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THE IMPACT OF STREET ACCESSIBILITY ON TRAVEL AND INDEPENDENCE OF DISABLED PEOPLE

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1. Street accessibility and the social model of disability

Streets and highways are the arteries of transport networks. They connect communities to one another, businesses to one another and communities with businesses. Their use is required – to a greater or lesser extent - not only for the purposes of walking journeys, but also for most cycling, motoring and public transport journeys. Their accessibility has been acknowledged as an important part of the disability access jigsaw for some considerable time(for example, the Dutch Ministry of Transport and Public Works, 1986; the Institution of Highways and Transportation, 1991; the Swedish Association of Local Authorities, 1993; and the Canadian Standards Association, 1995). However access to streets and highways for many disabled people is, as we will elaborate in this paper, still the source of major problems, serving as a barrier that constrains disabled people's independence, opportunities, health and wellbeing. This gives rise not only to costs to those affected individuals, but is, we argue, also the source of costs to society; i.e. in economic terms, there are both private and external costs to continuing inaccessibility.

There are a number of possible explanations for the continued existence of street and highway accessibility problems, many years on from the acknowledgement of their importance. One issue is their ubiquity, combined with their long-lived nature. Streets and highways are all around us and most were created some considerable time ago, before their accessibility for disabled people had been placed on the agenda. This ubiquity and long-lived nature means that redesign or refurbishment of streets and highways tends to occur infrequently.

Another issue is that designing accessible streets and highways is far from straight-forward to do, and what might constitute an accessible design could change overtime. One of the reasons for this stems from the diversity amongst disabled people, perhaps most notably in terms of their impairments and their life experiences. That is, whilst disabled people may be viewed as a social group, bound together by them being disabled, there are actually many different impairments experienced by different people that can then give rise to disability. Indeed, the Social Model of Disability makes a clear and useful distinction between the impairments people have, in terms of some loss or lack of function or capability, and the disability they face, in terms of society's failure to design and organise itself to accommodate for those impairments. Hence, the challenge becomes one of understanding how to design streets and highways in ways that accommodate the range of impairments experienced. Accessible design has changed over time in part as a result of the changing priority afforded to disability issues, in part due to technological developments changing what it is possible to incorporate into a design and in part as a result of research with and greater involvement of disabled people themselves.

The aim of this paper is to re-examine the understanding of street and highway accessibility in specific relation to people with physical mobility impairments and to people with visual impairments, and the potential impacts on these groups flowing from accessibility improvements. In the next section of the paper, we provide some context regarding disability and transport accessibility, before then focusing in turn specifically on physical mobility impairment issues and then visual impairment issues. In doing so, we hope to demonstrate the range of

design issues in play, and the clear and real difficulties sometimes in finding solutions that accommodate both types of impairment, whilst at the same time remaining practicable. It draws on the authors' experience in both research and practice, as well as on two specific studies conducted recently, one with Leeds City Council (for which we also acknowledge the support of the Research Councils UK for its funding) and another with the Guide Dogs Association for the Blind.

2. Disabled people and transport access

How one defines 'disability' can be contentious, depending upon the extent to which it is viewed as a medical issue or a social issue; that is, whether the source of disability is viewed as emanating from the individual's medical condition or from society's failure to organise itself in a way that accommodates the diversity of the population. Using what they describe as a 'balanced approach' to defining disability that seeks to recognise both medical and social components, the World Health Organisation estimates there to be over 1 billion disabled people worldwide (WHO, 2011). Furthermore, they highlight that this figure is on the increase and is predicted to continue doing so in the coming years, stemming both from the trend toward an ever ageing population - and the higher risk of disability amongst older age-groups - and the increasing prevalence of chronic health conditions, such as diabetes, cardiovascular disease, cancer and mental health disorders. So, in these ways, disability becomes closely linked with ageing and health.

There is a widespread acknowledgement that disabled people face a range of difficulties in relation to transport and other goods and services, and that these difficulties result in diminished life opportunities. For example, disabled people tend to travel less, be more isolated, have poorer health outcomes, have lower educational attainment, have lower employment rates and lower incomes than do non-disabled people.

Barriers to travel for disabled people may be grouped into six categories:

1. Difficulties in using the built environment and transport infrastructure, principally associated with physical design issues;

2. Difficulties in using transport vehicles, again principally associated with physical design issues;
3. Difficulties in using transport services, associated with variations in their availability in time and space;
4. Difficulties in using transport due to its cost, in relation to disabled people's incomes;
5. Difficulties in accessing travel information, associated with the variation in information requirements; and
6. Difficulties linked to customer service, associated with varying levels of support and disability-awareness.

There is a widespread acceptance that efforts should be made to tackle these barriers, with many countries having passed legislation to embed and obligate such efforts. At the global level, the United Nations has adopted the Convention on the Rights of Persons with Disabilities (2006), with specific articles relating to Accessibility and to Personal Mobility, and this now has over 150 government signatories. Yet, progress towards removing the barriers seems, to many observers, to be all too slow.

In this paper, we are primarily concerned with the first of the above types of barrier, both in relation to the degree of ease with which it is possible for disabled people to make use of streets and highways and the level of safety. It is observed that disabled travellers tend to self-regulate their behaviour in order to avoid real or perceived dangers (e.g. that might arise from their diminished reaction-times, increased physical frailty etc.) and mitigate accident risk. However, this tends to mean that they suppress their travel and mobility in some way, and so safety becomes part of the disability transport access issue.

In the following two sections, we seek to summarise some of the key findings emerging from our recent interviews with wheelchair and mobility scooter users in Leeds and with UK-based visual impairment stakeholders, and to review some of the key literature.

3. Choice and independence for travellers with physical mobility impairments

Stakeholder-focused research by Bromley et al (2007) and Imrie (2000) highlights both the importance of the provision of accessible infrastructure as well as engaging with disabled people to meet their travel needs and provide choice as to destinations and means of travel. Frye (2010) points out that:

> *Access in and around the pedestrian environment is fundamental to the ability to remain independent and self-sufficient: to get to shops, to medical facilities and to be part of the community (*Frye, 2010:1)

and warns that 'unless older and disabled people are able to retain their mobility and to live independently, there will be severe economic and social consequences'. In many places, these are pedestrian-friendly or pedestrianized environments which contain many of the services that people need and want to access (Bromley et al, 2007). Nevertheless, this still presents disabled people with a challenge of how to access these places from their homes and means that many local services such as doctors surgeries, local shopping parades, libraries and post offices could remain inaccessible to disabled people, not because of a lack of access to the building itself, but because of a lack of a safe, accessible pedestrian route which links these services to places where disabled people live (Bromley et al, 2007).

In *Disability and discourses of mobility and movement* , Rob Imrie makes use of taped and transcribed interviews with disabled people gathered in the course of three research studies and points out that:

> *A range of respondents concurred in arguing that the facilitation of their mobility was meaningless if nothing was done to improve their access into the places they choose to visit. For one person, the experience of visiting a public building, acclaimed for its*

> *accessible design features, was diminished by her inability to move from the pavement to the building's main entrance. As she recalled: "I went up to visit this so-called state-of-the-art accessible building, and when I got out of the taxi I found I could hardly move my chair. Every inch of the pavement was uneven and full of pot holes, so even though they had all those facilities inside, it's no good if we can't get to the building. They don't think of this do they?"* (Imrie, 2000: 1648).

Mobility policies largely revolve around the provision of commuter networks between home and the workplace, seeking to facilitate movement which is limited to specific social, geographical, and temporal ranges. The effect is, as Huxley (1997: 2) observes, one of reducing mobility to "predictable, purposeful trips, origins and destinations'' rather than seeking to conceive of mobility as "a messy, unpredictable, diverse and changeable reality'' (Imrie, 2000: 1644). However, when these policies are implemented with the aim of making transport system and networks accessible, the effect on disabled users would be that of reducing their choice of travel to predictable, limited movement to a small number of destinations. This tends to cater for 'essential' journeys, such as trips to work or shopping for food or attending hospital appointments, but severely reduces social and leisure trips.

If their local streets and shopping parades are not accessible, disabled people have limited choices as to what services they can physically access and how they are going to get there. It was with this in mind that we set out to conduct a study to evaluate an ongoing programme of highway access improvements in Leeds, involving in-depth interviews with 20 disabled people from across the City. These interviews have, firstly, indicated that the choice of destinations is influenced by physical access, provision and availability of accessible parking, accessible toilets, level surfaces, etc. In the words of a disabled person interviewed in the course of the study:

The whole thing. It's all access. It's unpredictable: can you park, are there dropped kerbs to get from car to pavement can I get there, can I get to the premises, do they have a loo, is it accessible – you just have to make sure. It's no point just thinking – right, I would love to go and see that, it's: have they got access, have they got this, have they got that. You cannot just choose a place and have the guarantee that you can access their service on equal basis.

This tends to favour supermarkets and shopping centres over high streets and shopping parades because of the physical distance from accessible parking to the service and the shop layout allowing for access and circulation within. The community transport also tends to focus on this type of destinations. Many smaller shops still lack ramped or level access and limited space available inside makes browsing and shopping inside difficult. Wheelchairs, mobility scooters and walking aids do not enable users to carry a lot of shopping with them, making the car the only realistic transport option food shopping beyond the smaller groceries. This then leaves many disabled people with a choice of using their own car, a taxi or a lift from a friend or a relative, or a form of dial-a-ride or access bus, which limits the flexibility of how often they travel and, in turn, how often they leave their house. A stakeholder in the Leeds study commented:

The cost of taxis is prohibitive and I do feel trapped in the house, especially in icy weather when I can't go anywhere; I like my house but don't like to feel like there is no life outside of it.

This view is representative of many older people with mobility problems - recent figures from Great Britain suggest around 342,000 over 75 year olds 'feel trapped' in their own homes through lack of suitable transport (WRVS, 2013). Frye (2010) warns of the consequences for those who either are, or feel, unable to venture out alone - even to get to the local shop for food - as well as for the wider society, as loss of independence will lead, in the developed world, to an increased level of support and intervention from the medical and welfare

services. She strongly advocates the 'need to develop more effective ways of engaging older and disabled people in the process of planning and prioritising access improvements'.

Emerging findings from our interviews in Leeds indicate that for some disabled people, especially those living at home alone, the only time when they can go and access a range of destinations is on a particular weekday when they have assistance available. Because of the limited time for which the assistance is available, the essential trips tend to take priority over leisure journeys, again reducing the trips to "predictable, purposeful trips, origins and destinations''. One of the stakeholders told the researchers she would love to go to a farmer's market but, because she would require assistance which was only available on a specific weekday, it was difficult to find a farmers' market on that day and even then there were always other trips which were more essential and which therefore had to take precedence. This may in turn reduce the sense of independence and severely limit opportunities for social interaction especially for those disabled people who are not able to drive and who do not own a car. According to Imrie (2000), "bodily incompetence" is, for many respondents, reaffirmed by their dependence on particular support structures or services to facilitate their mobility, and the major barrier to be overcome is the absence of any means or mechanisms for disabled people to facilitate their mobility without some recourse to help or being placed in a situation where they are dependent on a third party. He calls for "levels of participation and involvement of disabled people in civil society" as "a precondition for transforming their mobility and movement" and argues for the need to "establish social independence for all inhabitants" by empowering people "to meet their own needs within a network of mutual obligations rather than within a hierarchy of dependency relationships".

Recent changes to the provision of public transport in the UK, such as low floor, accessible vehicles and raised boarders at stops have made many of the bus services accessible and made the bus stops easier to board for wheelchair users and others with a mobility impairment. However, a number of people with disabilities still feel limited in how they can use the buses. One of the major

issues is the physical distance from the house to the bus stop; depending on the level of individual mobility and the mobility aid used. Some of the participants in our ongoing Leeds study highlighted the fact that it was difficult or impossible to take a mobility scooter on the bus and the distance to the stop was too far to walk without the use of one. One of the participants mentioned how she has not been to the city centre of Leeds for three years (a distance of under 6 miles or 10 km) because she could not get to the bus stops at either end of her journey without the help of her mobility scooter, and the distance and the nature of the road network prevented her from making the whole trip on the mobility scooter. Another female participant could not manage the walk to the bus stop to the services which could take her into the city centre, or out to market towns. As she could not take her mobility scooter on board and had nowhere to leave it near the bus stop, she needed a lift in a car between the stop and her front door on the outward and return trip – a factor that was limiting how often she used the bus. Without reliable transport she felt unable to join courses or interest groups. Several participants have indicated that they would like to use the bus more often if they could access the stops and if the reliability of the services would improve. On the other hand a number of electric wheelchair users interviewed in the course of the study commented on how the ability to get to the bus stop and back (because of the dropped kerbs) has transformed how often they went out and how far they travelled. Good availability of dropped kerbs along the bus route also gave them confidence and opportunities to continue their journey even when they got off at the wrong bus stop.

Frye (2010) argues that there have been major improvements in recent years in making public transport accessible to disabled and older people but that the pedestrian environment often remains a barrier to mobility.

> *Poorly designed or maintained pavements, street clutter, inadequate or unsafe crossing points and poor traffic management are among the deterrent factors and obstacles in our towns and cities. For many older and disabled people, the pedestrian environment presents safety challenges, both real and perceived.*

Participants in the Leeds study identified the provision and quality of dropped kerbs, the width of the footway and the presence of any crossfall as well as the maintenance of the footways in terms of surface, cracked tactile paving or flags and eroded tarmac, which are all perceived as real or potential hazards, as aspects of its accessibility (other than the overall length of the route). Negotiating these exacerbates the discomfort of the journey for wheelchair users, especially those suffering from chronic back condition and back pain, therefore reducing the overall length of the trip. The fear of the wheelchair overturning is also a significant barrier – many users feel vulnerable as they know they would not be able to get back into the chair unassisted. Winter maintenance is another major limiting factor (as is the wet and cold which can exacerbate certain conditions) as most of the wheelchair and mobility scooter users interviewed in Leeds stated they cannot go out in snowy weather.

The emerging findings indicate that the ability to go out, whether realised or not, was important to the participants well-being. Several participants spoke of depression and how social interaction, including chance meetings in local shops and cafes, or just being out and about in the local neighbourhood, park or high street, helped them alleviate the effects of both depression and physical disability. Reducing stress associated with uncertainties of going out, or with coping with barriers also had a positive effect on physical wellbeing and enabled more trips to happen more often. Provision of adequate infrastructure, including dropped kerbs and pedestrian crossings, also enabled some of the participants to go out independently, whereas in the past their journeys would need to be accompanied by an assistant who helped to manoeuvre the wheelchair over high kerbs or made with a family member in a car.

One of the ways in which older and disabled people regain control of their own mobility is through the ever increasing ownership of mobility scooters. These are becoming increasingly popular among older people as a mobility aid, resulting in greater independence and reduced reliance on car transport. They are an economic alternative to an electric wheelchair and seem to be preferred over a

wheelchair as they do not have the same negative social connotations[i]. One participant in the Leeds study described the effect of getting a mobility scooter:

> *The mobility scooter has been a life-line. Before I lived in an upstairs flat and I could not have a scooter. I used to use taxis a lot – they were very good but they cost £6 per day. […]The main difference is that now if you forget to buy something you can always go back out, and not think, oh, this is going to cost me another £3 there and back…*

Another commented on how she could access a greater range of destinations over greater distance when she used a mobility scooter due to faster speeds and a more powerful battery in comparison to the power wheelchair she is using at the moment. However, as discussed above they can limit access to other transport modes and therefore reduce the choice of destinations disabled people can access. They also require more storage space and greater footway widths, and would not fit through certain types of access barriers.

The aging population and growth in use of mobility aids, scooters in particular, increases the demand for more accessible streets. The provision of level or ramped access, which in highway terms means dropped kerbs or a form of raised crossing together with tactile paving, is one of the key recommendations of the UK Department for Transport's (DfT) guidance on best practice *Inclusive Mobility* (2002). The guidance recommends the provision of dropped kerbs with appropriate tactile paving at junctions (positioned just behind the radius to achieve crossing of a side road at a right angle) and the provision of informal crossing points every 100m or so along the length of the street to avoid lengthy de-tours, and contains technical advice on maximum upstand, gradient, crossfall and camber as well as tactile paving colour, depth and layout to ensure maximum accessibility. The more recently published *Manual for Streets* (DFT, 2007) notes that 'the kerbed separation of footway and carriageway can offer protection to pedestrians, channel surface water, and assist blind or partially-sighted people in finding their way around, but kerbs can also present barriers to

some pedestrians' and highlights the need to provide 'dropped kerbs with the appropriate tactile paving […] at all side-road junctions where the carriageway and footway are at different levels. They should not be placed on curved sections of kerbing because this makes it difficult for blind or partially sighted people to orientate themselves before crossing'. (DfT, 2007: 66)

Whereas the above documents highlight best practice and provide technical guidance on the standards that ensure maximum accessibility, the obligation on UK local authorities to make their streets accessible arises from the Equality Duty, now part of the 2010 Equality Act. The Act places an obligation on all public bodies to give 'due regard' to protected characteristics (i.e. disability, gender, race etc.), through:

- Removing or minimising disadvantages suffered by people due to their protected characteristics.
- Taking steps to meet the needs of people from protected groups where these are different from the needs of other people.
- Encouraging people from protected groups to participate in public life or in other activities where their participation is disproportionately low.

More specifically, in terms of meeting the needs of disabled people, the Act contains the Duty to Make Adjustments, which would include the provision of an auxiliary aid or/ and removal of a feature that puts a disabled person at a substantial disadvantage, whenever it is reasonable to do so.

Local authorities can adopt different strategies to help achieve more accessible street environments. The most common one is the inclusion of accessible features, such as dropped kerbs and tactile paving, in all full street refurbishment schemes and all new developments. Others include making town and district centres accessible, especially as part of regeneration schemes or a pedestrianisation project or a 'shared space' type intervention, as well as providing dropped kerbs where there are specific types of housing, such as sheltered accommodation or assisted living. High kerbs and lack of dropped

kerbs are consistently identified by people with a mobility impairment as one of the most frequently encountered barriers (Kirchner et al, 2008; Bromley et al, 2007; Meyers et al, 2002). Focus group research conducted in Coventry indicates that high kerbs and lack of dropped kerbs are the most important factor limiting the mobility of disabled people (Vujakovic and Matthews, 1994: 367). Similarly, the findings of research by Bromley et al, involving 120 wheelchair users in Swansea, found that lack of dropped kerbs was a major or insurmountable obstacle to 65% of interviewees (Bromley et al, 2007). Furthermore, wheelchair users identified obstacles in the city centre environment, which impeded movement, but which could be removed in the short-term, which included more dropped kerbs (21%), improving the quality of pavements (13%) as well as removing steps.

Participants in the Leeds study variously described the effect of dropped kerbs as 'transformational', 'very convenient' as 'having enhanced their mobility'. One of the stakeholders said:

> *It gave me back independence – being able to go out unassisted. It is the most important thing',* others said*: 'without them I couldn't go anywhere. You have hit a kerb and you have had it', 'They are very important and their lack is the main limiting factor. Without them I need to travel a long way around' and 'Without the dropped kerbs I doubt I would be able to go out locally very often at all'.*

The lack of accessible infrastructure can adversely affect the confidence and willingness to go out and result in the loss of independence; as one of the stakeholders summed up [quotation marks?]:

> *The traffic can be quite busy and fast. It made it awkward to go out; I could not get across the road [the pavement on same side of the road is too narrow for the wheelchair], it was just very inconvenient and it affected my willingness to go out and independence.*

A report for the East Sussex scrutiny board indicated that "dropped kerbs have been cited as a significant factor in town regeneration by ensuring access to shops and services for those who rely on them. They help to maintain the independence of many people who otherwise may not be able to travel very far from their homes, a key aim for Adult Social Care and health services". An American study on accessibility of destinations to disabled people and barriers encountered on their daily journeys recommends improved pavements and dropped kerbs as the key features for improving mobility on not only wheelchair users but others using mobility aids as well as other sectors of the population, for example parents with pushchairs[ii] (Kirchner et al, 2008).

4. Navigation and street-crossing for people with visual impairments

One of the key ways in which visual impairment impacts on people is the way it affects them getting about as a pedestrian. In the largest recent survey of visually impaired people, 'mobility on foot' was by far the most frequently reported travel difficulty amongst respondents (Pavey et al, 2009). Particular problems cited by respondents to this survey included a lack of confidence in going out alone or to unfamiliar places, obstacles in the environment that made navigation more difficult, and fears about busy traffic. Consequently, for a lot of visually impaired and elderly people, fear of getting around means they do not go out as much and/or that they spend more on taxis as a means of overcoming the need for mobility on foot. This leads to suppressed levels of physical activity (with consequent knock-on negative impacts on health and wellbeing) and reduced levels of disposable income, amongst a group often already experiencing lower than average levels of personal income.

Visually impaired people's lack of confidence about going out alone or in unfamiliar places results in large part from difficulties with orientation and wayfinding, and the likelihood of becoming disoriented and unknowingly putting themselves in situations of heightened danger. When thinking about this, it is

important to acknowledge the diversity amongst visually impaired people, and the variation this leads to in individuals' coping strategies. For example, Atkin (2010) found it informative to group visually impaired people into three: those who rely on their residual vision, those who use a guiding cane and those who use a guide-dog.

The challenge that emerges is to develop an "environmental information system" accessible to all. Passini expresses this as "a coherent ensemble of architectural and graphic cues that provides the decision-making user with adequate wayfinding information at the appropriate place in a form that is both accessible and understandable" (Passini, 1984). The challenge then for design, is how to put together this coherent ensemble of architectural and graphic cues to draw meaningfully on these information channels?

Unfortunately, a lot of the research in this area is old, or reliant on small samples. It seems clear that better understanding is needed of:

- what spatial information should be given;
- in what form that information should be given;
- at what locations information should be given; and
- how these vary with key parameters, e.g. visual impairment and time.

And how they relate to technologies

It is well-known that risk to pedestrians is increased when road design and land-use planning do not appropriately incorporate the pedestrian, e.g. by including delineated footways, controlled crossing points, adequate lighting, etc. With specific reference to visual impairment, The UK's Guidance on the Use of Tactile Paving Surfaces, sets out five more generic key design principles:

- Layouts of all pedestrian areas should be simple, logical and consistent;
- Contrasts in colour and tone should be used to accentuate the presence of certain key features
- Orientation and wayfinding information should be provided by the use of high visibility and, where appropriate, tactile signing

- Lighting levels should be even and adequate and should minimise glare
- Important information about the environment should be conveyed by the use of non-visual features

More specifically, Atkin (2010) highlights a number of design features, which he divides as follows:

Features which benefit all visually impaired people

- 'predictability';
- smooth even paving and streets free of obstructions;
- pedestrian triggered signalled controlled crossings with audible or tactile indicators;

Features relevant to those with residual vision

- clear tonal contrast (e.g. between footway and carriageway, between street furniture and the surrounding paving, etc);
- Coloured paving;
- Level surfaces;
- Wide footways;

Features relevant to Long Cane users

- Footways that are 'not too wide';
- Well-defined curbs;
- Tactile paving, e.g. to alert to the presence of a pedestrian crossing point or to delineate footways from carriageways where there is not a well-defined kerb;
- Unobstructed building lines;
- Guidance paving in pedestrianised areas and around bus stops or other obstructions;
- Guard rails;

Features relevant to Guide dog users

- Wide footways;

- Well-defined kerbs;
- Tactile paving, e.g. to alert to the presence of a pedestrian crossing point or to delineate footways from carriageways where there is not a well-defined kerb;
- The sound of traffic.

In addition to concerns about navigation and wayfinding, Pavey et al (2009) also highlight visually impaired people's concerns about traffic. Whilst no specific data on road accidents involving blind and partially sighted people is routinely collected, a small number of studies have sought to quantify this, most notably that of Carroll and Bentzen (1999), whose survey work revealed that a quarter of respondents had been involved in an incident where their cane had been run over and just under 10% had actually been struck by a vehicle. These sorts of incidents can impact on blind and partially sighted people's confidence and perception of safety and security in the public realm, with subsequent impacts on the overall mobility of this group of vulnerable road users. Furthermore, given the link between visual impairment and ageing, with approximately 65% of blind and partially sighted people being over the age of 65, it is interesting to note the patterns in age-disaggregated accident statistics. For example, in the US, the age group with the highest risk of being killed as a pedestrian was those over 75 years old. A review of the UK accident database (STATS19) from 2008-2012 shows that in a sample of 129,438 road accidents involving a pedestrian; older and younger age groups are over-represented. More generally, it is widely acknowledged that reduced walking speed and diminished reaction time amongst elderly people are particular risk factors, whilst the likely severity of an accident involving an elderly pedestrian will be increased due to age-related physical frailty.

In this context, we were interested to conduct a study for Guide Dogs, looking at the role and importance of street crossings for visually impaired people. To this end, interviews were conducted with a range of stakeholders, including a rehabilitation officer, members of visually impaired persons' advocacy organizations, a proponent of shared space environments, and a representative of a national charity that works towards creating safe, attractive and enjoyable

streets for pedestrian use. Three of the interviewees were blind or partially sighted themselves.

A previous survey by Guide Dogs (Nzegwu, Dooley, 2007) found that 80% of visually impaired people reported difficulty crossing the street, with a number of barriers to mobility reported, including high vehicle speeds, poor and inconsistent driver etiquette, the difficulty of judging oncoming vehicle speed and distance, and inadequate or absence of appropriate crossing facilities. In our study, the visually impaired stakeholders consulted were unanimous in their agreement that street crossings are 'vitally important' in allowing them to get from one side of a road to the other. One visually impaired stakeholder emphasized their importance to successful navigation on foot, suggesting that they would alter their route choice to go via crossings facilities, even if these diversions extended the overall distance travelled. In fact, this is a strategy that was advocated by the rehabilitation officer:

> *"We always stress the importance to the visually impaired person of being prepared to walk that little bit further to a controlled crossing or at the very least, a zebra crossing or an island in the middle. If we are teaching a route to a destination, we would not teach a route without a crossing if there was an option to go via a crossing".*

Street crossings can be divided into two main categories:

- **Formal crossings** are structured crossing facilities, which provide a defined position where pedestrians should cross. These types of crossings come in many forms, and are typically either **controlled** or **uncontrolled**. Controlled crossings (e.g. pelican, puffin and toucan crossings) use traffic and pedestrian signals to communicate which group of road users have right of way on the roadway at a given time and to minimize conflicts between vehicles and pedestrians. These crossings have pedestrian demand units which should be installed with tactile cones to allow visually impaired users to know when the traffic has been signaled to stop (Department for Transport, 2006). Official guidance also suggests that these units should be positioned such that a visually impaired individual can use them whilst facing the traffic (Department for Transport

2002). Uncontrolled crossings (e.g. zebra crossings) involve no control of right of way by pedestrian or traffic signals. Instead, pedestrians and drivers react to each other's presence based on learnt rules regarding who has priority.

- **Informal crossings** (e.g. dropped kerbs, raised crossing areas and pedestrian refuges) are specific kerb or street furniture layouts that are installed to assist pedestrians in crossing the roadway, where the provision of a controlled crossing cannot be justified. The crossing is provided for the benefit of the pedestrian and confers no obligation on the driver to give way to a waiting pedestrian. In many cases, the layout of the area still provides a clear indication to the driver that pedestrians are likely to be crossing in the vicinity.

Few systematic studies exist that consider the preferences of visually impaired people for different crossing types, although preferences can be inferred from a usage survey conducted by Guide Dogs (Nzegwu, Dooley, 2007), in which 43% of individuals never or rarely crossed a road away from a pedestrian crossing facility, compared to 33% who never used a pedestrian crossing without traffic lights, and 23% who never used a pedestrian crossing with traffic lights. These findings are in concurrence with the Department for Transport publication, Manual for Streets (2007), which states that "signalized crossings are preferred by blind or partially sighted people". This was evidenced by our stakeholder group, amongst whom there was general consensus for the provision of formal crossings instead of informal crossings, and more specifically, controlled crossings instead of uncontrolled, zebra crossings. The latter preference was explained by the visually impaired individuals in terms of their ability to control the traffic flow and to minimize uncertainty when using a street crossing facility:

> *"Safety is the top priority at a crossing, however, not far behind that is peace of mind. If you talk to a visually-impaired pedestrian, they would always prefer a controlled crossing because they have much more certainty that the traffic will stop. In comparison, at a zebra crossing you hope the traffic will stop, and it does not always".*

The challenge of the zebra crossing for the visually impaired pedestrian is in achieving confidence that the vehicles have stopped to allow them to cross, without having the support of a designated traffic signal. Multiple stakeholders discussed difficulties in using a zebra crossing due to the inability of visually impaired pedestrians to establish eye contact with the driver and the difficulty of judging the vehicle behaviour effectively. Three stakeholders suggested that zebra crossings are more appropriate in low flow traffic, where it is easier to discriminate between different vehicles in the vicinity of the crossing, and thus identify which are moving and which are stopped at the crossing.

There was no suggestion amongst the stakeholders that uncontrolled, formal crossings could not be used effectively by the visually impaired user, and in fact they would prefer a zebra crossing instead of an informal crossing or the absence of a crossing facility. Furthermore, there was appreciation amongst both sighted and visually impaired stakeholders that it was not always possible to provide the highest specification crossing, and that factors such as traffic flow influenced the type of crossing that was necessary in that area. Nevertheless, the prevailing opinion amongst interviewees was that a controlled crossing offered the highest level of safety and certainty when crossing the street.

The UK Department for Transport recommends that controlled crossings are installed with auditory and tactile cues to assist pedestrians in crossing the road and thus increase the accessibility of these areas to visually impaired pedestrians (1991, 2007). The presence of auditory and tactile cues were seen as beneficial by a number of stakeholders, with problems caused when these were absent or incorrectly installed.

> *"A crossing that is not functioning correctly can be very stressful, for example on a crossing where the audible or tactile signal has failed, you would be very reluctant to use the crossing".*

"There are instances of 'bleeping' sounds being (installed) on multiple crossings in the vicinity of each other, or irregular positioning of the tactile, rotating cone, such that the user has to face away from the traffic to use it. There also many controlled crossing where the rotating cone is not installed".

One type of controlled crossing - the toucan crossing - was not favoured by the visually impaired stakeholders;. This street crossing facility permits pedestrians and cyclists to cross the path of traffic, using two delineated sections of the same path, and a number of visually impaired people explained how they would actively avoid these facilities:

"One other worrying feature is crossings that are shared with cyclists, where cyclists do not have to dismount. It is frightening for visually impaired people who are standing at a crossing when a cyclist arrives at speed beside them".

The initial finding and identification of a street crossing was a task that a number of visually impaired stakeholders also found challenging. Specifically, these individuals stressed the importance of sound cues and correctly installed tactile paving in directing them towards the crossing point. However, discontinuities in the implementation of these guidance cues had the potential to cause confusion, as illustrated by one stakeholder:

"In a lot of areas, the tactile paving is laid incorrectly, and the extension of the tactile cues across to the building line is left out, meaning that you could walk past a crossing without knowing it was there".

These inconsistencies in street crossing design and implementation were identified as barriers to visually impaired people's mobility by all stakeholders. There was a general feeling amongst all stakeholders that the installation of a street crossing facility needs to be considered on a

case-by-case basis, with adequate early consultation of both able and visually impaired pedestrians. There was a degree of concern that that absence of specific guidance regarding the visually impaired pedestrian in documentation such as the Manual for Streets (2007) and Local Transport Notes (1995, 2002, 2008) meant that highway engineers and street planners were often at liberty to be more selective in their provision of crossing facilities for these individuals. One stakeholder noted that different interpretations of the guidance could lead to a crossing being installed that is inappropriate for the location:

> *"There are different levels of road and road context, but the problem is that traffic engineers and planners try to apply regimes that are suitable for one area to other areas that may not be appropriate".*

Two visually impaired stakeholders also expressed concern that there is a lack of awareness of the capabilities of a visually impaired individual, and furthermore a certain amount of ignorance to the different levels of visual impairment:

> *"Local authorities make the assumption that all individuals have some residual sight when considering their provision of crossing facilities. This misperception extends to over-estimating the navigational capabilities of a blind or partially sighted individual using a white cane or guide dog. This may lead to an over-reliance on the provision of colour-contrasted surfaces at the expense of tactile paving. This is evidently a flawed assumption, as many blind people remain mobile, and thus road and road crossing design should cater to all levels of the visual impairment spectrum, including those who can see nothing at all. People with different extents of visual impairment will rely on different cues to decide when it is safe to cross the road".*

It was also noted that sighted and visually impaired people cross the street using different cues to assess the safety of the crossing manoeuvres. It was suggested that road user safety could be improved by training motorists to recognise and understand these differences, whilst instilling visually impaired pedestrians with the necessary knowledge to facilitate consistent and safe road crossing

behaviours. There was also a suggestion that town planners would benefit from more extensive training on the accessibility needs of the visually impaired pedestrian, and what is required for them to successfully use pedestrian environments. These points were particular pertinent in stakeholder discussions of shared space areas.

The UK guideline on shared spaces in urban street environments defines a shared space as "a street or place designed to improve pedestrian movement and comfort by reducing the dominance of motor vehicles and enabling all users to share the space rather than follow the clearly defined rules implied by more conventional designs (DfT, 2011). It is argued that removing the demarcations between pedestrian space and road user space and designing for lower traffic speeds can lead to greater freedom for the pedestrian and greater caution from the motorists, due to increased uncertainty regarding each other's movements (Fyhri, 2012).

The principle of shared space was accepted as an admirable idea by the majority of stakeholders in our study, with attempts to address the balance of power between motorized vehicles, cyclists and pedestrians viewed positively. However, there were a number of concerns about the implementation of these areas amongst the visually impaired stakeholders and their advocates, including:

- An over-focus by shared space designers on the reduction of traffic speeds, with less attention to vehicle flow. Visually impaired stakeholders discussed the difficulties that remain with high traffic flows, even if they are travelling at lower speeds;
- The extension of the shared space concept beyond implementation in low flow residential areas, to its use in busy urban areas and shopping streets;
- The misinterpretation by designers that the implementation of a shared space requires a shared surface. In particular the removal of kerbs results in the absence of a well-established and crucial means for visually impaired people to orient themselves and navigate, in addition to aiding in the identification of a crossing point (e.g. a dropped kerb);
- The over-reliance on eye contact to manage pedestrian-vehicle interactions in shared space;

- The misunderstanding of the capabilities of the visually impaired pedestrian within shared spaces. For example, stakeholders mentioned apparent assumptions that all visually impaired pedestrians had sufficient residual sight to identify that they were in a shared space area, can navigate without kerb delineation of the roadway, and are able to detect vehicle presence, vehicle movement, and their desired crossing start and end points;
- The provision of informal crossings or absence of any crossing facility in shared space. A number of visually impaired stakeholders and their advocates felt that informal crossings were a good idea, yet expressed concern that in some cases they were being applied in areas were the vehicle flow was too high for them to function effectively. Furthermore, anecdotal evidence suggested that the recommended design principles for informal crossings are not being applied consistently. The absence of beige or buff-coloured tactile paving for the assistance of blind and partially sighted pedestrians (Department for Transport, 2007) was mentioned as a particular concern, as it could prevent visually impaired individuals from identifying where these crossing points are. Two visually impaired stakeholders argued that informal crossings were insufficient for their needs and that controlled pedestrian crossings should be available for use in shared space, preferably with audible and tactile signals.

This seems to concur with an earlier survey of 500 visually impaired people (TNS-BMRB, 2010), which revealed that 91% had concerned over using shared surface streets. Of the 61% of respondents who had experienced a shared surface environment, 44% reported actively seeking alternative routes to avoid a shared space area, with a further 18% being reluctant to use the area. In terms of accident rate, 7% of those who had used a shared surface area had been involved in an accident, with a further 42% experiencing a near-miss. Worryingly, 81% felt that their independent mobility would be negatively affected by the introduction of shared surfaces. In fact, this reflects a more general concern amongst our stakeholders that the relatively low number of reported incidents between visually impaired individuals perhaps disguises the underlying impact of such areas on the mobility of these individuals.

5. Conclusions, Conflicts and Co-design

Streets perform a vital role in connecting people and places, and the ways in which they are designed has a big impact on the ways in which they are used – particularly in the case of disabled people. their scale and ubiquity, and the diversity of street uses and user needs, undoubtedly lead to difficulties in trying to achieve a street environment that is accessible to all. Efforts over several decades to raise awareness of disability access issues, and to develop accessible design guidance and practices, have certainly led to improvements. However, as we have illustrated above, many problems remain for disabled people seeking to make use of the streets around them; and this despite there being some clear legal frameworks in place to obligate accessibility.

One challenge for those seeking to improve street accessibility arises where the preferences or requirements of one group of users would appear to be in conflict with the preferences or requirements of others. For instance, issues of pavement width and the presence or lack of well-defined kerbs and tactile paving are specific cases where people with physical mobility impairments and those with visual impairments appear to be at odds with one another. This can apply similarly to visually impaired people using different mobility aids. Whilst working in collaboration with users to co-design interventions within principles of inclusive or universal design would seem like it should offer the opportunity to work through these conflicts, the need to work within the constraints of the built environment itself and, perhaps, the degree to which co-design or inclusive or universal design principles are actually embedded into practice, mitigates against this.

Another challenge for those seeking to improve street accessibility is the decision of where to start and how to prioritise different possible interventions. The strategy adopted by Leeds, to incorporate accessible design into all programmed street refurbishment works and, beyond that, to seek to be user-led by responding to disabled people's incoming requests for street modifications, appears to be an effective one in this regard; it would, by working directly with users in order to arrive at an

agreed solution, also tend toward being collaborative and inclusive in its approach. Consequently, the transformational impact of sometimes relatively minor street modifications, revealed through our interviews is quite remarkable. Challenges remain, however, when it comes to disseminating information regarding the implemented access improvements amongst the wider community of disabled people and in relation to ongoing maintenance issues.

Our work in relation to visually impaired people focused on the act of crossing the street, and clearly highlighted the importance to visually impaired people of facilities to support this; preferably formal, controlled crossings. Whilst it is acknowledged that formal crossing points are not feasible everywhere, our work reveals some lack of awareness amongst those responsible for street design of how visually impaired people, with widely varying degrees of visual impairment, go about crossing the street; in particular, the importance of traffic volume as well as traffic speeds. Furthermore, the importance of formal, controlled crossing points for visually impaired people comes into direct conflict with current moves toward shared space street designs. Whilst there appears to be a reasonable degree of consensus regarding the aims of shared space, the ways in which it is implemented and the implications for visually impaired people, and other vulnerable road users, clearly need to be revisited. Perhaps a more collaborative approach, fostering user-led, co-designed accessible streetscapes offers the best hope of moving toward resolving these conflicts and, in doing so, speeding up the transition to street accessibility for all.

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[i] For respondents' views on the use of wheelchair, see quotes in Imrie (2000:1650): *Most disabled people are short distance walkers and most want to stay out of them [wheelchairs] it's a stigma to have to go into a chair, a real label which everyone can see.]*

[ii] Kirchner et al (2008): *Ensuring that sidewalks and curbs are adequate for wheelchair users is a top target for policy implementation that would likely benefit users of other assistive mobility technologies as well as the population without disabilities.*