
Cycling and disability: a review

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Abstract

People with a disability have been found to be at increased risk of developing serious health conditions – often linked to obesity as a consequence of a more sedentary life. Cycling has the potential to offer significant health benefits to disabled people – improving energy, fitness, and mental wellbeing – in addition to mitigating secondary diseases. These benefits mean that it is important that people with mobility impairments are not excluded from cycling. Disability remains an under-researched area within cycling studies, and in the UK there are low rates of cycling amongst disabled people. There is little funding in this area, and this is despite a fair level of third sector activity to try to help promote access to cycling. This lack of focus is perhaps a consequence of a perception that cycling is not an activity accessible to people with disability. However, this assumption is often not true, particularly considering the availability of adapted bicycles – which importantly are much cheaper than adapted cars, and also provide the physical and mental health benefits attributed to cycling.

This paper presents qualitative data from interviews with disabled cycle users, analysed in the context of current cycling guidance from the UK and Europe. The analysis assesses the degree to which current cycling design guidance represents and addresses the needs of people with a disability, and furthermore the implications of this for encouraging greater levels of cycling amongst disabled people. Specifications for cycle infrastructure are increasingly taking adapted cycles into account, however with limited academic research into disabled peoples' experiences of cycling, it is possible that these designs are not taking into account the wider needs and considerations of disabled cyclists – which go beyond simply the more physical attributes of cycle infrastructure design.

1 Introduction

1.1 All ability and disability

In order to consider cycling for those of all abilities, it is necessary to define the obverse, what a disability might comprise of, in order then to ensure that planning and design covers all needs. A disability is a physical or mental condition that limits a person's movements, senses, or activities. The Equality Act (2010) definition says a person has a disability if they have a physical or mental impairment and the impairment has a substantial and long term adverse effect on their ability to perform normal day-to-day activities.

The Papworth Trust (2014) usefully summarises data on disability in the UK population. Approximately 19% of the UK population has a disability, with only 17% of those with disabilities having them from birth. The prevalence of disability increases with age. Disability results in a person on average experiencing significantly different employment opportunities, lower income, and lower educational attainment. Mobility impairment is the most commonly reported form of disability, with 57% of people with a disability experiencing this. At the same time however, most mobility impairment is relatively invisible, with fewer than 8% of those with disabilities using a wheelchair, for example. 14% of people in the UK have some form of mobility impairment. The forecast is that depression will be the leading cause of disability by 2020.

Transport is the largest concern for disabled people in their local area, with footway and road maintenance, access issues, and frequency of public transport being the biggest issues. Disabled people travel a third less often than the general public, and use buses, taxis and minicabs more often than the general population. 75% of adults with a disability experience barriers to using transport, compared with 60% of adults without a disability. These challenges posed by the existing transport network translate directly into issues of employment, with 29% of adults with impairments reporting difficulty with transport as a significant barrier to work. One in six people who become disabled while in work lose their job within a year.

Despite forming 19% of the population, disabled people make up approximately 33% of users of the NHS. Poor health is associated with low socio-economic status and those who have never worked or are long term unemployed have the highest rates of self-reported 'poor' health. Ells *et al.* (2006) found that disabling conditions have a significant positive statistical association with obesity. The relationship between obesity and disability is complex. Sometimes disability can be the cause of obesity – for example where a person with a mobility impairment is unable to engage in sufficient physical activity; in other cases obesity can be the cause of disability – for example where excess weight can lead to conditions such as osteoarthritis. Often it is the case that both of these are true, and a disabled person can experience an accumulation of interrelated health issues over time.

1.2 Physical activity, transport, and health

Physical activity describes 'any force exerted by skeletal muscle that results in energy expenditure above resting level' (Caspersen, Powell, Christensen, 1985). Physical exertion is part of journey making. It may involve different proportions of walking, standing, or cycling as part of the journey. The intensity of physical activity may also vary, for example depending on the speed of cycling (Davis and Parkin, 2015). Some cycle users will exert to the level of vigorous activity for longer periods (Vuori, Oja, Paronen, 1994).

Physical activity can reduce the disease burden (WHO, 2000) and enhance well-being benefits partly linked with aspects such as the greater social connectivity that transport offers (Environment Canterbury, 2010; Betts Adams, Leibbrandt, Moon, 2011; Nordbakke, S. and Schwanen, T. 2013).

Current data demonstrates a need for improvements to the transport network which can help address the accessibility gap observed between disabled people and their peers (Papworth Trust, 2014). Aldred and Woodcock (2008, p. 491) have explained that disabled people are 'disproportionately excluded from the streets', and experience lower rates of physical activity and higher rates of obesity as a result. The accessibility imperative is not just limited to the realm of active travel, but also public transport (Jones and Jain, 2006). The current auto-centric design of the UK transport system means that for people with a mobility impairment to achieve a *seamless journey* (an essential factor in making a journey achievable), often a person currently must rely on the private car (be this through driving, lifts, taxis, etc.), which is the mode least associated with beneficial physical activity and exertion (Maynard, 2009). Aldred and Woodcock (2008) have described the dominance of car travel as a disabling force at the societal level, raising barriers to access for populations larger than those conventionally identified as 'disabled'. Whilst all of those in the population who do not have access to a car must attempt to struggle over the barriers created by urban sprawl and car-centric development (infrequent or non-existent public transport, disjointed walking and cycling paths, dangerous road crossings, circuitous routes), for many people with a disability these barriers are simply insurmountable; thus the current system effectively excludes disabled people to a greater or lesser degree from the broader personal travel domains beyond the car (namely active travel and public transport) (Ibid; Maynard, 2009). If it were possible to provide greater transport opportunities for people with disabilities – particularly if the means involved physical activity – then some of the socio-economic and health inequalities resulting from disability could be tackled simultaneously.

While some people may not be able to walk easily, they may, by contrast, be able easily to cycle. This may be because, for example, they have a hip problem which does not now allow comfortable perambulation, but, by contrast, does allow for the circular motion of pedalling. If someone is unable to use their legs to pedal, then they may be able to use their hands and arms and a hand-cranked bicycle may allow them greater locomotion than a foot pedalled cycle.

While the ability to cycle with a disability may not be in question, there remain issues however about – for example – mounting and dismounting, walking alongside the cycle, balancing at very low speed or while static, and the ability to manoeuvre and successfully park the cycle. Cycle design that is inclusive needs to cater for those of all levels of experience and ability.

Training is also an issue, as many people with a disability may not have cycled previously, and require practise to gain experience and remain safe – particularly if the intention is to use roads and shared paths. In respect of teaching people with disability to ride, Klein *et al.* (2005) report a methodology which includes innovative teaching techniques and specialised

equipment. MacDonald et al. (2012) investigated the effect of a cycle training intervention for children with Down syndrome (DS) and autism spectrum disorders (ASD).

1.3 Types of cycle

Cycles may often therefore be used as what could be termed ‘mobility aids’ (Hickman, 2015), or cycles may be used as part of an overall journey with other mobility aids (TfL, 2014). Some cyclists with disability use standard bicycles, others use adapted cycles.

The UK legal definition for a cycle is contained in the Road Traffic Act (1988, Section 192). Types of Cycle include standard cycles, solo tricycles, hand-cranked cycles, tandem cycles, recumbent cycles, trailer cycles (tandems with a hinge, usually with the rear seat to carry a child), cycles towing trailers, cargo cycles, and cargo tricycles. An electrically assisted pedal cycle is not treated as a motor vehicle (Road Traffic Act 1988, Section 189).

The term ‘cycling’ covers a range of different types of vehicle. The Traffic Signs Regulations and General Directions 2002 define a pedal cycle as a ‘unicycle, bicycle, tricycle, or cycle having four or more wheels’, while bicycles, tricycles, velocipedes, and other similar machines are defined by Section 85 of the Local Government Act 1888 as ‘carriages’ within the meaning of the Highway Acts.

Electrically assisted bicycles are regarded as pedal cycles under the Electrically Assisted Pedal Cycles Regulations 1983, provided they do not exceed 40 kilograms and 200 watts in power (or 250 watts in the case of tricycles and tandems) and are not electrically assisted above fifteen miles per hour. They cannot be ridden on the highway by children under fourteen.

Bicycles are treated as carriages under the various highways and traffic acts, except when the cyclist is dismounted (and they are treated as pedestrians). Cycles are permitted on all roads other than motorways, unless specifically prohibited. Cyclists are also permitted by the Countryside Act 1968 to use bridleways, though they must give way to pedestrians. Cyclists have no right to cycle on footpaths away from the road (except in Scotland, see below), but they only commit an offence where local bylaws or traffic regulation orders create such an offence. Footpath landowners can undertake a civil action if property is damaged, but this applies also to walkers. Cycling on footways, however, is illegal unless specifically marked as a shared use cycle path (Highways Act 1835, S.72).

Figure 1 illustrates a variety of types of cycle. In general these may be classified as tricycles, hand-cycles, recumbents, and quadricycles. They may be either solo or tandem, and each class may or may not be electrically assisted.

Figure 1 – General classification of adapted bicycles

	Solo	Tandem
Tricycle		
Handcycle		
Recumbent tricycle		
Recumbent handcycle		

	Solo	Tandem
Mixed recumbent / upright and pedal / hand-crank	N/A	
Pedalled quadricycles		
Hand-cranked quadricycles (tandem example is mixed pedal and hand-cranked)		
Wheelchair clip-on cycles (tandem example is electrically assisted)		

The reader may be able to conceive of further permutations! On the one hand, it should be realised that it may not only be people with some sort of disability, registered or otherwise, who may wish to take advantage of the types of bicycle described in Figure 1, other people who – for what might be termed ‘milder’ reasons of comfort or balance – may also prefer to use them as well. Conversely, it should be noted that some people with a distinct disability may still cycle a two-wheel pedal cycle that may in some way have been adapted. As examples, one author [JP] has a friend with a single arm whose bicycle is adapted by linking both front and rear brakes to a single brake-lever. Hickman (2015) rides a Brompton folding bicycle with the aid of a leg prosthetic, and has described how the free mobility offered by the bicycle to some people with a disability can often mask disability. This has both benefits and disbenefits. From one perspective it means that those with a disability can experience free motion and the sense of simply ‘fitting into’ to the bicycling crowd. From another perspective however, it contributes to the perceived invisibility of disability in cycling, which means that levels of disabled cycling (and the consequent need for consideration of disabled individuals’ needs in relation to cycle infrastructure) are underappreciated (Ibid).

Blumenstein et al. (2014) reported results of a trial of an electric bike adapted for use by youths with cerebral palsy. The bike was fitted with ultrasonic sensors which created an audible signal to help direct the machine. It monitored muscle performance and heart rate. The results suggest to the experimenters that an adapted electric bicycle can provide improved space orientation and adjustment of the electric motor could be made to optimize comfort and therapy effects.

1.4 Legal obligations

There is currently no legal requirement for local highway authorities to prepare cycling

strategies or provide urban cycle networks. There is a variety of relevant legislation however as follows:

- The Traffic Management Act (2004) for England and Wales creates a duty to manage traffic expeditiously and provide a safe local road network (for Scotland see the Roads [Scotland] Act 1984).
- The Active Travel (Wales) Act (2013) strengthens the legal requirements for providing safe routes for cyclists and pedestrians. The aim is to promote greater provision for cycling and walking.
- The Countryside and Rights of Way Act (2000) for England and Wales requires local highway authorities to prepare Rights of Way Improvement Plans (ROWIPs), which assess the extent that existing rights-of-way meet present and future needs.
- The Land Reform (Scotland) Act (2003) establishes the right of responsible access by all non-motorised users (including cyclists) to most land, and not merely to paths and rights-of-way.
- The Infrastructure Act (2015) requires the Secretary of State to set a Cycling and Walking Investment Strategy. In order to help inform the strategy, a project is underway to develop a National Cycling and Walking Infrastructure Plan.
- The Disability Discrimination Act (1995) requires that no body or person prejudices the rights or freedoms of a person who is disabled as compared with a non-disabled person.
- The Disability Discrimination Act (2005) amended Part 3 of the 1995 act such that the principles apply to statutory functions of public authorities and hence cover highway and planning.
- The Equality Act (2010) requires authorities to make reasonable adjustments to remove barriers for disabled people. This applies to the street environment and to public transport services and covers disabled cyclists as well as pedestrians.

2 Disability cycling in design guidance

It is important for the needs of disabled cyclists to be incorporated into the design of cycle infrastructure, to ensure that a safe and accessible environment is provided and disabled cyclists are not excluded through poor design. Xiang *et al.* (2006) found from United States data that of the class of user comprising child pedestrians and cycle users involved in collisions, those with disabilities were five times more likely to have been hit by a motor vehicle. There was also a higher risk of collision for those reporting difficulties with traffic such as 'too few or missing sidewalks/paths,' and 'do not know when it is safe to cross,' and 'insensitive/unaware drivers'.

Public sector bodies are recognising their need to pursue 'inclusive design for all streets and spaces, ensuring that everyone using these environments should be able to participate independently in everyday activities with confidence' (TfL, 2014, p18). This section discusses UK national and local guidance as well as international guidance as exemplified by the Dutch and the Danish national guidance. The ordering of the section is related to the year of publication of the current version of the guidance.

The genes of the Dutch guidance (CROW, 2006) can be traced forward into much other guidance that has been created in the UK and other countries. The central tenet of the guidance is that, in addition to the geometric engineering principles needed to develop any design for a vehicle capable of speed, *the designer also needs to be aware of the special characteristics of the bicycle and rider*. Seven rider characteristics are identified, the seventh of which states that the number of tasks a 'traffic participant' can perform, and their complexity, are bound by limitations and designers should respect these limitations, taking less experienced and less able bodied road users into account. These characteristics in turn influence the design characteristics appropriate for cycling infrastructure. These are suitably defined by the Dutch as being coherence, directness, attractiveness, safety, and comfort.

Arguably, if the Dutch cycle network system accounts for limitations and is attractive and comfortable, and if the geometry is appropriately defined, there will be no special and detailed requirements for users with disability.

Even though it was produced in relatively modern times so far as cycle design is concerned, many commentators (e.g. Parkin and Koorey, 2012) recognise that aspects of Local

Transport Note (LTN) 02/08 (DfT, 2008) now need substantial revision. Users with disabilities are subsumed as a class of users of 'specialised equipment', deemed also to include those with trailers, trailer cycles, and tandems. The point is made that these types of users need adequate width and absence of pinch-points, 'sharp bends' and features that require a user to dismount. This implies that the general class of cycle user can live with these deficiencies, however as Hickman (2015, p. 7) notes, this is something of a fallacy when considering what all cyclists might expect from a truly acceptable and accessible cycle network: 'the requirement for a step-free network extends beyond the needs of disabled people'. The LTN suggests that the needs of disabled cycle users should be taken into account through consultation and design. It is noticeable that most references to people with disabilities is in relation to them as pedestrians rather than cycle users.

LTN 1/12 (DfT, 2012) was issued after the Equality Act (2010) and recognises that people with disabilities may be particularly 'affected' by shared use routes. The point is made that the degree of suitability for use by those with disabilities is in the end related to the quality of the design. Specific mention is made of the need to avoid obstructions, again as though these are not a significant problem for the general class of cycle user. Otherwise, as with LTN 02/08, in the generality, the consideration in respect of disability is principally towards those on foot.

Transport for London issued its first version of the London Cycle Design Standards in 2005. It was ground-breaking in a variety of ways, not least because it recognised that there were cycles of a great many types besides the usual solo pedal cycle. Figure 2 provides dimensions for designers to account for in the second edition (TfL, 2015).

The guidance suggests that infrastructure for cycle traffic should be designed in an inclusive way based on the concept of 'the inclusive cycle', the variety of which include: cycles with trailers; cargo cycles; recumbent cycles; tandems (including steer-from-rear and side-by-side); hand cycles; and tricycles (including wheelchair friendly models).

A point is made that a 'more forgiving environment' is required, although this is not well specified. Infrastructure should be able to accommodate inclusive cycles, but it is not expected that these would predominate. There is reference throughout the guidance as to how inclusive cycles may need to be catered for in particular circumstances. Inclusive cycles encompass freight bicycles. The following are listed as being particularly important to consider:

- The narrowest gap that any cycle should be expected to negotiate is 1.5 metres wide
- A minimum turning circle of 2.25 metres round a fixed point and 3.15 metres for a full 180° turn, with usual exceedance of these minima required in common practice.
- Lifts for cycles should be at least 1.2 metres by 2.3 metres
- Long wheel base cycles are more susceptible to vertical deflections than short wheel base cycles

In their usually well designed way, the Danish have produced a document called the 'Collection of Cycling Concepts' (Cycling Embassy for Denmark, 2012) in two editions which – principally pictorially – demonstrates approaches to planning, design, and the process of implementing infrastructure for cycle traffic. This has been taken to a greater level of detail with the Handbook for Cycle Traffic (Celis Consult, 2014), which provides much more engineering detail to allow for the expansion of the networks of cycle routes in Denmark, specifically addressing issues relating to what they term Cycle Super-highways, a phrase they have adopted after use in London. Again, there is little specific reference to provision for cyclists of all abilities.

The 'Design Guidance Active Travel (Wales) Act 2013' was produced specifically to support the aims of the by the Welsh Assembly Government (2014). The guidance recognises that there is no homogeneity within disability and there are a range of design requirements, with the example that the needs of wheelchair users are quite different than those of the blind. Features of benefit for one group, can and do benefit other groups though. For example, logical and clear routes benefit not only those with disorientation issues, but all sectors of the population that use a route. The guidance references in many places to the particular issues relevant for disabled users.

The Design Manual for Roads and Bridges is the design document used by those engaged in designing the strategic road network for Highways England, and is also used by the

governments of Scotland, Wales, and Northern Ireland (with suitable country amendments) for their trunk road networks. The document has referenced cycle users quite inappropriately with it being part of a class of users called 'non-motorised users', grouped with pedestrians and equestrians. Current guidance is contained principally in the following Technical Advice Notes and Highways Design notes which form the Manual:

TA 91/05 Provision for Non-motorised Users

TA 90/05 The Geometric Design of Pedestrian, Cycle and Equestrian Routes

HD 42/05 Non-motorised User Audits

These will be partially or wholly superseded in 2016 with an Interim Advice Note (being co-authored by one of the authors of this paper, JP) which addresses specifically the issues of design for cycle traffic. The document will not cover design of shared use facilities for pedestrians, equestrians, and cyclists. Where a facility is required to cater for pedestrian movements, it will be a footway separate to the cycle track. The provision of a shared use facility which caters for cycle traffic and meets an identified need for a pedestrian facility would require a departure from standards.

This distinguishing of cycle traffic from pedestrians is long overdue in guidance and should again help align UK design guidance much more with the Dutch and the Danish guidance. The standards specified in the IAN will cater for a 'cycle design vehicle' and all types of machine commonly used by those with disabilities will be encompassed within its envelope.

Gray et al. (2012) review what they term 'universal design' instruments for the built environment in relation to the needs of those with disability. These instruments are essential design tools such as questionnaires and audit tools rather than design guidance. Forty-four of the ninety-five tools identified covered cycling either specifically or in part. Approximately one-third of instruments include some disability-specific items.

It may be seen that most guidance is now at least sensitive to the issue of inclusive cycling. However, generally speaking, there is not much specific detail addressed for users of inclusive cycles. This is perhaps as it should be, if – and only if – the requirements of design for the general class of cycle users are strictly adhered to. It is perhaps only because in the UK that we seem to have attempted wilfully to misconstrue what appropriate design for the general class of cycle user should be that we have, therefore, also missed the target for provision for those cycle users who also have disabilities.

3 Experiences of all ability cycling investment in Bristol

This paper reports on a focus group and interview held with disabled cycle users, their attendant support workers, and the scheme organiser of a nascent inclusive cycling scheme in Bristol, UK. As a part of the West of England Sustainable Travel (WEST) project, a number of community schemes in Priority Neighbourhoods have been allocated a grant through the UK government's Local Sustainable Transport Fund.

The scheme in question is a small inclusive cycling group set up to support cyclists with additional needs from across the city and surrounding area. The scheme places a particular focus on introducing people who might never have cycled before to the experience of using an adapted bicycle.

The aim of this paper is to assess the current state of knowledge surrounding cycling and disability, and highlight the relative lack of existing research into the actual experiences of disabled cyclists (i.e. accessibility/usability of the cycle network, benefits of cycling, challenges and barriers to participation, etc.) and the relevance of the subjective experience to current cycle design guidance.

Earlier discussion has explained that the spectrum of ways in which disability impacts people is broad and complex, and thus the benefits of cycling and the barriers to participation will vary greatly dependent upon the type of disability experienced by a particular person. The authors would like to note that the data presented here is representative of the experiences of only a small sample of people. The cyclists who participated in the group had a combination of mental and physical disabilities ranging from more to less profound, and this meant that the majority of the participants required the support of a care worker to utilise the adapted cycles (most often as a tandem). The nature of the participants' disabilities will dictate to a degree the experience of cycling and also the perceived benefits and barriers.

One of the main intended outcomes of this paper therefore is that it be a 'call to action' for a

set of subsequent research studies which take forward and expand the initial findings presented here with other groups of cyclists experiencing different types and degrees of disability.

3.1 Methodology

A focus group was conducted with inclusive cycle scheme users and the care assistants supporting the majority of the users. The discussion focussed on the experience of cycling and the benefits and challenges of using adaptive technology both on and off the designated cycle network. A follow-up interview was held with the scheme manager to explore the operation of the scheme, and gain additional insight into the value of inclusive cycling and also the barriers faced by people with disabilities. The sample composition is presented in Table 1:

Table 1 - Sample characteristics

	Disabled cyclists (DC)	Care providers (CP)	Scheme organiser (SO)	Total
Focus group	8	7	1	16
Interview	0	0	1	1

3.2 Experiences of cycling for people with a disability

The scheme has 11 adapted cycles in a variety of different configurations to suit users' varying needs. The inclusive cycling scheme focusses predominantly on leisure cycling with the aim of increasing the health and wellbeing of the users:

For many of the people in the group, the adapted cycle was their first experience of being on a cycle, and this was generally agreed to be having a positive benefit for the users:

"A lot of people who come to this service haven't ridden before." (SO)

"It is making a massive difference for quite a few people." (CP-3)

The inclusive cycling centre provided a safe off-road space for people who had not experienced cycling before to practise and gain experience of the cycles before heading out on the the main routes.

There were a range of different benefits associated with cycling using the adapted cycles. The most commonly discussed was simply the increase in confidence that riding the adapted cycles could engender in the users:

"What I have found great is just the progression of people's confidence on the bikes. I have a lady that comes along every Thursday and uses the tag along with me, and I go out with her and she doesn't pedal at all and I'm like, "come on [Debbie] pedal!" And she is like "I am!" and I get to the top and I'm about to die, and then I go back down the hill. Then yesterday I was like "shall we try and use your legs today?" – and this is probably the third month she has been using the service and we were doing up the hill – and I was thinking "this is much easier than normal", and she finally figured out how to do her legs and she just loved it and was over the moon. So there are the moments you go "yes, I'm glad were doing this". She got a lot from that." (SO – Interview)

For the disabled cyclists, one of the main positive aspects of the experience was simply the same pleasurable kinaesthetic sensations of cycling reported so commonly throughout the cycling literature. Cycling was described often as fun and exhilarating by the cyclists and the care providers, and there was discussion of experiences of speed and flow, which for most of the scheme's users were completely novel:

"I like going really, really fast!" (DC-2)

Several people discussed the perceived health benefits of cycling for people with a disability. Whilst the people in the group most often went on supported rides, nonetheless this was seen to improve people's health as well as increasing their wellbeing and confidence:

"Yes [Gerry] gets on the side of it with [SO] and he loves it. Where before he wouldn't go on a bike he wouldn't even attempt to get on the bike he wouldn't even attempt to go on a bike but now he looks so much healthier [...]. But it is [Gerry]'s highlight of the week he loves it." (CP-6)

For some, the experience of cycling in the group had given them the confidence to cycle

elsewhere:

"[Poppy] recently went on holiday to one of the big Butlin's camps and they had four-wheel bikes there for two people to sit on but they actually ended up giving her one for the whole week because she wouldn't get off it! I think I lost about 12 pounds on that weekend." (CP-3)

One disabled cyclist explained in clear terms the positive effect that cycling was having on his health:

"I went for a check-up and they said my blood pressure has really dropped." (DC-5)

Improvements to health can be attributed to the act of cycling itself, however there were wider wellbeing benefits of the inclusive cycling scheme which went beyond just the physical exercise. Foremost of these was the opportunity the scheme provided for people whose disability made regular employment impossible to help with the running of the scheme and the maintenance of the fleet – activities in which people placed great value:

"[Gordon] comes down and helps out. He does some oiling for me and stuff, and he meets and greets and helps with that." (SO)

"It gives the service users a chance to come down and do a voluntary job where they are supported and they are outdoors and there is a café there. [Annie] really enjoys it [...] and she had never cycled before but I think it gives my service users a chance to feel like they are doing a job. [Annie] has put oil on the chains and handed out helmets and got the bikes out [...] so from that aspect it has been very beneficial." (CP-7)

"One of the guys [at a local support group] wanted to become one of my volunteers, he had had a stroke a couple of years ago and he sort of lost a bit of purpose, so we were like, 'come and volunteer with us!'" (SO – Interview)

This aspect of the data is evidently only relevant to people whose disability precludes them from the experience of working. As discussed earlier, a large proportion of people with a disability are able to work and would be using adapted cycles for different purposes (e.g. commuting). In the context of this group of disabled cyclists however, the broader benefits of involvement in an inclusive cycling scheme are very relevant.

The physical setting of the scheme was also important. The scheme's headquarters were situated alongside one of the main National Cycle Network routes, adjacent to a local café which is a popular spot amongst cyclists taking the route. This means that the people using the adapted cycle can go out onto the cycle network and experience the surrounding area in a new way.

The benefits here were seen to be both physical and social. From a physical perspective, some scheme users were able to use the designated space of the cycle network to venture further than they would have felt comfortable doing on the road, and it was evident that the infrastructure here played a key role in enabling greater levels of cycling for people:

"But it is lovely [on the cycle path] because you can... [Gerry] can be pushed to go further, but now it goes further and further." (CP-6)

From a social perspective, the proximity to the cycle path provided an opportunity for the disabled cyclists to experience being a part of the general cycling crowd, and there was suggested to be generally a welcoming atmosphere for those using adapted cycles:

"They are so lovely there and you do get all the regulars that come along every day as well and they are really supportive as well. It does feel like a nice little community hub. They are all such a nice bunch. People on the cycle path are also very receptive and we see them honking their horns, and so yeah respectful and enthusiastic about it." (SO – Interview)

Conversely however, the infrastructure and other cyclists' use of it was one of the things which could also create a negative experience for people with a disability:

"So I had said to the support worker that was supporting this guy, 'do you feel confident enough that he is going to be okay on the cycle path? He must keep left.' And she said 'ah yeah, he will be fine'. So she took him out and came back about 30 mins later crying his eyes out. So I was like, 'what happened?', and he was on the wrong side of the road and [...] there was a guy speeding down and he just got a telling off. Unfortunately the service user has never been back. He was really enjoying it but just something like that can really put you off." (SO – Interview)

"So for some people the cycle track is too fast you know you have some people

bombing down on the racing bikes and everything else and it is just too fast." (CP-3)

"I do find some cyclists are a little bit annoying. Like you will be going along and there will be someone bombing it and it's like, hold on... It is everyone's path not just yours." (SO – Interview)

With relevance to earlier discussion of cycle design guidance, one participant noted that the design of the path could create a barrier for those using an adapted cycle

"In terms of access, they were cycling to [village] on the side by side bike and they were manoeuvring through all the little bollards there and the only problem there is when you get to the cycle path you get to the [village] side you can't get the bike through at all so they could just widen it slightly... Because [...] if you just widen it a little bit it makes it more accessible for people on these kind of bikes." (SO)

During the discussion, a number of further barriers were identified which made cycling more challenging for the participants. A barrier mentioned regularly was cost. Adapted cycles are often significantly more expensive than the average bicycle, and because of this people with a disability may not be able to access one:

"As individuals [service users] couldn't afford to buy them [adapted cycles].[...] These bikes are expensive you know and as soon as you specialise them the pound signs keep ticking away by bringing the bikes together we are actually able to use them together." (CP-3)

In this respect the inclusive cycling group was seen to remove the price barrier for people by providing access to the cycles for a small fee, as opposed to people having to buy one for themselves:

"This kind of equipment has always been too expensive for individuals to have within the home and stuff like that. So to have it in one place where we can go along and have it at various different times and use it in a safe environment is kind of what we are doing and we are using it like that. It is actually opening up the whole cycling thing in a more user friendly kind of way." (CP-3)

Evidently it is not the case that for all (or even most) people experiencing a disability the price of an adapted cycle will be too high (and indeed as Aldred and Woodcock (2008) explain, an adapted cycle is often considerably cheaper than a car), however, when combined with the earlier statistics relating to the relatively reduced rates of employment amongst those with a disability compared to those without, it is clear that price remains a crucial factor in the accessibility of cycling for a large number of people who require an adapted cycle.

Attached to the barrier created by high cost, is the issue of high value and the subsequent risk of theft.

"Leaving it there and locking it would just be dangerous because the bike is worth £6000." (SO)

Fears about the safety of the high-value adapted cycles means that people may be unwilling to leave them locked up in an unsecure location, which will limit the accessibility of certain areas or parts of the cycle network. Potentially the requirement for the provision of more secure cycle parking facilities at key points along cycle paths could help alleviate this.

Another participant spoke about the difficulty they encountered when one of the adapted cycles broke down during a ride, and some distance from the headquarters. For a person with mobility issues, an adapted cycle can be a freeing vehicle which allows them to overcome some of the mobility restrictions they face. However if that vehicle does break down, then a person with restricted mobility might find themselves in a difficult situation if they were unable to continue (or backtrack) without the use of the cycle as their mobility aid:

"Me and [scheme provider] go out on the bikes together, but then the bike broke down. The pedal came off. We were so far away from where [scheme provider]'s office is we had to carry it back. So I said to [scheme provider] the top question of the day is, "what happens if we break down?" (DC-5)

Other barriers described by the group mainly centred around specifics of the scheme itself, including funding and staffing – particularly in the context of disabled cyclists who require someone to support them during a ride:

"We aren't open as much as we would like to be. That is limiting as well for people"

particularly for families that want their kids to come down after school and we can't offer that quite yet because they would have to pay me to do that and that would cost them a lot of money." (SO – Interview)

"If you have got more than one service user with you, you might be supporting one person on the bike but somebody has to stay with the other person while they are waiting to get on the same kind of bike [...] because there is only so many bikes, but there is so many different adaptations. So there is quite a fair bit of support required in order to achieve getting people out there and on to the bikes." (CP-3)

Because we have only got 11 bikes now; some are more popular than other like the side by side one in particular. So that one was out of action around Christmas and December January and the beginning of February and I lost about 13 service users from that because that is the one they want you know..." (SO – Interview)

However, despite the range of barriers discussed in the group, by far the dominant narrative was of the value of cycling to people with a disability and the need for improved support in this area to broaden the reach of inclusive cycling and get more people out and about:

"I'm sure some people would be there every minute of the day if they could. We would use it a lot more than we do now if we had the funding to be able to provide staff support and all that kind of stuff." (CP-3)

"[The project's biggest achievement is] the increased interest and seeing the progress of people as they are getting better and better at their cycling and their level of fitness improving, and that is really nice especially if they are enjoying it. [...] Just seeing that it is making an improvement in people's lives. Is that a bit cliché?" (SO – Interview)

5 Conclusions

Cyclists with disabilities experience many of the same pleasures and frustrations of cycling as able-bodied cyclists, such as the enjoyment of the sensory experience and the feelings of freedom, versus the occasional altercations with other cyclists and the barriers thrown up by poor infrastructure. At the same time however, there are a number of specific infrastructural and support needs which relate either solely or principally to disabled users. The requirements for support vary drastically dependent upon the type of disability that a person experiences.

A primary consideration of this paper has been the ways in which current cycling design guidance is taking into account the needs of disabled cyclists. It is evident from the literature that design guidance documents in the UK are slowly improving in respects of their attention to these needs, however most of the recommendations for designing for adapted cycles are vague, and limited to the physical dimensions of the cycle. The data presented in this paper detailing disabled cyclists' experiences has shown that the simple problem of dimensions remains an issue for users of adapted cycles, with some cycles of this type being unable to traverse obstructions built into the cycle infrastructure (e.g. bollards). Beyond this however, the data has been very useful in identifying a number of broader needs.

Adapted cycles are often relatively expensive, and consequently were seen as being particularly at risk of theft. In the case reported in the data, this was a limiting factor in disabled cyclists' rides, because the worry of locking up the bike in an insecure location meant people simply would not do it. Enhanced security (e.g. lockable shelters) at key locations along routes might help address this barrier.

Participants' also discussed the experience of breaking down on a cycle, and this was described as a particularly significant event for a person with a mobility impairment. In the case reported here, the disabled cyclist was riding in tandem with the scheme organiser, and so was assisted back to the scheme headquarters; however, when considered in the context of a disabled cyclist riding solo, the situation could be more serious due to the fact that the cycle is often acting as a mobility aid, and a person could find themselves stranded and unable to easily progress or retreat without the aid of the cycle. Consideration could be given here to the mitigation of such a crisis through infrastructure design – for example through the provision of simple public repair stations along key routes, regular seating/recovery areas. And of course, these would be valuable to all riders.

The health and wellbeing benefits of cycling to disabled people are evident – encouraging fitness, enjoyment, and freedom. This review has highlighted that the needs of disabled

cyclist are increasingly being taken into consideration in infrastructure design, but that there is a long way to go before the current UK network is accessible or acceptable for users with additional needs. The review has highlighted a significant gap in the literature in terms of understanding the experiences of disabled cyclists, and what this can tell us about the ways in which current design guidance is either meeting or neglecting peoples' needs. The data presented in this paper is a useful insight into the experiences of a group of disabled cyclists, but this data is limited to the specific context of that group. Further research is needed to understand the vast range of different contexts in which people with disabilities are cycling, and what the specific requirements from these might be.

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