conclude with certainty that Pistorius gained an advantage over other athletes due to the use of his prosthetic blades (Kwon, 2017).

Legal Arguments Surrounding Prosthetics in Sports

A journal article concerning the legality of the prohibition of athletes using prosthetics in sports uses the Americans with Disabilities Act (ADA) as a primary source to review whether or not bans should be upheld on prosthetics in athletics. The legal argument effectively comes down to fact that mandating that sports allow the use of prosthetics will fundamentally alter the sports themselves, and thus do not constitute a reasonable accommodation (Bidlack, 2009). The article cited does state that this argument for upholding of bans comes purely from legal standpoint, not a moral or ethical judgement (Bidlack, 2009). In some sports where allowing for the use of prosthetics would require a change in the rules that would fundamentally alter the experience of other athletes playing, it may not be feasible to allow athletes to compete with prosthetics. However, in competitions and cases such as Oscar Pistorius, allowing the use of prosthetics should fall under "reasonable accommodations."

Limitations and Future Research

One significant limitation on this research is the lack of studies or journals posted in the STS field in particular concerning prosthetics and how the Social Construction of Technology has shaped their development. Without a pool of academic research to draw from, the STS applications of this particular research paper are limited to the experiences I can draw from and the connections I am able to make on my own from the academic research and social discourse

surrounding prosthetics, fairness, and inclusion in sports. Another limitation on the research shown above is the specialization of prosthetics required for different patients meaning that it is difficult to make blanket generalizations on whether or not prosthetics could possibly give a competitive advantage to athletes, since the technology is so different for each athlete. Further research should be done in order to determine the impact of prosthetics on the competitive balance of sports for each different competition, as the conclusions drawn may vary. Further research should also be conducted in the field of STS to more deeply analyze how social discourse surrounding fairness and integrity in sports impacts not only the technological advancements of prosthetics and their applications in sports, but the willingness of athletes to attempt to participate in these events when they have disabilities.

Conclusion

Based upon the evidence analyzed in this paper and the research conducted up to this point, prosthetics should be allowed in sporting competitions under the initiative of increasing the accessibility and inclusivity of these events. This conclusion is significant because it goes against most sporting regulations in major professional competitions that typically do not allow for the use of prosthetics under the reasoning that doing so would be unfair to able-bodied competitors. However, unless there is a specific scientific study showing definitively that in a certain sport or event athletes gain a significant advantage, these individuals should not be prohibited from competing.

References

AStrange1 – KPSS [@strange1_a]. (2021, Dec. 11). *Males don't belong in women's sports, however they identify. The anti-woman backlash* [Tweet]. Twitter.

Bidlack, C. (2009). Prohibition of Prosthetic Limbs in the American Sports: The Issues and the Role of the Americans with Disabilities Act. *The Marquette Sports Law Review*, *19*(2), 613–638.

De Bellefonds, C. (2020). Why Michael Phelps Has the Perfect Body for Swimming. *Biography*. https://www.biography.com/athletes/michael-phelp-perfect-body-swimming

Devine, J. W. (2019). Gender, Steroids, and Fairness in Sport. *Sport, Ethics and Philosophy*, *13*(2), 161–169. https://doi.org/10.1080/17511321.2017.1404627

Du Plessis, J. H., & Berteanu, M. (2020). The importance of prosthetic devices in sport activities for Romanian amputees who compete in Paralympic competitions. *Sports Medicine Journal / Medicina Sportivâ*, *16*(1), 3197–3204.

Farrugia, S. (2021). Why NBA Players Get Drug Tested: All You Need To Know. *Field Insider*. https://fieldinsider.com/why-nba-players-get-drug-tested/

Garcia-Falgueras, A. (2015). Psychological Benefits of Sports and Physical Activities. *British Journal of Education, Society & Behavioural Science*, *11*, 1–7. https://doi.org/10.9734/BJESBS/2015/21865

Jarvis, H. L., Reeves, N. D., Twiste, M., Phillip, R. D., Etherington, J., & Bennett, A. N. (2021). Can high-functioning amputees with state-of-the-art prosthetics walk normally? A kinematic and dynamic study of 40 individuals. *Annals of Physical and Rehabilitation Medicine*, *64*(1), 101395. https://doi.org/10.1016/j.rehab.2020.04.007

Klein, H. K., & Kleinman, D. L. (2002). The Social Construction of Technology: Structural Considerations. Science, Technology, & Human Values, 27(1), 28-52. https://doi.org/10.1177/016224390202700102

Kwon, D. (2017). *A Prosthetic Advantage?* https://www.the-scientist.com/notebook/a-prosthetic-advantage-30236

Lamberg, E., & Pierre-Glaude, J. (2022). Athletic ability in the sport of amputee soccer. *Soccer & Society*, *23*(1), 1–7. https://doi.org/10.1080/14660970.2021.1908269

Pinch, T. (1996). The Social Construction of Technology: A Review. In Technological Change: Methods and Themes in the History of Technology. *Australia: Harwood Academic Publishers*, 17-35.

Poonsiri, J., van Putten, S. W. E., Ausma, A. T., Geertzen, J. H. B., Dijkstra, P. U., & Dekker, R. (2020). Are consumers satisfied with the use of prosthetic sports feet and the provision process? A mixed-methods study. *Medical Hypotheses*, *143*, 109869. https://doi.org/10.1016/j.mehy.2020.109869

Sanchez, R. (2022). To Swim as Herself. *Sports Illustrated, 133*(3), 60–69.

Schoolman, K. (2022). *The Unfair Advantage: Prosthetics and Their Role in the Olympics. Biomechanics in the Wild*. https://sites.nd.edu/biomechanics-in-the-wild/2019/03/06/the-unfair-advantage-prosthetics-and-their-role-in-the-olympics/

Smith, L. R. (2015). The Blade Runner: The Discourses Surrounding Oscar Pistorius in the 2012 Olympics and Paralympics. *Communication & Sport*, *3*(4), 390-410.

Seabrook, B. E. (2022). *Methods Workshop and STS Framework Selection* [PowerPoint Slides]. University of Virginia.

WanderingThoughts [@abookintime]. (2022, Jan. 25). *The women's categories don't exist to validate the feelings of gender dysphoric men.* [Tweet]. Twitter.