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'A small leap for disabled man': the athlete-led evolution of the sports wheelchair and adaptive sports

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ABSTRACT

The history of the sporting wheelchair demonstrates that wheelchair athletes and non-disabled medical professionals – two distinct social groups as defined by the Social Construction of Technology – held different interpretations of wheelchair sport and technology, and their purpose. Originating as a form of rehabilitation, wheelchairs and wheelchair sport were once interpreted solely within the medical realm, resulting in restricted technical development for sporting wheelchairs due to concerns around user safety. Wheelchair athletes, however, adapted their equipment in resistance of medicalised rules, based on their reinterpretation of the technology and desire to advance wheelchair-based sports beyond the institution, legitimising technical innovation as a site of agency for disabled athletes. In doing so, the functionality and form of wheelchairs evolved, facilitating the creation of specialised, sport-specific wheelchairs, such as the basketball wheelchair and racing wheelchair. In response to this, the rules of these sports were altered, stabilising the athletes' interpretation of wheelchair technology as sporting devices, and wheelchair sport as elite competition.

KEYWORDS Paralympics; wheelchair technology; adaptive sports; disability history; athlete activism; social construction of technology

Introduction

At the 1976 Summer Paralympics in Toronto, Canada, Swedish athlete Lars Löfström entered a racing event with a unique modification on the wheels of his racing chair.¹ Löfström had added a second, smaller hand-rim to his wheel, effectively providing his chair with a form of gearing; he could build up speed with the larger outer rims, and then maintain higher speeds with the smaller 12" or 13" rim whilst expending less energy.

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Reportedly, this provided Löffström with a noticeable advantage over his fellow athletes. However, the system was banned due to the unfair advantage it provided, and the rule remained that athletes could only have one push rim per wheel. Using wheels inside the accepted regulations, Löffström still performed successfully in other events at that Paralympic Games. However, the benefits of the smaller push rim were noted by other athletes, and in future wheelchairs, racers started to use a single, smaller push-rim on their wheels, similar to Löffström's modified wheel. In turn, rules changed to match athletes' preferences, and this became the new standard for racing wheelchairs. This example of athlete-led innovation and rule-based technological restriction is emblematic of the wider history of sporting wheelchairs, as two distinct social groups – wheelchair athletes and non-disabled rule makers² – shaped the evolution of this technology based on their different interpretations of the technologies' purpose. Wheelchair athletes resisted medically based regulations in order to improve their performance. This technical development is part of a wider expression of agency by wheelchair athletes, as they took control of their equipment and the sport itself at a period in time where disabled people were marginalised socially and politically, and had little control over their medical care or assistive devices.³

As general interest in disability sport has developed, it has become more present in sporting history, highlighted by a variety of academic publications, alongside heritage projects and products in mainstream media.⁴ However, research has largely focused on other topics, such as the media representation of disabled athletes, and the impact of major events like the Paralympics.⁵ This is not unreasonable, given the importance of mainstream representation of disabled people and the growing visibility of the Paralympics in recent years. Yet, there are many more sites of potential research within the topic of adaptive, disabled or para sport, made possible with the introduction of alternate focuses, new methodological approaches, and intersectional lenses. Given the necessity of specialist assistive devices for many of these sports, and that early Paralympic Games held at Stoke Mandeville were primarily for wheelchair users with spinal cord injuries and wheelchair sports, the history of the sporting wheelchair is a logical avenue of inquiry. In approaching this topic, however, the value placed on technology in sporting history – and specifically around innovation and technical development – must be considered, as the narrative surrounding the sporting wheelchair cannot be separated from its origins in athlete-driven technological development.

Scholarship has already identified the role of athlete activism in Paralympic sport, either by identifying the need to represent protesting athletes as empowered and knowledgeable actors, or specific instances of athletes' actions as activists.⁶ Mallett and Sikes, for instance, highlight the activism of athletes Maggy Jones and Bernard Leach in protesting South African

participation in sanctioned events during the height of apartheid.⁷ Political agency is a vital part of the development of these sports, and these mechanisms can also be found in the equipment used by wheelchair athletes. As Hamraie and Fritisch state in their Crip Technoscience Manifesto, disabled people often become ‘knowers and makers’ of everyday technology, becoming experts in reshaping environments and redesigning inadequate products to better suit their needs.⁸ This not only highlights the historic role disabled people have played as innovators, but also emphasises technology as a site of activism and social agency. In this process, disabled people resist exclusionary or inaccessible design, as Williamson demonstrates with historic examples of disabled women crafting makeshift devices to make their homes more accessible.⁹ Prior research into the history of everyday wheelchairs has elevated a wheelchair user-led focus, highlighting how tinkering and modifications allowed users to improve on their wheelchairs.¹⁰ Sport has played a role in these narratives, importantly, as adaptations for sporting wheelchairs made by casual and elite athletes helped to inspire further technological leaps for lightweight everyday wheelchairs.¹¹ In order to further recognise the role of disabled people as ‘knowers and makers’, explicit focus must be made on the disabled people that facilitated technological development in this sporting equipment.

There are similar examples in sporting history of players facilitating the evolution of sporting technology. Shah, for instance, demonstrates that in skateboarding, snowboarding, and windsurfing, major equipment innovations were made by athletes instead of sporting equipment manufacturers.¹² Similarly, Munkwitz highlights how late nineteenth-century female equestrians were innovators in saddling technology, sport clothing, fiction and non-fiction writing, and instructing.¹³ Drawing on Vamplew’s concept of sporting entrepreneurship, she argues that these developments were based on women’s innate understanding of the challenges presented by male-designed equestrian riding.¹⁴ In many ways, the development of the sporting wheelchair mirrors these patterns, as wheelchair users drew on their lived experience to explore new ways to iterate on the technology. This is also significant in the socio-political implications of these innovations, as both cases feature people excluded from mainstream sport in some way, developing specialised equipment for themselves and those like them. Wheelchair athletes, accordingly, radically changed the design and functionality of wheelchairs as they re-interpreted the fundamental purpose of the sport and the equipment.

Drawing on Woods and Watson’s exploration of the Model 8F everyday wheelchair, the history of the sporting wheelchair can be approached via the Social Construction of Technology (SCOT), as developed by Pinch and Bijker.¹⁵ SCOT suggests that a technical artefact has interpretative flexibility, meaning the concept and purpose of a technology can have multiple

interpretations according to different social groups. Individuals who share a particular interpretation of a technology form these social groups, and said interpretation impacts the design and evolution of a technical artefact. In this example of sporting wheelchair technology, two key social groups have been identified: the wheelchair-using athlete and the medical professionals who set the rules for the sport. These two groups formed distinct interpretations surrounding wheelchair technology, and this conflict ultimately shaped the evolution of these devices and wheelchair-based sports. Previously, SCOT has been criticised for not encapsulating broader political and social oppression within its technical framework, or excluding certain social groups.¹⁶ However, by centring the actions and experiences of disabled people, wheelchair athletes become a distinct social group in this framework and are understood as key agents of technological change.

Furthermore, the concept of user agency is reinforced by the utilisation of oral history data in this paper, collected as part of PhD research into the same topic. Due to a lack of dedicated research into this specific area, archival information regarding the history of sporting wheelchairs is limited. However, knowledge of this technological history is known within the wheelchair sport community. As such, it was appropriate to interview wheelchair designers and athletes, among other individuals, to draw on the historical narratives known to these communities. Oral history also helps to address the invisibility of disabled people in traditional archives, by literally ‘giving voice’ to their experiences and perspectives. Quotes from interviewees will be used to flesh out the narrative surrounding this topic. By drawing on wheelchair athletes’ experiences directly, a greater understanding of their agency and self-determination can be demonstrated, as they developed wheelchair technology based on their athletic needs.

Medical professionals as rule makers

Prior to the era of athlete led innovation in sporting wheelchair technology, wheelchair users historically had little input in the design, look or functionality of wheelchairs, as devices were normally precured from medical institutions or suppliers. Due to a medicalised approach to disability, the needs or desires of wheelchair users were superseded by the perspectives of medical staff and rehabilitation professionals. For instance, it was not considered that disabled people or their assistive devices would be ‘active’ in any real way, as culturally, disabled people were thought to be bound to the institution or their home, and manufacturers made these interpretations manifest in wheelchair design.¹⁷ This can be demonstrated in wheelchair models such as the armchair-like travaux wheelchair (Figure 1). These chairs suggest a lack of a consideration around the weight or manoeuvrability of a wheelchair, as the priority was given to comfort, robustness and safety



Figure 1. Photo of Basketball, played in travaux wheelchairs. c1950. ©WheelPower Stoke Mandeville Stadium Archive.

– with safety in particular remaining a core focus of the medical community in regard to wheelchair sport. Aside from their bulky design, issues around weight can also be attributed to the materials used, such as steel. Similarly, high backrests limited upper body movement,¹⁸ and back-facing push handles that were present on some models implied a dependency on non-disabled people.¹⁹ Significantly, wheelchair technology had remained stagnant since the 1930s, marked by the introduction of Everest & Jennings’ (E&J) folding wheelchair in the United States and similar designs in the UK and Europe.²⁰ By the 1960s, manufacturers were hesitant to make new designs due to production costs and fear of production rejection by the medical community²¹ – the reception of chairs by this social group was deemed more important than the reactions of those using the chairs.

The medicalised aspect present in the early form of wheelchair technology was also found in the origins of the sport themselves. In the UK, competitive wheelchair-based sports can be tracked to the mid-1940s, as the scale of the Second World War resulted in new rehabilitation programmes for newly disabled veterans. German-Jewish neurosurgeon Professor Sir Ludwig Guttmann became head of the National Spinal Cord Injuries Unit at Stoke Mandeville hospital in 1943, and he introduced a number of revolutionary changes to the rehabilitation programme, including the introduction of sport.²² Patients were encouraged to play sport, not only to provide physical

activity, but also to take advantage of any competitiveness between many of the young men, inciting active participation in their rehabilitation.²³ At Stoke Mandeville, regular sporting competitions between patients were established, evolving into international events – now known as the Paralympics. Sporting programmes were developed for disabled veterans elsewhere in the world, inspired by Guttman's success and employed similar methods, such as the Netherlands, Sweden, Israel and Japan, to name a few.²⁴ Simultaneously, after the Second World War disabled veterans in the US started to play basketball in their wheelchairs at veterans' hospitals of their own accord. Unlike wheelchair sport in the UK, veterans initially faced considerable opposition from the medical community about the sport due to fears about player safety.²⁵ However, as sport became a recognised part of rehabilitation programmes, these concerns were eventually withdrawn. Eventually, dedicated wheelchair basketball programmes were developed at the Rehabilitation Education centre at the University of Illinois in the US, highlighting the different development of these sports between the US and UK. Nevertheless, any formal competition was subject to the rules and regulations established by the medical professionals at Stoke Mandeville and the International Stoke Mandeville Games Federation (ISMGF). By 1970, for instance, any country wishing to conduct an international tournament reportedly had to request permission directly from Dr Guttman, exhibiting the influence of his work and his version of these competitions.²⁶

In the UK and other territories, competitive wheelchair sports developed as a rehabilitative tool, dictated by non-disabled medical professionals' interpretation of its purpose. Due to the benefits sport presented in rehabilitation, medical professionals sought to keep wheelchair sport within the purview of the institution. Accordingly, many of the rules surrounding wheelchair technology, alongside other factors such as player classification, were designed by medical professionals, not athletes or dedicated sports organisers. Labanowich and Thiboutot, for instance, detail that the ISMGF Technical Committee – who had the power to approve changes to equipment and rules – was reportedly hand-picked by Dr Guttman.²⁷ Many members had a background in physiotherapy or other rehabilitation linked services, such as British physiotherapist Charlie Atkinson²⁸ or Benjamin H. Lipton, the American founder of the National Wheelchair Athletic Association and director of the Joseph Bulova School of Watchmaking – an organisation which supported disabled men to train in mechanism skills for employment opportunities.²⁹ Those who were trying to change the rules of their sports – such as athletes and sport sub-committee members – often found the technical committees' conservative approach slow to make effective changes, particularly in basketball, as they reportedly had little technical knowledge of the sport.³⁰ As such, the evolution of wheelchair sports and equipment was

primarily dictated by medical professionals, who largely had little background in sport beyond the hospital.

Additionally, this interpretation can be seen in the introduction of the Paralympics in post-war Japan, as Frost states the event was used to introduce sport as a new rehabilitative technique to Japanese doctors. Japanese advertisements about the 1964 Paralympic Games, for instance, described disability sport as the 'social rehabilitation of the physically disabled' and informed readers 'the goal wasn't about winning competitions', framing the event as a means of rehabilitation.³¹ Furthermore, Frost lists the example of the first charter for the Far East and South Pacific (FESPIC) Games, a Pan-Asian movement for disability sport. This charter was developed in 1974 based on the success of the 1964 Paralympics, and explicitly focused on the organisations' goal to develop new rehabilitation techniques and exchange medical information.³² In fact, the desire of establishing sporting events remained a minor point of the charter, largely prioritising the dissemination of medical information, developing research, and promoting social welfare for disabled people. Whilst not intending to challenge the rehabilitative, social or physical benefits of wheelchair games, this demonstrates how medical interpretations were built into the development of these sports at a global level.

Medical professionals approached sport as a tool of rehabilitation first, with the idea of competitive sport as an afterthought. This is not unexpected, however, as the lives and status of disabled people remained firmly in the medical realm in this period, and the idea of truly competitive sport for disabled people was not necessarily the aim of many of the pioneers of these sports³³ – although there was at least some appeal of the competitive aspect to the sport, given the reported enthusiasm of staff at Stoke Mandeville hospital.³⁴ Vitaly, this interpretation impacted wheelchair technology, as medical professionals had little reason to pursue equipment that would enhance athletes' competitive performance.

Clashes of interpretation

Aware of medical professionals' interpretation of the sport, and how these interpretations affected its rules and equipment, athletes sought to fight restrictions that surrounded these sports. Whilst two interpretations of a technology can co-exist according to SCOT, and this is demonstrated by the modern availability of multiple wheelchair types for different sports and day-to-day activities, athletes at the time did not want said interpretations dictating the development of wheelchair sports. As demonstrated in the introduction by Lars Löfström's wheel adaption, wheelchair users were willing to advance their interpretation of wheelchair sport by frequently flaunting restrictions and technical rules. At the same time, medical

professionals sought to retain their rehabilitative view of disability sport, based on their concern surrounding safety, at the detriment of improved competition and performance.

At first, wheelchair users made modifications to their devices, regardless of the consequences of these actions. In the UK, for example, wheelchairs were provided by the NHS, and the technical officers would chastise wheelchair users who 'damaged' their chairs via modification.³⁵ From the perspective of the prescriber, it was seen as medically or practically appropriate to limit adaptations to wheelchairs. Deviations from existing medical norms could potentially harm wheelchair users, and practitioners could be liable for any harm done by an adapted hospital chair. A major design concern in medicalised wheelchair design, accordingly, was safety – as seen in the aforementioned armchair-like travaux wheelchairs – and to the limitations made on modifications later on. Consequently, manufacturers were wary to introduce new designs to the market, partially due to fears of product rejection from the medical community.³⁶ To manufacturers, medical institutions were the only real market for wheelchairs, and thus worked with their interpretation of wheelchair technology. Further, standardisation in design was solidified by governmental departments, who facilitated a singular type of wheelchair design. Woods and Watson showcase how development of the Model 8F wheelchair by the Ministry of Health in a post-war UK was a collaborative endeavour between the government and medical experts, often ignoring users' feedback in favour of the prevailing medical guidance.³⁷ From the players' perspectives, this attitude conveyed that medical professionals knew better than wheelchair users in regard to the day-to-day and sporting use of their chairs, tying into infantilising attitudes towards disabled people, which restricted their agency.³⁸

As international wheelchair sport developed under the remit of the ISMGF, restrictions surrounding the shape or form of a wheelchair developed. These restrictions applied to all official events, particularly as other countries drew on the medical foundation that Stoke Mandeville provided. Thus, many sanctioned events, including Paralympic competitions, enforced certain restrictions on wheelchair technology. British wheelchair rugby player and coach Robin Tarr commented during interview:

[As] athletes were coming up with ideas, the referees were having to monitor these ideas, to make sure that it was actually safe for everybody to play with. So, that's when they started ... getting the measuring sticks and, putting restrictions on what you could and couldn't do.³⁹

If equipment was in violation of the restrictions, athletes could be banned from events, such as the aforementioned example of Lars Löfström's disqualification. Some sports like basketball even required athletes to carry

measurement cards, ensuring their chair dimensions matched – although this was reportedly scrapped by the early 2000s.⁴⁰

Following on from this early point of contention was the rule stipulating that wheelchair sports such as basketball needed to have one standardised wheelchair design that all players used. This standardised rule was reportedly based on the E&J hospital chair, a popular medical wheelchair already used by many due to its wide availability. On the surface, this rule appears appropriate for the players, as it ensured fair competition and negated concerns around technological advantages (Figure 2). Accordingly, the US-based National Wheelchair Basketball Association (NWBA) – which was mostly led by the players themselves by the 1960s – also stated that the official



The Girls are on their mark for the Wheelchair Dash.



The goal that might make all the difference.

Figure 2. Two images from the sixteenth international Stoke Mandeville games, which show a standardised wheelchair being used in women's racing and men's basketball. From *The Cord*, Volume 19, No. 3, 1967. Page 12. WheelPower Collection, AR116/2019, Box 1, Item 84. © WheelPower Stoke Mandeville Stadium Archive.

chair should be the standard E&J wheelchair.⁴¹ Additionally, there was a possible economic incentive to restrict wheelchair modification, as previous wheelchair racer and designer Jim Martinson reported during an interview that players at the time speculated that E&J chairs were made the standard model due to sponsorship the ISMGF received from the manufacturer.⁴²

Yet this concern around accessibility and fair competition was, to some extent, still more concerned with the rehabilitative aims of these sports. Aside from ensuring the use of prescriber-approved equipment that conformed to existing medical norms and a medical concern around athlete safety, it was also an effective marketing tool for the benefits of sport as rehabilitation. After the 1964 Paralympics, Japanese society was reportedly shocked by the independence and confidence of western athletes, and used the difference in performance between domestic and international athletes to highlight the medical benefits of sport.⁴³ Later competitions in Asia served a similar purpose, as a goal of the FESPIC games was to spread the advantages of wheelchair sport to other countries in the region. The economic differences between countries in the region necessitated the practice of loaning chairs to competitors, which was only practical if there was a standard model used at all events.⁴⁴ However, this also reinforced the connection between these sports and rehabilitation, via the use of standardised hospital wheelchairs with a lack of sporting modifications, in an environment designed to export the benefits of sport as rehabilitation. Canadian Wheelchair racer Paul Clark outlined the logic behind this decision:

The reason for those rules was to try and keep all countries as equal as possible. We didn't have countries back then with the technology that Canada had, or the United States had, or Europe had. And so the idea was to allow some of these countries that are coming from out of the hills in the Andes Mountains, to actually use their day-to-day chair and compete equitably with others, from other richer nations. And with simple modifications, they could do those simple modifications as well. So it was a way of trying to equalise the playing field. And you've got to understand that it was ... well meaning, but it was very limiting.⁴⁵

Accordingly, many athletes rejected the idea of a standardised chair, not only as this would take away advantages found in modified chairs, but also as a standardised piece of equipment did not suit the majority of players. Speaking about the impact of standardised wheelchair technology, former International Paralympics Committee (IPC) president and wheelchair basketball player Sir Phillip Craven noted:

Denver Branum [and] Kim Pollock ... they [both] had good leg movement, at least in one leg. But they were still playing with a high backrest, which they never needed, and they never lent against. But those were the rules. Same for everybody. Well, that meant it fitted nobody, except maybe one in a

hundred players. So it was stupid. But that's [what happens] when you don't have sports people organising your sport.⁴⁶

Here, the difference between interpretations of wheelchair basketball are clear, as players were forced to use equipment that was ill-suited to them, regardless of their ability or range of movement. For many athletes, this was not an effective foundation on which to build highly competitive wheelchair basketball, as the restrictions around technology were made with a medical approach to the technology and sport. However, this also reinforced the athletes' own interpretations of wheelchair basketball and drove the impetus behind further sporting chair modifications.

Wheelchair athletes as tinkers and designers

Many of the early user-led developments in sporting wheelchair technology were for sports such as basketball or racing. Working in garages, living rooms and workshops, users acted on their interpretation of wheelchair technology via technical modifications, or in the creation of new devices. These developments facilitated changes in their sports, as specialised technology facilitated new techniques and overall improved athletic performance.

Athletes initially made modifications by removing unnecessary parts, like side guards, arm rests, footplates and back-facing push handles, as these contributed to the weight of their devices.⁴⁷ As well, depending on the athlete's range of movement, a high back rest might have limited their upper body mobility.⁴⁸ Swedish racing athlete and wheelchair designer Bo Lindqvist, for instance, adapted his hospital-provided E&J chair, stating:

You took away the arm rest, you took away the backrest, you kept down the backrest height ... You changed the footrest, you [added] simple plates so you could change the centre of gravity of a chair, so you get the rear wheel [in] a little bit better position and you could take away weight from the front end to get the chair a little bit lighter [and] roll easier.⁴⁹

Further, not all changes made significant cosmetic or structural differences. LaMere and Labanowich note that to reduce rolling resistance, some athletes swapped to pneumatic tires, whilst others removed push rims, pushing on the wheels themselves.⁵⁰ By making these adaptations, athletes challenged the medical intentions of these devices, and in this way, re-interpreted their purpose via use.

Although, sometimes problematic elements of these medicalised chairs were of benefit to the athlete. A key example would be the introduction of camber in wheelchairs. Experimentation with negative camber – referring to the angle position of wheels, where in the bottom half of the wheel sits further out than the top – was first achieved in folding wheelchairs. Whilst the folding mechanism was a major innovation in everyday wheelchair

technology, it had little benefit in sport, as it impacted the rigidity and stability of the chair and added considerable weight to the overall design.⁵¹ However, users were able to add a slight degree of negative camber to their chairs by modifying the crossing point of the collapsible 'X' frame with a camber plate, a small piece of metal with two holes drilled in. Each bar of the 'X' frame was attached to one of the camber plate's holes, replacing its previous X-shaped crossing with a slightly wider crossing point.⁵² This spread the bottom of the wheels out, providing greater stability via the wider footprint and lower stance of the chair, whilst also providing a more natural pushing position (Figure 3).⁵³ Whilst not as extreme as the camber used in modern sports chairs, even this slight improvement made a considerable difference to the athletes, and was possible due to the folding system.

It should be noted that these sporting improvements also had significant benefits for everyday use. In the early days of these sports, there was no delineation between wheelchairs used for sport or everyday activities, and athletes would use the same chair on and off the court. Users found improvements around weight, responsiveness, and rigidity useful in everyday life, and a lightweight wheelchair model, known as the 'ultralightweight' evolved from these designs.⁵⁴ Additionally, modifications allowed users to customise their wheelchairs to their bodies, improving their fit and functionality. This helped users address issues that arose from medicalised standardisation, via their own ingenuity and experience as wheelchair users.



Figure 3. Gary Kerr (left) and Brad Parks (right), in modified wheelchairs for racing. Early example of cambered wheels. c1979. Provided by John Brewer. Private collection.

These developments, however, were ultimately modifications to devices inherently not intended for sport – or the type of sport many users desired. Whilst small adaptations did make an impact, the benefits of these modifications could be expanded upon if they were implemented as part of the initial design. For instance, the benefits provided by the negative cambering of wheels could be enhanced if built into the chair, rather than being a removable modification. By the mid-1970s, wheelchair users set out to create a new type of frame for wheelchairs, returning to the rigid style frame abandoned with the introduction of the folding chair in the 1930s. These frames were developed initially in the US, due to the popularity of wheelchair basketball, by a number of creative pairings, such as Jeff Minnebraker (Figure 4) and Brad Parks, and Bud Rumble and Joseph Jones.⁵⁵ Similar developments also occurred later in the UK, after athletes like Vincent Ross saw the American team's chairs and was inspired to create comparable devices.⁵⁶ By crafting a cube-shaped frame using new materials like aluminium, these innovators created wheelchairs which were lighter, stronger, and more responsive. These chairs also implemented negatively cambered wheels, expanding on the benefits provided by the new frame. This innovation provided a huge advantage to athletes in sports like basketball, due to their strength and improved handling, as well as racing, due to their reduced weight. In this sense, the reinterpretation of the wheelchair carried out by athletes as a social group was not just to use wheelchairs for a new



Figure 4. Jeff Minnebraker using one of his first rigid style chairs to play tennis. c1977. Sarah Bunting, *More than Tennis: The first 25 years of wheelchair tennis* (Houten, Premium Press, 2001). 10.

purpose, but to introduce a new end-user experience that altered how equipment was initially designed and constructed.

At a basic level, better optimised sporting technology allowed for the improvement of athletic performance. Lighter and more responsive basketball chairs facilitated the quick-paced nature of the game, and improved speed, handling and manoeuvrability allowed athletes to get through gaps and chase the ball in ways not possible before. Sir Phillip Craven, speaking about his first rigid-style frame, said:

The manoeuvrability that it would give me, I mean, once I went past three guys, just by ... and I can't move my hips, but I just did a bit with my upper body. And I went left, then I went right, and I couldn't believe it and went into the key to score - and I think all [other] players bought one after that.⁵⁷

Performance like the type described above was simply not possible in the previously used medical style chairs, highlighting the obvious benefit of these rigid frame chairs for sport. As their creators were also wheelchair users, and approached their designs specifically as sporting chairs, this facilitated a dramatic improvement to overall athletic performance.

Similarly, the development of sporting wheelchair technology led to the introduction of new skills and techniques. For instance, the later addition of features like anti-tip wheels at the back of basketball chairs not only improved safety, but enhanced athletes' abilities to tip back to make shots, as they no longer had to focus on balancing when shooting.⁵⁸ This enhanced an existing aspect of the sport, and furthered athletes' abilities via improved specialisation of wheelchair technology. Other features, however, added entirely new techniques to their sports. In basketball, strapping was introduced to hold athletes into their chairs, but this allowed for the development of tilting, where higher-point players (athletes with more core muscles based on their individual disability and assigned a higher point designation according to the sport's classification system) could tip up on their wheels to gain more height in shots. These skills would not be possible without strapping, as wheelchair basketball athlete and coach Anna Jackson commented:

One of the big changes is people being strapped into their chairs. So you can't tilt if you haven't got a strap across the top of your thigh really, because otherwise, your bum just comes out your chair and ... you tilt but your chair doesn't!⁵⁹

The inclusion of strapping actively introduced new techniques and tactics to basketball, as these movements would not have been possible in previous wheelchairs. However, such developments also highlighted the need for sporting wheelchair to be specialised for their individual sports, as athletes' abilities worked in tandem with their equipment's capabilities and functionality. As

wheelchairs intended for basketball started to implement adaptations specifically for said sport, other athletes did the same for their sports.

As suggested by Lars Löfström's story of disqualification described previously, wheelchair racers also made specific adaptations for their sport. At first, the racing chair benefited from many of the developments made for basketball, such as weight reduction and wheel cambering. In fact, the removal of the folding system proved advantageous, as the development of rigid-frame chairs created lighter chairs and allowed racers to use the space under the seat to tuck their leg(s) in, allowing for better optimised pushing and aerodynamic seating position. Unlike basketball, however, racing requires athletes to accelerate in one direction, as opposed to manoeuvring around a court and other players. Racing athletes thus had to interpret wheelchair technology in new ways, in order to address the challenges of aerodynamics, rolling resistance and efficient energy transfer. In the 1970s and early 1980s, as the sport grew in popularity worldwide, some modifications were introduced to address said issues. This included, for instance, increasing the size of the rear wheel from 24-inches to 27-inches, extending wheelbases to make the chairs longer to improve the chair's aerodynamic performance,⁶⁰ and the changes to push rim size and positioning inspired by Lars Löfström's aforementioned modification (Figure 5).⁶¹ Racers also



Figure 5. 4 wheeled racing chair, made by Magic in Motion under their 'Shadow' product line. 1984. Provided by Jim Martinson. Private collection.

had to find ways to eliminate challenges unique to their sport, such as the fluttering of the two front wheels at high speeds. This was addressed by washers, new wheel forks, and horizontal bars cross the front wheel forks to ensure consistent alignment.⁶² Significantly, these advantages were also sanctioned with small rule modifications, making these advantages legal for all racers. However, racing chair technology continued to push on the restrictions of the sport, putting racing at odds with the rule makers.

As racing chairs developed, they ultimately moved away from the standard four-wheel medicalised wheelchair into a specific racing style chair, much like the development of a specific basketball chair. This process of specialisation emphasises the importance and benefits of the technological reinterpretation performed by wheelchair users for their specific needs. Athletes were conscious that the equipment designed by the medical establishment was fundamentally not suited for competitive sport, and that the sports themselves could not advance if the technology could not facilitate improved performance. Reinterpretation was a necessary process in the evolution of these sports. However, the development of racing chair technology challenged the medical conceptualisation of the technology and sport even further.

New rules for new devices

Within their own technical niche, racing chairs experienced rapid development, as design ideas and modifications were continually introduced and iterated on throughout the 1970s and 1980s. Yet the rules of wheelchair racing, like other wheelchair-based sports, were still based in a medicalised system which dictated the functionality and form of these devices. However, two key developments in the later history of racing chairs encapsulates the ways in which wheelchair athletes' reinterpretation of their devices resisted the medical interpretation of these sports: the three-wheel racing frame and the steering compensator.

The idea of a three-wheeled wheelchair was not unheard of by the mid-1980s. Three-wheeled bath chairs had been used in spas in the early twentieth century, and racers had experimented with three-wheel designs in the 1970s.⁶³ In fact, Canadian racer Paul Clark developed a three-wheeled racing chair in the early 1980s, reminiscent of the racing chairs used today (Figure 6).⁶⁴ However, this was not allowed at the time due to rules explicitly requiring four wheels, as many modifications like the three-wheeler were perceived as unsafe.⁶⁵ Clark got around this restriction by simply attaching a smaller wheel to the front, which only just touched the ground, allowing his chair to qualify as a 'four-wheel' chair – and other athletes like Bo Lindqvist and Rory Cooper shared similar stories when interviewed. Further, Cooper explained the effectiveness of the three-wheel design:



Figure 6. Paul Clark's '4 wheeled' racing chair. 1985. Taken from the poster for the 6th Oita International Wheelchair Marathon, 1986. Shared with permission of Rudi Van den Abbeele. Private collection.

Three-wheelers eliminated [wheel] scrubbing, because when you have four wheels, you have to get all four wheels aligned perfectly. And not only in the straights, but in the turns, which was virtually impossible. ... And then I did a mathematical model that showed that, you know, a three-wheeler and a four-wheeler are equivalent, if you have infinite length, right? But turns out they're 99% equivalent if you just get to like, a little bit longer.⁶⁶

Seemingly, the medical concerns surrounding safety in racing surpassed testing and research by individuals like Cooper, as rule-makers resisted calls to legalise the three-wheeled design in the early 1980s – reinforcing the concept that medical professional advanced their interpretation of wheelchair technology over the competitive needs of the athletes.

Similarly, the development of steering compensators facilitated improved speeds and safety in races. The steering device had a turning angle programmed in, which could be activated by hitting the mechanism. Once the turn was completed, the compensator could be hit on the other side, returning the front wheel to tracking straight.⁶⁷ This improved turning in races, as athletes could now push with both hands during turns, whilst eliminating issues of control and wrist injuries common previously.⁶⁸ This innovation was banned by officials in track racing, but not in road races and competitions governed by other, new organisations, meaning athletes were often alternating between two different types of chairs. This innovation was also restricted by the ISMGF for concerns around athlete safety, as it was reportedly worried racers may have been ‘locked into’ their turning angle – although these fears were eliminated with increased usage by athletes and testing again by individuals like Rory Cooper.⁶⁹ Notably, such changes to racing chair technology dramatically deviated from a ‘normal’ wheelchair even further, therefore distancing racing technology from the rehabilitative wheelchair to a greater degree, and stabilising this new interpretation of wheelchair technology beyond the institution.

By the mid-1980s, three-wheeled racing chairs with compensators were becoming increasingly popular, utilised primarily in road races and marathons, as the American road racing organisation altered their rules to allow such designs in 1985.⁷⁰ Yet the ISMGF rules remained the same, meaning track racing rules necessitated the four-wheeled, compensator-less design. This meant that athletes would alternate between chair types for different events, presenting some concerns around safety due to the different handling and steering of the chair types. Overall, athletes became frustrated with such restrictions, which they interpreted as archaic. Racer and wheelchair designer Jim Martinson commented how American racers felt they were held back by the rules at Stoke Mandeville:

Stoke Mandeville was feeding the rules down to the national level. So we couldn't do anything in the United States. ... But we'd say, 'All the rest of the world,' you know, 'they're building kind of cool stuff.' ... and [the] wheelchair guy [said] 'Well, we'll just keep doing that 60lbs wheelchair.'⁷¹

Beyond highlighting the international differences that existed (and continue to exist) in these sports, Martinson's comment suggests there was no technical need for the continued use of comparatively old technology. As enterprising athletes like Clark demonstrated, lighter and better chairs

existed already, but were simply restricted by the rules of the organising committee.

Asserting their agency and interpretation of technology, wheelchair racers from developed nations once more challenged the medical interpretation of the sport, making these chair designs visible at major competitions, and debating the rules at ISMGF technical committee meetings. Previously, athletes and other individuals had been successful in advocating for changes to equipment and rules for multiple sports. Importantly, the issues surrounding the three-wheeled racing chair and use of steering compensators were addressed in 1988, with a rule change implemented to allow these adaptations.⁷² Notably, arguments forwarded by Rory Cooper and Martin Morse to the technical committee resulted in this change. Both men were prior athletes with a notable interest in the sport beyond their athletic performance. Cooper, as described before, was heavily involved in the testing and engineering of racing chairs, briefly running his own sporting chair manufacturer, Cooper Engineering, and publishing academic research about wheelchair sport science and technology.⁷³ Further, Morse worked as head coach for the University of Illinois Wheelchair Track and Road Racing Team at the University of Illinois between 1983 and 2005, training key athletes in the sport like Sharon Hedrick, and helped to create key equipment innovations such as the Harness Wheelchair Racing Glove.⁷⁴ They were not simply athletes with a vested interest in improving their own results, but individuals



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Figure 7. Advertisement for 3 wheeled racing chair, made by Magic in Motion under their 'Shadow' product line. 1990. Archive advert March/April 1990 SPORTS 'N SPOKES, Volume 15, No. 6, p 26.

with a radically different view of wheelchair sports, who wanted to change the nature of the sport and improve athlete performance and safety. After this change, the three-wheeled chair was allowed for track races, and it sparked what Morse referred to as ‘A huge technological leap for disabled men and women’, due to a substantial increase in development between 1988 and 1992.⁷⁵ Reportedly, nearly all chairs at the 1988 games were four-wheeled designs, whereas by 1992, all racers used the three-wheel design (Figure 7) – suggesting the stabilisation and general acceptance of wheelchair athletes’ interpretation of sporting chair technology over the medicalised interpretation of the rule-makers.⁷⁶

Conclusion

The example of Löfström’s racing wheelchair modification highlights the eagerness with which disabled athletes in developed nations modified their equipment and pushed on the boundaries of the sport even in the face of disqualification. As a social group, athletes reinterpreted wheelchair sport from a tool of rehabilitation to one of elite competition, and technology facilitated this shift. In this sense, the technical development of the sporting wheelchair was a site of agency for athletes, as disabled people challenged the medical interpretations of rule makers and rehabilitation professionals who controlled the sport. In this process of reinterpretation, athletes developed new types of devices and techniques, and facilitated improved athletic performance, whilst changing the sport’s rules and governance. Following on from this period, the manner in which wheelchair users maintained autonomy over this technology altered, as the industry became increasingly professionalised. The age of the home-built sports wheelchair disappeared, as the site of innovation shifted to manufacturing firms and companies involved with bicycle and car manufacturing. These developments also occurred with increased economic opportunities for disabled athletes, and the development of the modern International Paralympic Committee. In the modern day, sporting wheelchair technology has largely stabilised, presenting different conditions in which athletes’ agency can be conceptualised from their equipment. In line with the Social Construction of Technology, however, this early era of technical evolution was dictated by the actors’ interpretations of wheelchairs, and the new ways these athletes used this technology.

Notes

1. Abu Yilla (Former wheelchair basketball athlete and lecturer in Kinesiology at University of Texas Arlington), interview with author, March 11th, 2021, Microsoft Teams. Yilla also provided slides of a presentation he gave which

mentioned this incident. Further, I enquired about Löffström in a Facebook group for ex-wheelchair racers and athletes, known as *History of Wheelchair Racing*. According to commentor Ron Malik, Lars and other racers such as Dane Shank experimented with two push rims in 1970s and could only use them in local races due to restrictions at sanctioned wheelchair events.

2. This identification of rule makers as non-disabled is partially an assumption, based off comments from oral history interviews with wheelchair athletes such as Sir Phillip Craven, who did not identify individual doctors or therapists as disabled or neurodivergent. Medical and rehabilitation staff at Stoke Mandeville, such as Professor Sir Ludwig Guttmann or physiotherapist Charlie Atkinson did not explicitly self-identify as disabled or non-disabled in this period, although they were seemingly not wheelchair users from what can be understood.
3. Bess Williamson, *Accessible America: A History of Disability and Design* (New York: New York University Press, 2019), 78–89.
4. Recent publications include Dennis J. Frost, *More than Medals: A History of the Paralympics and Disability Sport in Postwar Japan* (Ithaca: Cornell University Press, 2020); Carolyn Jackson-Brown, *Disability, the Media and the Paralympic Games* (London: Routledge, 2020); David Davis, *Wheels of Courage* (New York: Centre Street, 2020). Projects in the British heritage industry have been carried by the National Paralympic Heritage Trust since their establishment in 2015, and also The Sporting Heritage of Disability and Women's Sports, by Sporting Heritage. As well, there had been increased coverage in mainstream media, such as *Rising Phoenix* (Netflix, 2020), an episode of BBC's Panorama series, entitled *Paralympic: The Unfair Games?* (BBC, 2021), and coverage in the BBC's *One Show* in the lead up to the Tokyo 2020 Olympic and Paralympic Games.
5. Such publications would include the previously mentioned books by Carolyn Jackson-Brown and Dennis J. Frost, which use the Paralympics to frame broader explorations of the representation of disability sport and disabled people in media, and in Frost's case, the broader development of disabled sport in Japan. As well, Ian Britain's research into Paralympic History, and the impact of the 2012 London and 2016 Rio Games on disabled people, demonstrate important academic focus on the Paralympics as large-scale sporting events. Ian Brittain, *From Stoke Mandeville to Stratford: A History of the Summer Paralympic Games* (Champaign, Illinois: Common Ground Publishing, 2012).; Ian Brittain, 'A Critical Perspective on the Legacy of the London 2012 Paralympic Games', *Journal of the Nippon Foundation Paralympic Research Group* 5 (2016): 23–42.; Ian Brittain, and Aaron Beacom, 'Leveraging the London 2012 Paralympic Games: What Legacy for Disabled People?' *Journal of Sport and Social Issues* 40, no. 6 (1 December 2016): 499–521.; Doralice Lange de Souza, and Ian Brittain. 'The Rio 2016 Paralympic Games: The Visibility of People With Disabilities in Brazil as a Possible Legacy', *Communication & Sport* (29 July 2020). doi:10.1177/2167479520942739.
6. Danielle Peers, '(Dis)empowering Paralympic Histories: Absent Athletes and Disabling Discourses', *Disability & Society* 24, no. 5 (2009). doi: 10.1080/09687590903011113
7. Cam Mallett and Michelle M. Sikes, 'Paralympic Protest: Athlete Activism, Apartheid South Africa, and the International Sport Boycott in British para sport, 1979–1981', *Sport in History* (2021). doi:10.1080/17460263.2021.1963827

8. Aimi Hamraie and Kelly Fritsch, 'Crip Technoscience Manifesto', *Catalyst: Feminism, Theory, Technoscience* 5, no. 1 (2019): 7–10.
9. Williamson, *Accessible America*, pp. 83–9.
10. Hilary Stewart and Nick Watson, 'A Sociotechnical History of the Ultralightweight Wheelchair: A Vehicle of Social Change', *Science, Technology, & Human Values* 44, no. 6 (2019); Brian Woods and Nick Watson, 'In Pursuit of Standardization: The British Ministry of Health's Model 8F Wheelchair, 1948–1962', *Technology and Culture* 45, no. 3 (2004).
11. Stewart and Watson, 'A Sociotechnical History of the Ultralightweight Wheelchair'; Thomas LaMere and Stan Labanowich, 'The History of Sports Wheelchairs, Parts 1-3', *SPORTS 'N' SPOKES*, March-August 1984; Alan Roulstone, *Disability and Technology: An Interdisciplinary and International Approach* (London, Palgrave Macmillan, 2016).
12. Sonali Shah, 'Sources and Patterns of Innovation in a Consumer Products Field: Innovations in Sporting Equipment' (Sloan Working Paper #4105, March 2000).
13. Erica Munkwitz, 'Designing Diana: Female Sports Entrepreneurs and Equestrian Innovation', *The International Journal of the History of Sport* 35, no. 7–8 (2019): 746.
14. Ibid.
15. Trevor J. Pinch and Wiebe E. Bijker, 'The Social Construction of Facts and Artefacts: or How the Sociology of Science and the Sociology of Technology might Benefit Each Other', *Social Studies of Science* 14, no. 3 (1984).
16. Stewart Russell, 'The Social Construction of Artefacts: A Response to Pinch and Bijker', *Social Studies of Science* 16, no. 2 (1986).
17. Stewart and Watson, 'A Sociotechnical History of the Ultralightweight Wheelchair', pp. 5–7; Williamson, *Accessible America*, p. 84.
18. Stan Labanowich and Armand 'Tip' Thiboutot, *Wheelchairs can Jump! A History of Wheelchair Basketball* (Boston, Massachusetts: Acanthus Publishing, 2011), 46–7.
19. Stewart and Watson, 'A Sociotechnical History of the Ultralightweight Wheelchair', p. 13.
20. Woods and Watson, 'In Pursuit of Standardization', pp. 546–7.
21. Clifford E. Brubaker, 'Wheelchair Prescription: An Analysis of Factors that affect Mobility and Performance,' *Journal of Rehabilitation Research Development* 23, no. 4 (1986): 19–26.
22. Julie Anderson, "'Turned into Taxpayers': Paraplegia, Rehabilitation and Sport at Stoke Mandeville, 1944–56', *Journal of Contemporary History* 38, no. 3 (2003): 466–7; Susan Goodman, *Spirit of Stoke Mandeville: The Story of Sir Ludwig Guttmann* (London: Collins, 1986), 142–3.
23. Anderson, "'Turned into Taxpayers'", p. 465.
24. John R. Gold and Margaret M. Gold, 'Access for all: The rise of the Paralympic Games', *Journal of the Royal Society for the Promotion of Health* 127, no. 3 (2007): 134.
25. Labanowich and Thiboutot, *Wheelchairs can Jump! A History of Wheelchair Basketball*, p. 6.
26. Ibid., p. 51.
27. Ibid., p. 56.
28. Goodman, *Spirit of Stoke Mandeville*, p. 128.

29. Martin Morse (Head Coach of Wheelchair Racing at University of Illinois, 1984–2005), interview with author, January 29th, 2021, Telephone; Ian Brittain, *From Stoke Mandeville to Stratford: A History of the Summer Paralympic Games* (Champaign, Illinois: Common Ground Publishing, 2012), 176.
30. Labanowich and Thiboutot, *Wheelchairs can Jump! A History of Wheelchair Basketball*, p. 56.
31. Frost, *More than Medals*, pp. 36–7.
32. Ibid., pp. 58–9.
33. Ibid., p. 39.
34. Goodman, *Spirit of Stoke Mandeville*, pp. 147–9.
35. Phillip Craven (Former head of the IPC, 2001–2017, and Ex-Paralympic Wheelchair Basketball player for Great Britain), Interview with author, November 3rd, 2020, Zoom.
36. Brubaker, 'Wheelchair Prescription,' pp. 19–26.
37. Woods and Watson, 'In Pursuit of Standardization', pp. 556, 559–560.
38. Williamson, *Accessible America*, pp. 78–80.
39. Robin Tarr (Ex-Paralympic Wheelchair Rugby player for Great Britain and Coach), interview with author, March 2nd, 2021, Zoom. Edit and emphasis by author.
40. Anna Jackson (Ex-Paralympic Wheelchair Basketball player for Great Britain and Coach), interview with author, October 20th, 2020, Zoom.
41. Thomas LaMere and Stan Labanowich, 'The History of Sports Wheelchairs, Part 1', *SPORTS 'N' SPOKES*, March-April 1984, 6–7; Davis, *Wheels of Courage*, pp. 216–7.
42. Jim Martinson (Founder of Magic in Motion, Wheelchair designer and ex-Paralympic Wheelchair racer for the United States), interview with author, October 13th, 2020, Zoom.
43. Frost, 'More than Medals', pp. 44–6.
44. Ibid., 88, 224; Steve Bailey, *Athlete First: A History of the Paralympic Movement* (Chichester: John Wiley & Son, 2007), 28.
45. Paul Clark (Ex-Paralympic Wheelchair racer for Canada), interview with author, March 25th and 31st, 2021, Zoom.
46. Phillip Craven, Interview with author. Edit and emphasis by author.
47. LaMere and Labanowich, 'The History of Sports Wheelchairs, Part 1', pp. 7–8.
48. Labanowich and Thiboutot, *Wheelchairs can Jump! A History of Wheelchair Basketball*, pp. 46–7.
49. Bosse Lindqvist (Designer of Swede Wheelchairs and ex-Paralympic Wheelchair racer for Sweden), interview with author, October 12th, 2021, Telephone.
50. LaMere and Labanowich, 'The History of Sports Wheelchairs, Part 1', p. 7.
51. Stewart and Watson, 'A Sociotechnical History of the Ultralightweight Wheelchair', p. 13.
52. LaMere and Labanowich, 'The History of Sports Wheelchairs, Part 1', p. 8; Paul Clark, interview with author.
53. Stewart and Watson, 'A Sociotechnical History of the Ultralightweight Wheelchair', p. 13; Paul Clark, interview with author.
54. Stewart and Watson, 'A Sociotechnical History of the Ultralightweight Wheelchair', p. 15.
55. LaMere and Labanowich, 'The History of Sports Wheelchairs, Part 1', pp. 7–8.

56. Phillip Craven, interview with author.
57. Phillip Craven, interview with author. Edit and emphasis by author.
58. Anna Jackson, interview with author.
59. Ibid. Edit and emphasis by author.
60. Bosse Lindqvist, interview with author.
61. Abu Yilla, interview with author.
62. Paul Clark, interview with author.
63. Jennifer Best, 'What an Evolution', *SPORTS 'N' SPOKES*, May 2021, 26; Paul Clark, interview with author.
64. Paul Clark, interview with author.
65. Rory Cooper (Wheelchair designer, academic, product designer and ex-Paralympic Wheelchair racer for the United States), interview with author, October 6th, 2020, Zoom.
66. Ibid. Edit and emphasis by author.
67. Craig Blanchette (Ex-Paralympic Wheelchair racer for the United States), interview with author, December 15th, 2020, Zoom.
68. Rory Cooper, interview with author.
69. Ibid.
70. Martin Morse, interview with author.
71. Jim Martinson, interview with author. Edit and emphasis by author.
72. Martin Morse, interview with author; Rory Cooper, interview with author.
73. Rory Cooper, interview with author. Examples of his academic work include Rory Cooper, 'Wheelchair Racing Sports Science: A Review', *Journal of Rehabilitation Research and Development* 27, no. 3 (1990); Michael L Boninger et al., 'Propulsion Patterns and Pushrim Biomechanics in Manual Wheelchair Propulsion', *Archives of Physical Medicine and Rehabilitation* 83, no. 5; Jonathan Duvall et al., 'Design of an Adjustable Wheelchair for Table Tennis Participation', *Disability and Rehabilitation: Assistive Technology* 16, no. 4; and many more.
74. Martin Morse, interview with author.
75. Ibid.
76. Ibid.

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