UNIVERSITY OF THE WEST OF ENGLAND, BRISTOL

Evaluating the effectiveness of continuous side road crossings

Final Report

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by

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Contents

EXECUTIVE SUMMARY

Introduction

This report summarises research undertaken by the Centre for Transport and Society at the University of the West of England, Bristol (UWE) in relation to the provision of continuous footways across side road junctions as a means for providing enhanced priority and safety for people walking and people cycling. The outcomes from the research will help inform design guidance being developed by Sustrans for continuous footways. A continuous footway, which may also have a continuous cycleway lying adjacent to it, is a way of using design to establish continuous priority for pedestrians and cyclists across a side road.

The research comprises of four parts: observational studies of interactions, collision record analysis, focus groups with road users and key informant interviews. Each of these is discussed in turn, and a final section of describes the implications for the design of continuous side road crossings.

The observations

Ten sites were selected, six in London and one each on Leeds, Nottingham, Southampton and Edinburgh. These sites were selected based on them meeting most clearly a definition of a continuous footway created by design. Two sites had not specific provision for cycle traffic (Clapham and Walthamstow). Of the three with cycle tracks, one had a two-way cycle track (Nottingham), one was a one-way cycle track (Waltham Forest), and one was a one-way cycle track that became an advisory cycle lane at the junction (Southampton). The remaining five sites (Leeds, the Oval, Kingston, Stratford and Edinburgh had a stepped cycle track, which is a cycle track kerb separated from both the carriageway and the footway. The sites were selected from researchers' knowledge, and assistance from social media and key informants.

Video cameras were set up by TRACSIS, the survey partner for the project, and six hours of footage were collected at each location in dry weather. Interactions between carriageway users were defined driver/cyclist proceeds, or not, and footway/cycleway users proceeds or yields. Carriageway users are drivers and cyclists, and footway/cycleway users are people walking and people cycling.

The yields of interest are when people walking or cycling are forced to yield, rather than yielding voluntarily. Of the 4,583 interactions observed, 399, or 8.7% were forced yields. The two other types of yield defined were 'No yield', and were when people walking or cycling did not yield to the driver

or turning cyclist (89.7%). 'Voluntary yield' indicates that the crossing pedestrian or cyclists yielded voluntarily (1.6%). This suggests that in approaching 10% of interactions, people walking or cycling across a continuous footway or cycleway are still either voluntarily yielding, or being forced to yield. However, continuous footways are generally resulting in drivers offering priority to people walking or cycling across the side road. An assessment of the cause of the driver not yielding suggests that it is down to driver behaviour rather than the design of the layout.

The results from the sample of continuous footways in this study suggest a statistically significantly higher proportion of interactions where the driver gives way (91.7%) than in a similar study of seven sites for Transport for London (78.7%), and a further study for Transport for London where interactions at standard side roads were used as a control (58.9%).

As adjudged from the videos, in a majority of cases (89%), it was the action of the driver which caused the yield by the person crossing the side road. There is no relationship between main road flow and the number of forced yields, and neither is there a relationship between the crossing flow and the number of forced yields. A significant relationship has been found between the number of forced yields and the flows turning left in, turning right in and turning right out of the side road. This is unsurprising as the higher the conflicting flows, the higher the number of interactions and hence the higher the potential number of forced yields. There is no evidence from this relationship, however, that continuous footways should not be used above a certain level of turning flow. Design factors should be used to limit the number of forced yields, regardless of whether or not the number of turns is high.

Collision analysis

Data was collected from the collision record for five years before the continuous footway was installed and for as many years as were available for the period after installation. The number of collisions were generally low at all the junctions, and in some cases there were no collisions recorded. There were a total of 42 collisions before at the 10 junctions in a total of 50.3 junction-years and 11 collisions afterwards in 16.9 junction-years. Similarly, considering the 100m of approach carriageway to each junction, the number before were 186 and after were 63. These differences are not statistically significant, and there is little more that can be deduced from the collision data. The tentative conclusion is that continuous footways may not be any more safe, or any less safe than traditional side road crossings.

Road user focus groups

Five online focus groups were conducted and participants were recruited through a variety of channels, including e-mails to personal and professional contacts, and social media (Twitter, Facebook and LinkedIn). We sought to recruit people aged 18+ from all walks of life and especially from the cities and locations near the ten observed junctions. Twenty-six people took part and were cyclists, pedestrians, parents with young children, and other road users including drivers. Twelve participants reported having physical, sensory and learning disabilities or impairments affecting their day-to-day mobility.

The participants suggested the following:

- The use of a distinctive paving material for the footway, ideally in a different colour from the dark tarmac used for the road;
- Slowing down vehicles by raising the level of the footway crossing well above the carriageway;
- Avoiding gradients and obstructions on the footway throughout the crossing, which helps disabled people in particular;
- The use of tactile paving would be counterintuitive and should not be used.
- Actions to explain to local visually impaired people the nature and design of continuous footways may be appropriate.
- The provision of separated and protected cycle tracks rather than cycle lanes;
- The use of unambiguous and well-maintained road markings and colour patterns for the various elements of the crossing (footway, carriageway and cycle track), implemented consistently at local, national and international level;
- Use where traffic speed and flow are already low and where there are one-way systems minimise conflict with vehicles;
- Maximising visibility for all crossing users through enhanced visual contrast with the carriageway and ensuring good visibility splays unobstructed by parking;
- Meaningful and timely engagement with a broad range of road users during design.

Practitioner key informant interviews

Eight key informants were interviewed using a semi-structured interview template. The key informant interviews confirmed a number of design features that enhance the design for pedestrians and cyclists including the following:

- Continuity of kerb line along main road
- No visible radii
- Continuity of mainline road markings
- Vertical upstands to slow traffic
- Continuity of materials and colours
- Continuity of level for footway and cycle track
- Good sight lines and visibility at junctions
- Features to constrain drivers to their route
- A footway as wide as possible
- Design priority for pedestrians and cyclists should be self-evident

Non-design features that make it good for pedestrians and cyclists are as follows:

- Low turning count
- One-way operation of side road
- Reducing traffic volume by area wide traffic management
- Lower flows on the main road
- High numbers of crossing pedestrians and cyclists
- High ratio of non-motorised users to turning vehicles
- Using continuous footways as network transition points
- Uni-directional cycle tracks

Remaining design challenges were identified as being the following:

- Lack of guidance
- Apparent obligation to use tactile paving
- Over complicated junctions
- Poor sight lines and visibility at junctions
- Two-way cycle tracks
- Raised tables creating impression of shared space
- Narrow continuous footways may be ignored by drivers

- Set back hard to achieve
- Avoiding misleading road markings
- Choice of materials

Concerns also exist around the legality of use of some road markings, the legal status of continuous footways, and the ambiguity of turning regulations. There was also contention as to whether marked priority may in fact be better than the inherent 'priority by design' of continuous footways. Other challenges include rationalising the competing needs of different users, high speed and high volume roads with a high volume of turning traffic. There are the issues of the population becoming familiar with new designs and using them appropriately, and also the issue of differences of opinions within the professional community.

Implications for design

There are implications for the design of continuous footways arising from the research. Overall, designs need to aim at creating a situation where the turning vehicle driver does not give way are negligibly small. In circumstance where the driver does not give way, the design should ensure that the vehicle speed has to be low and such that contact between different road users can be avoided by the driver. These conditions can be achieved by the principles of having: distinctive difference in paving material between the carriageway and the continuous footway in all lighting and weather conditions; ensuring distinctive height difference across the whole continuous footway that is not compromised by the effects of longfall and crossfall; clear separation of cycleways from footways; ensuring well maintained and unambiguous road markings; having radii and height difference that create low motor vehicle speeds; maximising inter-visibility between all road users.

Specific design features include: continuity of kerb line along main road; no visible radii; continuity of mainline road markings; vertical upstands to slow traffic; continuity of materials and colours that are different for the different areas within the scheme (footway, cycle tracks and carriageway); having a wide continuous footway and cycleway extending at least from the main road kerb line to the building line.

Continuous footways will work best where some or all of the following are true: there are higher pedestrian and cycle flows; low vehicle turning counts; possibly lower flows on the main road; for outward turning movements from the side road (on both two-way and one-way out operation); for inward turning flows to the side road where there are mitigating factors; uni-directional cycle tracks;

and reducing traffic movements at the junction by area wide traffic management. There are interactions between the factors, for example, as turning counts rise, high numbers of crossing movements help the good functioning of the junction from the perspective of the road user who is crossing the side road. At junctions with high volumes of crossing movements, drivers exiting the side road were cautious, at other junctions high turning volumes are not mitigated by large enough numbers crossing.

More examples of good practice continuous footways should be constructed to enable further study of the which design factors and flow patterns work best.

1 INTRODUCTION

Sustrans Scotland is working on a rolling programme of research in relation to provision for people walking, cycling and wheeling, funded by Transport Scotland. This report summarises the research undertaken by the Centre for Transport and Society at the University of the West of England, Bristol (UWE) in relation to the provision of continuous footways across side road junctions as a means for providing enhanced priority and safety for people walking and people cycling. Continuous footways are called variously: access ramp, Copenhagen crossing, blended crossing, continuous pavement, or footway crossovers. A continuous footway, which may also have a continuous cycleway lying adjacent to it, is a way of using design to establish continuous priority for pedestrians and cyclists across a side road.

The aims and objectives of the wider programme are to identify design safety risks in order to:

- Incorporate good practice into guidance, regulation or legislation, including the update of the Scottish document 'Cycling by Design'; and
- Assist local authorities and Transport Scotland to deliver designs more likely to achieve the Scottish Government's Active Scotland Outcomes Framework (Scottish Government, 2017).

Priority junctions (or 'yield', or 'give way' or 'T-junctions') are the most ubiquitous type of junction, and two thirds of all collisions in urban contexts occur at junctions (Department for Transport, 2017). Priority junctions therefore need to be a focus for design development. The purpose of the research being carried out is to identify the factors that improve the effectiveness of continuous side road crossings to inform future guidance and implementation.

UWE has reported progress on the research in two reports. In the Phase 1 report, UWE investigated, by means of a literature review and by identifying case studies, the actual safety risk, perceived safety risk and convenience to all users of different crossing configurations at comparable priority junctions in UK cities (including Scottish examples). The Phase 1 report also made recommendations for a methodology to be adopted for the study.

In the Phase 2 report, UWE further developed the methodology for the full study and this comprises of observational studies of junctions, a descriptive analysis of the collisions at these junctions in the

collision record, a series of focus groups with road users, and key informant interviews with leading edge designers.

This final report presents the findings from the study. Section 2 presents the observational studies, Section 3 the collision investigation, Section 4 the focus groups and Section 5 the key informant interviews. Section 6 draws conclusions.

2 OBSERVATIONAL STUDIES

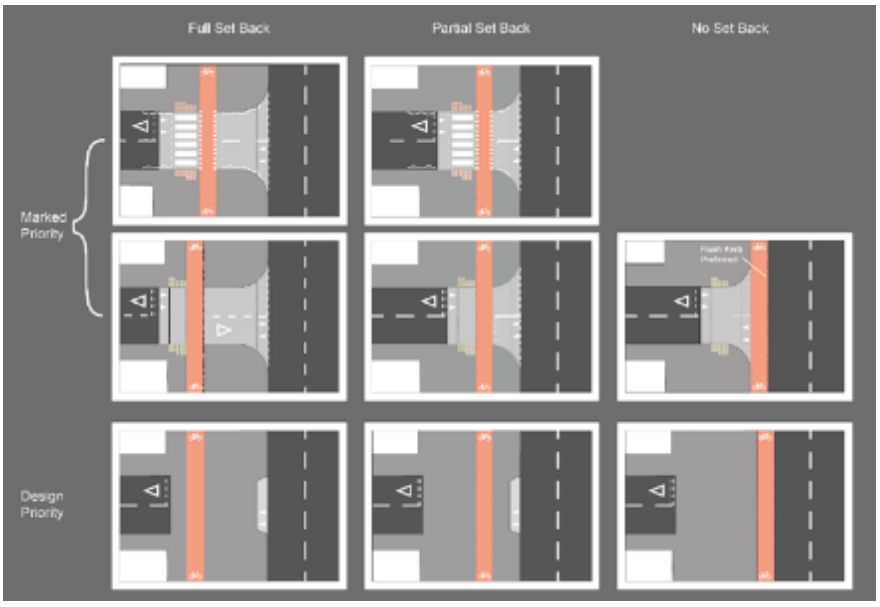
The study is primarily concerned with the interactions and safety of road users at side road crossings where there is a continuous footway. This chapter deals with the identification and categorisation of interactions, and their nature. Section 2.1 summarises the junctions that were selected as part of Phase 2 of the work, and Section 2.2 summarises the methodology adopted in the observational study.

Section 2.3 summarises turning volumes at the junctions as revealed from the observational studies to provide background context to the observations. Section 2.4 presents an analysis of the interactions, and focuses in particular on what have been termed 'forced yields', which is where a road user crossing the side road yielded, but had no choice other than to yield, because the turning vehicle took priority.

2.1 Site selection

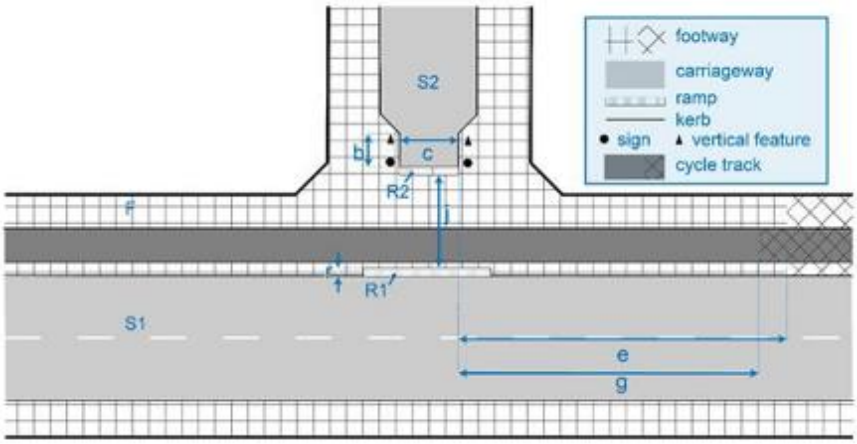
Continuous priority for the footway and cycles is priority created by design. This is different from priority created by marked priority, and as illustrated in Figure 2.1, which taken from the Department of Transport's Local Transport Note, LTN 1/20. This replaces LTN 2/08 Cycle Infrastructure Design.

Figure 2.1 Continuous pedestrian and cycle crossing marked priorities at side roads



The sort of 'priority by design' that is envisaged is illustrated in forthcoming Sustrans guidance as shown in Figure 2.2.

Figure 2.2 Continuous priority for the footway and cycle track



While there are no sites in the UK that have been designed to this guidance as yet, there are a number of sites which have the characteristics of continuous footways. Using the researchers' knowledge, and after using social media and the knowledge of leading designers in the field, a number of sites were identified as having the characteristics of continuous footways. Sites that most closely offer priority as per Figure 2.1, or most closely resemble the design proposed in Figure 2.2 have been assessed against five domains (informed by Weetman, 2018):

1. Characteristics of the continuous footway,
2. Characteristics of the cycle provision,
3. Characteristics of the side road from the mainline carriageway,
4. Characteristics of the side road exit,
5. Characteristics of the network.

Ten sites for the observational study were selected that have priority for both those using the footway and those using a cycle track across a side road (or, in two cases, an advisory cycle lane). Table 2.1 lists the locations of the selected junctions. The Phase 2 report provides more detail on the process of selection.

Table 2.1 Continuous footways and cycle tracks across side road junctions selected for study

Location	Designation	Comments	
Leeds Woodside Ave/Kirstall Rd	Site 1	Simple design with continuation of colour/material for footway and stepped cycle track. Continuation of line markings on carriageway. Part of wider network with similar treatment of side roads. Lack of narrowing of side road or parking restrictions leads to parking next to footway, impeding visibility.	
Oval, London, Magee St/ Kennington Park Rd	Site 2	Continuation of colour/material for footway and stepped cycle track, and of line markings on carriageway. Exit left turning traffic only, except bikes.	
Kingston, London, Grove Cres. / Penrhyn Rd*	Site 3	Continuation of colour/material for footway and stepped cycle track. Ramp back to carriageway. Part of wider network. Exit only.	
Stratford, London, West Ham Ln/Broadway	Site 4	Continuation of colour/material for stepped cycle track, and of line markings on carriageway. Lack of continuity of materials/design for footway. Clear kerb indicating side road.	
Nottingham, Coleby Ave/Abbey Bridge	Site 5	Continuation of footway, two-way cycle track and road markings across side road. Cycle track colour change highlighting crossing of side road.	
Edinburgh, Middlefield/ Leith Walk	Site 6	Continuation of material and colour for footway and stepped cycle track. Kerb radii indicating side road and road markings turn into side road.	
Southampton, Paddwell Rd/Middle Avenue*	Site 7	Continuation of kerb on footway across side road. Lack of continuity of materials/design for footway. Cycle track becomes advisory cycle lane across side road. Right turn in flow is via a give way in the median island of a dual carriageway.	
Leyton, London, Seymour Rd/ Lea Bridge Rd	Site 8	Continuation of kerb and cycle track across side road. Lack of continuity of materials/design for footway gives ambiguous shared space feel. Lack of continuation of road markings across side road on carriageway.	
Walthamstow London, Hatherley Rd/ Hoe St	Site 9	Continuation of kerb and footway across side road. Lack of continuity of materials/design of footway/on-carriageway road markings across side road.	
Clapham, London, Grafton Sq./ Old Town	Site 10	Clear continuation of footway across side road. Clear kerb radii indicating side road and road markings turn into side road.	

Note. The link in the title in the first column is to the Google Map image. An asterisk denotes that Google Maps image is out of date.

Table 1.2 provides an assessment of each of the junctions in Table 1.1 against the five Weetman characteristics.

Table 1.2 – Assessment of selected junctions against the five docharacteristics

Characteristics	Selected Junctions (Sites)									
	1	2	3	4	5	6	7	8	9	10
Characteristics of continuous footway										
Same colour/design/material as rest of footway in street	x	x	x		x	x				x
Treatment across side road looks like shared space								x		
Visible kerb/markings across footway demarking carriageway				x						
Change in level across the side road	x				x			x		
Deviation from pedestrian desire line			x							
Characteristics of cycle provision										
Continuous cycle track	x	x	x	x	x	x	x	x		
Same colour/material as rest of track in street	x	x	x	x		x	x	x		
Change in level across the side road	x		x							
Uni-directional	x	x		x		x	x	x	x	x
Bi-directional			x		x					
Advisory cycle lane									x	x
Characteristics of side road from mainline carriageway										
Carriageway markings continue across side road	x	x		x	x					
Corner radii				x		x				x
Additional markings such as cycle symbols	x	x	x		x	x	x	x	x	x
Give way road markings										
Speed hump triangles						x				
Short distinct ramp			x	x		x	x			
Carriageway flush with cycle track							x	x	x	x
Step from cycle track to footway	x	x		x	x	x	x			
Two-way movements permitted	x			x	x		x		x	x
Two-way simultaneous movements possible	x			x	x		x		x	x
Out only permitted		x	x							
Transition to a more minor street designed for lower speeds	x	x	x	x	x	x	x	x	x	x
Characteristics of side road exit										
N/A						x		x		
Give way road markings/signs	x	x		x	x		x		x	x
Speed hump triangles		x	x				x		x	x
Short distinct ramp		x	x	x			x		x	x
Step from footway to cycle track	x	x		x	x		x			
Good visibility of footway/cycle track/mainline carriageway	x	x		x	x					
Characteristic of network										
10+ adjacent junctions have similar treatments	x				x			x	x	
5-9 adjacent junctions have similar treatments							x			
2-4 adjacent junctions have similar treatments										x

2.2 Methodology

Observational studies were carried out using video footage. This was undertaken with the survey partner, TRACSIS Traffic Data Ltd, using their 'Felicity' Artificial Intelligence Software.

Video cameras were set up by TRACSIS at the selected junctions as per the schedule in Table 2.3*Error! Reference source not found.*. Six hours of footage were collected at each location in dry weather. Owing to observations taking place on two different days and at a variety of longitudes and latitudes, times were adjusted marginally to achieve comparable periods of daylight at each location. The three time periods were chosen to cover morning peak, interpeak and evening peak traffic. Weekdays were chosen when local schools and universities were in session:

- Morning times began at the start of civil twilight[i] and lasted for two hours, which covered the peak hour from 8am to 9am, the school run and at least an hour after sunrise
- The interpeak observations were the same time at each location, lasted for two hours, included the time when the sun was highest and were in full daylight
- Evening times began 40 minutes before civil twilight ended, which coincided with the approximate time of sunset, lasted for two hours, covered the peak hour from 5pm to 6pm and at least an hour of darkness

Table 2.3 - Survey times and dates by location

Location/date	AM peak	Interpeak	PM peak	Civil twilight
Edinburgh, 28/1/20	07h33-09h33	11h00-13h00	16h38-18h38	07h33-17h18
Leeds, 21/1/20	07h29-09h29	11h00-13h00	16h25-18h25	07h29-17h05
Nottingham, 28/1/20	07h16-09h16	11h00-13h00	16h38-18h38	07h16-17h18
London (x6), 21/1/20	07h16-09h16	11h00-13h00	16h27-18h27	07h16-17h07
Southampton,21/1/20	07h19-09h19	11h00-13h00	16h34-18h34	07h19-17h14

Three cameras were used per site and positioned as per the site diagrams in Appendix A. An example of a still taken from the video is shown in Figure 2.3.

[i] Civil twilight is the period after sunset or before sunrise ending or beginning when the sun is about 6 degrees below the horizon and during which on clear days there is enough light for ordinary outdoor occupations

Figure 2.3 – Turning vehicle yielding to crossing pedestrian, Nottingham (Site 5)

Types of interaction were categorised, and each one falls into one of 48 categories as shown in Table 2.3**Error! Reference source not found.**.

Table 2.3 Interaction categories

Carriageway user behaviours	Footway/cycletrack user behaviours			
1 - driver proceeds forward	1 - pedestrian yields	2a – pedestrian continues to cross in front 2b - pedestrian continues to cross behind	3 - cyclist yields	4a - cyclist continues to cross in front 4b cyclist continues to cross behind
2a - driver stops 2b driver stops on footway 2c driver stops on cycle track/lane	1 - pedestrian yields	2a – pedestrian continues to cross in front 2b - pedestrian continues to cross behind	3 - cyclist yields	4a - cyclist continues to cross in front 4b cyclist continues to cross behind
3 - cyclist proceeds forward	1 - pedestrian yields	2a – pedestrian continues to cross in front 2b - pedestrian continues to cross behind	3 - cyclist yields	4a - cyclist continues to cross in front 4b cyclist continues to cross behind
4a - cyclist stops 4b cyclist stops on footway 4c cyclist stops on cycle track/lane	1 - pedestrian yields	2a – pedestrian continues to cross in front 2b - pedestrian continues to cross behind	3 - cyclist yields	4a - cyclist continues to cross in front 4b cyclist continues to cross behind

Time stamps were recorded for every interaction so that more detailed analysis could be carried out. As part of the analysis the questions listed below were addressed. Examination of the detailed video footage was particularly useful for checking out times when people walking and people cycling yielded to turning vehicles and determining when they ceded priority and when it was taken from them.

2.3 Turning movement volumes by time of day

Table 2.4 provides data on the turning volumes at each junction.

Table 2.4 Peak hour flows at each junction

Location	Designation	Pedestrian flow	Cycle flow	Vehicle Turns (in and out)	Vehicle two-way main road flow
Leeds, Woodside Ave/Kirstall Rd	Site 1	60	70	16	1500
Oval, London, Magee St/ Kennington Pk Rd	Site 2	270	1700	75	4000
Kingston, London, Grove Cs./Penrhyn Rd	Site 3**Error! Reference source not found.**	550	10	95	750
Stratford, London, W Ham Ln/Broadway	Site 4	190	145	16	1440
Nottingham, Coleby Ave/Abbey Bridge	Site 5	70	85	19	1400
Edinburgh, Middlefield/Leith Wk	Site 6	680	25	30	1000
So'ton, Paddwell Rd/Middle Ave	Site 7	70	56	470	680
Leyton, Ldn, Seymour Rd/ Lea Bridge Rd	Site 8	160	200	60	1400
Walthamstow Ldn, Hatherley Rd/ Hoe St	Site 9	755	60	50	1400
Clapham, London, Grafton Sq./ Old Tn	Site 10	340	80	50	710

Note: data for Southampton main road flow is one-way and for the side of the dual carriageway nearest the side road

The volume of crossing pedestrians varied from 60 to 755 pedestrians in the peak hour. That is a significant variation and range from 1 per minute to one every five seconds. Similarly, there was a large variation in cycle flow from 25 to 1700 at the busiest cycle junction on the A3 at the Oval in London (site 2). Most sites had a modest amount of turning traffic in the range up to 95 per hour. However, Paddwell Road in Southampton (site 7) had a turning volume of 470 in the hour. The two-way main road flows were relatively consistent at between 1,000 and 4,000 vehicles per hour, but two sites (Kingston and Clapham) had flows of less than 1,000 per hour.

2.4 Analysis of the interactions

Interactions have been defined as the intersection of the path of a vehicle turning in or out of the side road with the path of a person walking or cycling across the side road. A yield is defined as an interaction where the person crossing the side road had to give way to a vehicle turning into or out of the side road, while 'Forced yield' indicates that the people walking or cycling yielded, but had no choice other than to yield, because the turning vehicle took priority.

Tracsis, the fieldwork contractor, undertook initial analysis of the video data in order to identify the total number of interactions taking place at the junctions. In addition, further and much more detailed analysis was undertaken by UWE of a sub-set of these interactions, which had been time stamped by TRACIS. These interactions are fully defined by a combination of the behaviour of the carriageway user (drivers and cyclists) and, separately, the behaviour of the footway user (people walking or cycling), and as already described in Table 2.3. UWE analysed the subset of interactions where there was a yield, plus a nominal set of others for comparison purposes.

It should be noted that 'Forced yields' would logically occur with the presence of a turning vehicle. There is one exception to this (the junction at London Stratford) where there were pedestrians turning into or out of the side road in the footway crossing the cycle track.

The following list of questions were adopted in informing the data extraction from the videos.

1. Do people using the footway or people using the cycle track/lane ever stop or hesitate before crossing the side road with no turning traffic?
    a. If yes, describe
    b. What seems to be causing this (design feature, characteristic[ii] of user, or other)?
    c. Any difference when approaching from either direction (where permitted)?
2. Do people using the footway or people using the cycle track/lane ever yield for turning traffic?
    a. If yes, describe
    b. What seems to be causing this (design feature, characteristic of user, or other)?
    c. Any difference when approaching from either direction (where permitted)?
3. Does turning traffic ever not yield to people crossing using the footway or cycle lane?
    a. If yes, describe and when it does yield does the vehicle slow down to walking speed in advance of the turn, or does it yield at the last minute?
    b. What seems to be causing this (design feature, characteristic of user, or other)?
    c. Any difference when turning in or out (where permitted)?
    d. Any difference turning left or right (where permitted)
    e. Any difference if foot/cycle traffic approaches from right (when turning in) or left (when turning out)?
4. Do drivers in turning vehicles ever not look in both directions before proceeding?
    a. If yes, describe
    b. Any difference when turning in or out (where permitted)?
    c. Any difference turning left or right (where permitted)

[ii] Characteristics might include independent children, stature, mode (foot, wheelchair, etc) or visual impairment (using white cane or dog)

5. When yielding do turning vehicles wait across the footway or cycle track/lane?
    a. If yes, describe, including how many people on the footway or cycle track are obstructed and what are there characteristics?
    b. What seems to be causing this (design feature or other)?
    c. Any difference when turning in/out (where permitted)?
    d. Any difference turning left or right (where permitted)
    e. Any difference by direction of approach from people using the footway or cycle track/lane?
    f. Do turning vehicles make a double movement or single movement (i.e. do they wait before the footway and then again before the carriageway when turning out, or do they wait in one or the other)?
6. Does turning traffic affect mainline traffic and if yes, describe?
7. Did anyone make a non-authorised manoeuvre?
    a. If yes, describe
    b. What seems to be causing this (design feature, characteristic of user or other)?

The data were extracted into a spreadsheet for each interaction observed.

Table 2.5 summarises the total number of interactions identified by Tracsis and their nature in terms of whether people walking or cycling crossing the side road yielded to drivers turning into the side road.

Table 2.5 Summary of interactions in terms of the nature of the pedestrian and cyclist yield.

Site	No yield by person crossing road	Voluntary yield by person crossing road	Forced yield by person crossing road	Percentage of no yield and voluntary yield by the person crossing	Percentage forced yield	Total
Leeds (1)	28	1	0	100.0%	0.0%	29
London, Oval (2)	1018	2	5	99.5%	0.5%	1025
London, Kingston (3)	1254	4	14	98.9%	1.1%	1272
London, Stratford (4)	194	2	10	95.1%	4.9%	206
Nottingham (5)	28	1	1	96.7%	3.3%	30
Edinburgh (6)	47	7	32	62.8%	37.2%	86
Southampton (7)	213	35	132	65.3%	34.7%	380
London, Leyton (8)	64	6	33	68.0%	32.0%	103
Walthamstow (9)	1119	9	133	89.5%	10.5%	1261
London, Clapham (10)	144	8	39	79.6%	20.4%	191
Total	4109	75	399			4583
Percentage	89.7%	1.6%	8.7%			100.00%

Note: recall that 'Forced yield' indicates that the people walking or cycling yielded, but had no choice other than to yield, because the turning vehicle took priority

Of the 4,583 interactions, the majority (89.7%) did not require the person crossing to yield. There were also a fairly small number of other instances where it was possible for the person crossing to take priority, but they voluntarily yielded to the driver turning into or out of the side road (1.6%). Taking these together, and changing the perspective to that of the driver, priority was offered in 91.3% of interactions. There are four of the ten sites where, by contrast, there were quite high proportions of interactions where the person crossing was forced to yield: Edinburgh (37.2%), Southampton (34.7%), London Leyton (32.0%) and London Clapham (20.4%)..

The study did not include controls, i.e. junctions where the layout does not include a continuous footway or cycleway. However, Wood et al. (2006) undertook a study of raised side entry treatment for Transport for London. None of these treatments can be classified as continuous footways: some may have had the kerb line continuing from the main road to the side road, and have the presence of tactile paving, for example. They undertook observational studies at eight sites with three controls. They took the perspective of the driver and analysed the number of times the driver yielded (which is slightly different from the approach taken above, which takes the perspective of

the road user crossing the road, and considers when they were required to yield as a result of driver behaviour).

Out of 633 interactions at junctions with various forms of side road treatment, they found that drivers yielded in 56% of cases. At the control sites, there were 263 interactions and 59% of drivers gave way. At the control sites, the movement with the lowest proportion of drivers giving way (28%) was the right turn into the side road, but these were all concentrated at one of the three control sites (Green Man Lane, a short road leading to shopping car parks off the A4020 Broadway in Ealing). For the other three drivers' movements, the proportion who yielded varied from 61% to 74%.

Their analysis also considered interactions where 'pedestrians appeared to force drivers to give way' (the opposite of our definition of forced yield, where the pedestrian is forced to yield by the driver). They found this proportion of driver yields was 5%.

Steer Davies Gleave (2018) undertook research for Transport for London on continuous footways at seven sites as follows Magee Street / Kennington Park Road (site 2 in current study); Clapham Old Road / Lydon Road; Clapham Old Town / Grafton Square (North of Scout Lane – site 10 in current study); Clapham Old Town / Grafton Square (South of Polygon); Coldharbour Lane / Cambria Road; The Pavement / Bromells Road; Upper Tooting Road / Stapleton Road. They report that in 3,537 interactions with pedestrians, drivers gave way in some form or another 77.5% of occasions, and for the 260 interactions with cyclists, drivers gave way on 95.3% of occasions. Pooling the pedestrian and cycle data gives a proportion of 78.7% of drivers giving way out of a total of 3.797 interactions.

In summary, we found the mean proportion for interactions where the road user crossing the side road could take priority was 91.7%, with a range of 62.8% to virtually 100% across the sample junctions. This compares with the Steer Davies Gleave study with mean percentages where pedestrians took priory of 77.5%, and cyclists 95.3% for cyclists. Using control data from Wood et al., the proportion of drivers giving way was 59%. The results from the sample of continuous footways in this study suggest a higher proportion of interactions where the driver gives way, and this is statistically significantly different from the Steer Davies Gleave data ($\chi^2(1) = 258, p < 0.00001$), and the control data ($\chi^2(1) = 254, p < 0.00001$).Table 2.6 shows a breakdown of the nature of the pedestrian or wheeled vehicle user depending on whether the yield was voluntary (75 from Table 2.5 above) or forced (the 399 from Table 2.5 above). The majority of yields were by people walking, and this reflects the fact there are more people walking at most of these side road junctions than people cycling (there was a total of 14,063 crossing pedestrians and 5,825 crossing cyclists). As

a proportion, pedestrians were forced to yield more frequently (373/14,063, 2.7%) as compared with wheeled users (26/5,825, 0.4%)

Table 2.6 Nature of the yield given by pedestrians and cyclists

	Pedestrian			Wheeled users				Overall Total
	Alone	With encumbrance	Total	Skateboard / e- or kick-scooter	Wheelchair / mobility scooter	Cycle	Total	
Voluntary yield	64	6	70	0	1	4	5	75
Forced yield	336	37	373	6	3	17	26	399
Total	400	43	443	6	4	21	31	474

Notes:

1. *Pedestrian encumbrances were either dogs, buggies, a baby, a cycle, or a combination of those.*
2. *Five of the forced yields of pedestrians were runners*

Note that the number of instances where the pedestrian was crossing with an encumbrance was small (roundly 10%). Cyclists make up around two-thirds of people using some form of human or electric assist wheeled vehicle.

Table 2.7 shows the breakdown of people who walked or cycled in front or behind the vehicle that was giving way to them. These data are based on the total sample of 4,583 interactions. Table 2.8 shows the split in relation to whether vehicles were turning into or out of the side road, and whether they were turning left or right. The data in Table 2.8 are based on the smaller sample of more detailed analysis undertaken by UWE, and hence the total of 1549 is lower than the total above 4109.

Table 2.7 Routeing of crossing pedestrian or cyclist relative to the yielding vehicle

	Pedestrian	Cyclist	Total
Crossed in front of vehicle giving way	1146	1108	2254
Crossed behind vehicle giving way	1820	35	1855
Total	2970	1143	4109

Table 2.8 Numbers crossing in front and behind the vehicle turning

		Vehicle turning in left	Vehicle turning in right	Vehicle turning out left	Vehicle turning out right	Total
In front	Pedestrian	69	47	232	29	377
	Cyclist	19	30	841	18	908
Behind	Pedestrian	10	11	189	45	255
	Cyclist	0	1	8	0	9
Total		98	89	1270	92	1549

Note that not all the interactions were viewed in detail hence the lower total number in Table 2.8 as compared with the total number in Table 2.7. The higher number in Table 2.7 is for all interactions determined from the TRACIS analysis.

The reason that many people walked or cycled behind the vehicle giving way was due to where turning vehicle stopped when turning onto the main carriageway. Junction designed varied, but in most of these cases this occurred when a vehicle turning onto the main road carriageway was stopped across the cycle track.

The majority of turns were out of the side road to the left, and the majority of the passing manoeuvres by the person crossing the side road were in front of the vehicle. For the other cases, again the majority of the passing by the person on the side road was in front of the turning vehicle, with the exception of the turn out to the right. In this case, it may well be that the driver has moved their vehicle partway into the nearside lane to 'force' a gap in the oncoming traffic in the lane which the driver will be joining. In this case, it is not too surprising that the person on the side road will frequently cross behind the turning vehicle.

Attention now turns more specifically to the cases where there was yielding by the people who were walking or cycling to see whether there are specific reasons linked within the design, or the circumstances. Table 2.5 has shown the breakdown of 'yield' to 'no yield' at each of the ten test sites. The contingency coefficient (=0.415, $p<0.0005$) suggests there is a moderate relationship between the site and the yield type. Hence, this suggests there are differences between junctions in terms of their nature which may be creating different patterns of yielding.

Edinburgh, Southampton and London Leyton (sites 6, 7 and 8) are the sites with the highest proportion of interactions leading to a yield by the people who were walking or cycling (between 38% and 45%). Other sites with relatively high proportions are sites 9 and 10, London Walthamstow and London Clapham (11% to 25%).

Thinking now turns to more specific issues relating to each junction. Table 2.9 summarises the causes, as adjudged from the video, that are causing the yielding behaviour.

Table 2.9 Causes of yielding behaviour by people walking and cycling

	No yield	Voluntary yield	Forced yield	Total
Design		5	4	9
Characteristic		18	6	24
Driver action	1	13	379	393
Other / no coded		10	4	14
	1	46	393	440

Note: recall that 'Forced yield' indicates that the people walking or cycling yielded, but had no choice other than to yield, because the turning vehicle took priority

There were a number of design features that differed across the 10 sites. Some of these features have been attributed in Table 2.9 to someone walking or cycling yielding to turning vehicles. Design features also contributed to driver actions in some cases. Listed below are some of the design features that appeared during the observations to either cause people walking and cycling to yield or to cause turning drivers to force a yield:

- Site 1 (Leeds) is the only one with a turn right pocket – the absence of this at some other sites like Nottingham and Edinburgh (5 and 6), combined with similarly busy main roads, caused drivers to accept a gap in the on-coming traffic without also verifying that there was no-one crossing the side road on foot or cycle
- Sites 2 and 3 (Oval and Kingston) were both one way out only, which reduces the number of pedestrian and cyclist yields, and, as seen across all of the junctions, turn out movements are less likely to cause yields than turn in movements, with movements turning right in being the manoeuvre most likely to cause people crossing to yield.
- Site 3 additionally had a sufficiently wide footway that even when an existing vehicle was waiting for a gap in the mainline traffic, crossing pedestrians felt confident to cross behind, still on the footway, taking priority over the next vehicle waiting to turn out; by contrast although Leyton and Clapham (sites 8 and 10) also had deep footways at the junctions, because they were two-way people crossing behind a vehicle on the footway would also be wary that a vehicle could also turn in from the main road and they would be obscured.
- Site 7 (Southampton) was a more unusual arrangement than the other junctions as the main road was a dual carriageway with the right turn into the side road being facilitated via

a short section of access road across the wide central reservation with a give way marked at the point where is crosses the nearside two-lanes. At some points in the day, queues formed to make this movement as vehicles waited to cross two lanes of fast moving traffic, and when a gap appeared drivers took the opportunity to accept the gap, often ignoring the presence of someone crossing on foot or cycle.

- Sites 6 and 8 (Edinburgh and Leyton) have bus lanes just prior to junctions which caused some drivers to turn in left at speed from the non-nearside lane, rather than moving over to the nearside lane, which was observed to cause some of the more risky looking forced yields, when pedestrians took a step backwards when they saw the turning vehicle

Note that causes have only be provided for 9.6% of the total number of interactions. They were coded when the cause seemed clear from observation of interactions when yields took place. Driver (or cyclist action) as a cause was the easiest to identify. This is when the driver/cyclist blatantly forced a yield without any other obvious external reason. Characteristic referred to something observable in the pedestrian or cyclist that contributed to or caused a yield (for example being preoccupied with something such as a phone, a child or a conversation with a friend, walking in an erratic or unpredictable manner so that their crossing intention was not clear). Design as a cause was when a design feature in the junction contributed to or caused a yield (or example the original dropped kerbs at the Southampton junction (site 7) which were slightly offset had been left when the continuous footway was installed – some pedestrians ignored the continuous footway and turned down the side road to the drops causing a yield).

It is clear that in a majority of cases (89%), it was the action of the driver which caused the yield by the person crossing the side road. Speed could be a mediating factor in this regard. However, of the 385 (out of the 393) cases where there was a driver action fault and a speed coding was allocated, the speed was determined as being 'high' in 97 cases, i.e. 25% of cases. The coding of 'high', 'medium' and 'low' for speed are subjective and based on the researcher's observation of the speed relative to the manoeuvre being undertaken.

A further demonstration of the severity of the nature of the interaction is based on the reaction of the person crossing. Table 2.10 presents a cross-tabulation of the reaction to the type of yield.

Table 2.10 Reaction of person crossing in relation to the yield type

	No yield by the person crossing	Voluntary yield by the person crossing	Forced yield by the person crossing	Total
Recoils / steps back	0	0	2	2
Turns head to vehicle	1	1	4	6
Stops short of kerbline	0	3	19	22
Acknowledges yield and proceeds	2	11	0	13
Adjusts route and proceeds behind vehicles	0	0	15	15
Cyclist going wrong way	0	1	1	2
Walks on the spot	0	0	4	4
Acknowledges yield but waves vehicle on	0	1	0	1
Adjusts route and proceeds in front of vehicle	0	0	1	1
Uses pre-existing dropped kerb	1	4	0	5
Crosses when others do	0	5	0	5
Adjusts route proceeds in front and acknowledges	0	0	1	1
	4	26	47	77

In only 77 cases was a discernible reaction able to be determined. The main types of reaction are an acknowledgement provided to the driver when the pedestrian voluntarily yielded, and this was presumably usually in response to an (unseen on the video) acknowledgement provided by the driver. In forced yields, people crossing either stopped short of where the kerb line would have been, or adjusted their route and proceeded behind the vehicle.

Thinking now in relation to the behaviour of the driver, Table 2.11 summarises the nature of the turn in relation to the type of yield.

Table 2.11 Nature of the turn in relation to the yield type

	No yield by the person crossing	Voluntary yield by the person crossing	Forced yield by the person crossing	Total
Turns from non-nearside lane	5	7	28	40
Illegal manoeuvre	11	2	2	15
Multiple stops at cycle track and footway	1	3	5	9
Forces yield on main road	0	1	7	8
Changes from RT to LT after delay	0	0	2	2
Crosses cycle track and footway before turning	0	2	2	4
Turns to cross carriageway and cycle track	0	0	3	3
Turning across moving traffic, waiting for gap in traffic not on continuous crossing	0	0	28	28
Waits in filter lane before turning	0	7	2	9
Turns from carriageway into cycle track/lane	0	0	1	1
Total	17	22	80	119

There is a high incident of illegal manoeuvres by the driver being linked with the situation when a person crossing the side road did not yield. Types of illegal manoeuvre included the following: going the wrong way up a one-way street and making a banned turn. It should be noted that these illegal manoeuvres are not linked with directly with the fact that a continuous footway was present and are a result of the nature of the traffic management of the local street network. The main reasons linked with a voluntary yield relate to drivers not being in the nearside lane, in some circumstances because that lane is for example a bus lane, or because where there is a break in a bus lane to allow vehicles to pull into the nearside lane to make a left turn. Most instances when the person crossing the side road is forced to yield are linked with two circumstances as follows: a) where drivers are turning left into the side road from the nearside lane, and where a driver is turning right in to the side road across approaching traffic and they are waiting for gap in that traffic in order to start to make the turn.

An analysis has been undertaken of the interactions where the person crossing was forced to yield relative to the crossing flow, the turning flow and the main road flow. This was undertaken by identifying the flows in 15-minute periods relative to the number of forced yields in that 15 minute period for all the junctions combined. No association was found for the number of forced yields with either the crossing flow or the main road flow. A strong correlation (0.678) was found for the total

turning flow (left in, right in, left out and right out) and the number of forced yields. This was explored in more depth and Figure 2.4 shows four scatter plots for each of the turning flows relative to the number of yields.

The correlations for the left turn in, right turn in, left turn out and right turn out respectively are 0.600, 0.702, 0.490, 0.200. This hence suggests a strong relationship between for flows turning in and people crossing on the continuous footway being forced to yield. The relationship for those turning left out is moderate and for those turning right out is weak.

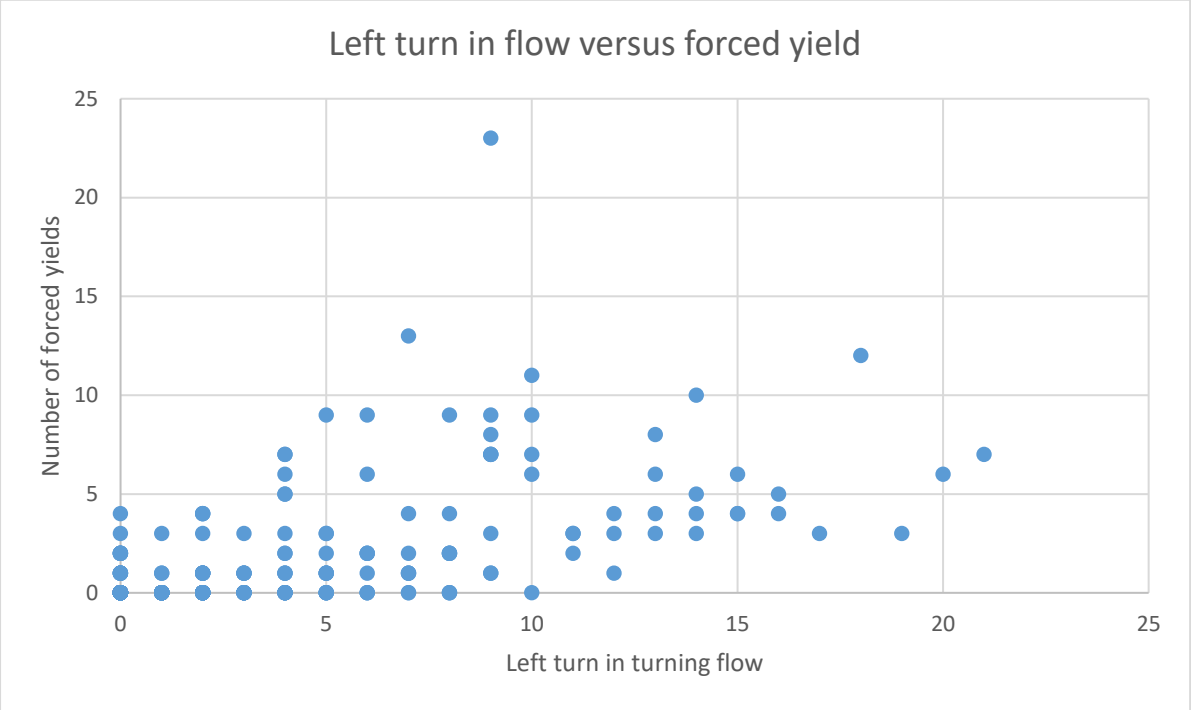
It should be noted, however, that there could be some confounding present in these correlations as a result for, for example, possibly higher left turn out and higher left turn in flows being present at some junction, leading to a high correlation for the left turn out being in fact as a result of the left turn in flow.

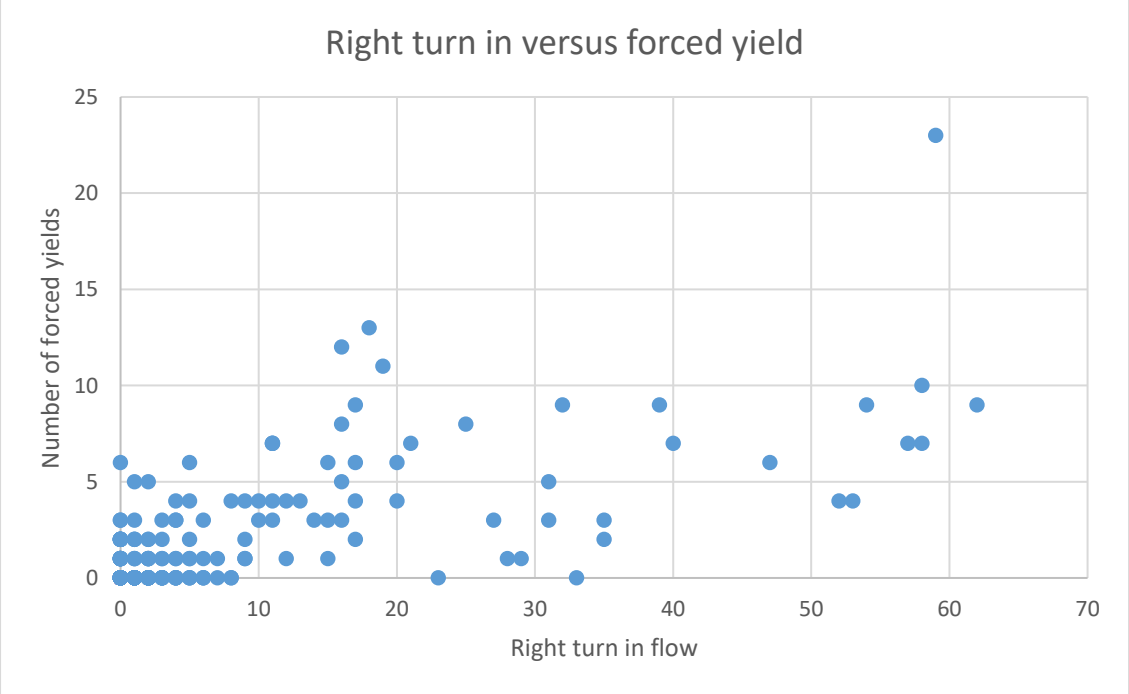
In order to understand these relationships more fully an ordinary least squares multiple liner regression was undertaken. The constant was set to zero (because for a zero flow, there would be no forced yields. In the model with all four turning flows it was in fact the case that the coefficient for the left turn out flow was not in fact significant. This suggests that, once the model has controlled for the other turning flows at the junction, there is in fact no relationship between the left turn out and the number of forced yields. The final model, shown in Table 2.12, therefore regressed the number of forced yields onto the three flows, left turn in, right turn in, and right turn out. The adjusted R-squared is 0.672, suggesting that a high proportion of the variability in the number of forced yields is explained by the flows turning right in, left in and right out. The coefficients for the turning in flows are highly significant, and the coefficient for the right turn out flow is just significant at the 95% confidence level.

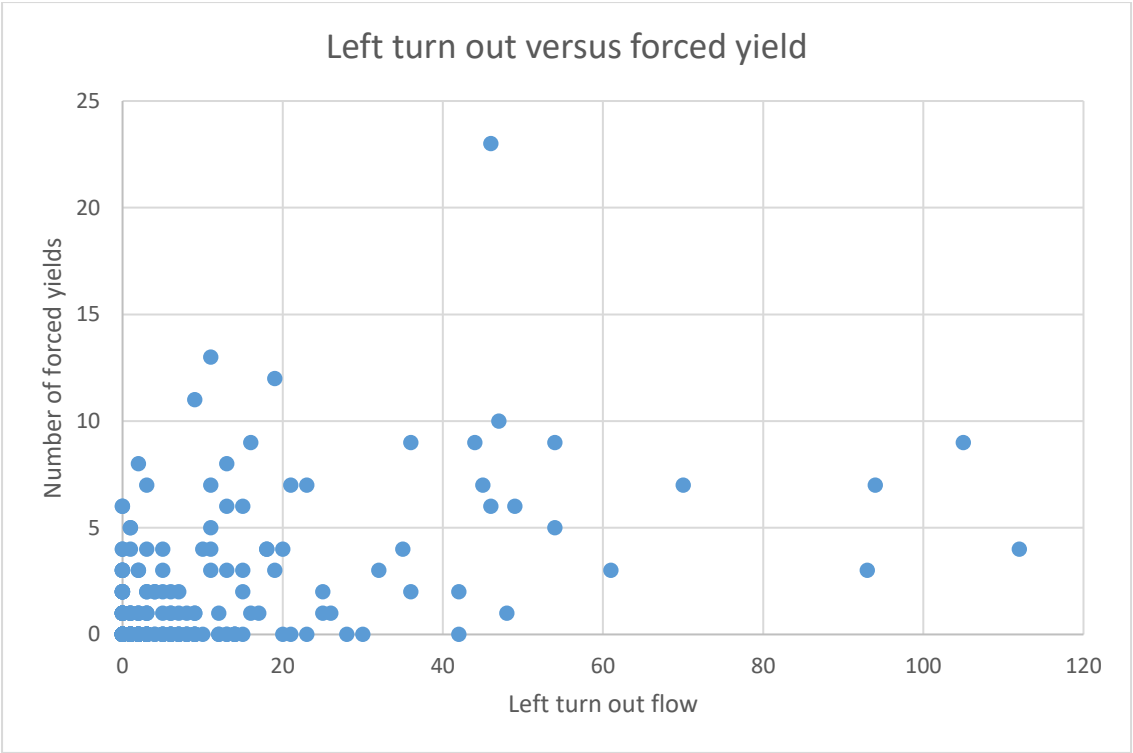
Table 2.12 Multiple linear regression model of turning flows onto number of forced yields

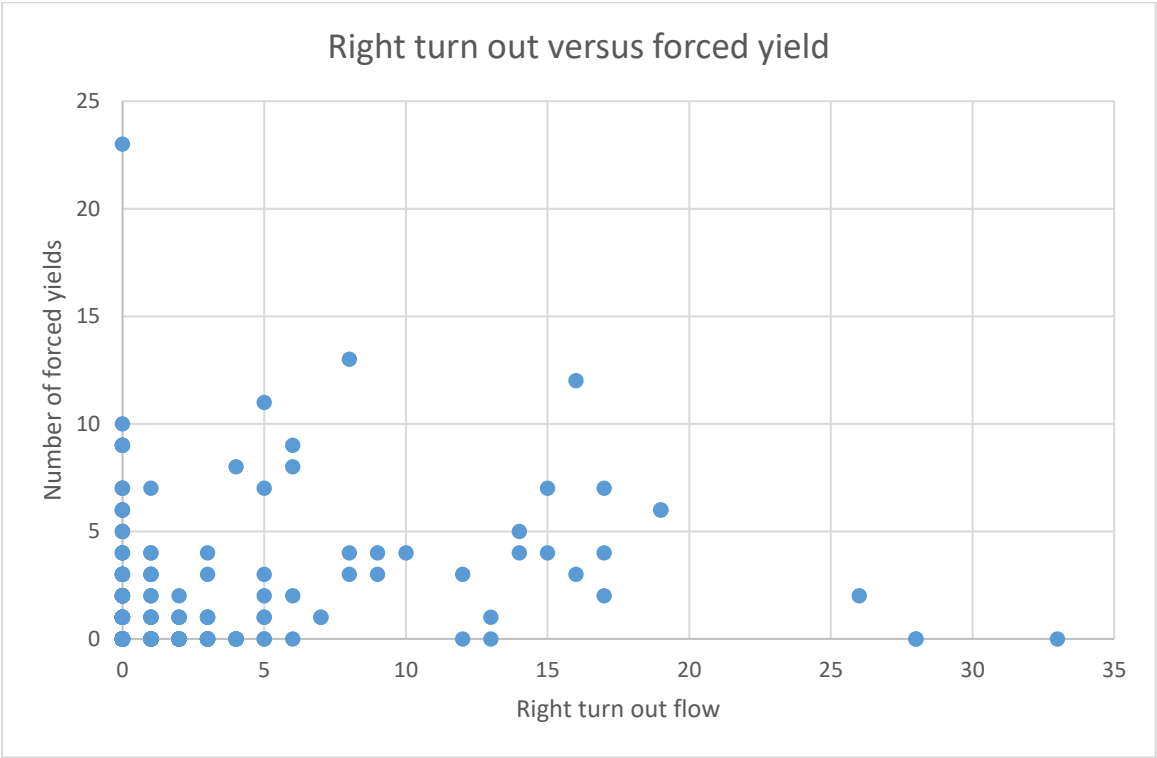
	Coefficients	*Standard Error*	*t Statistic*	*P-value*
Intercept	0	-	-	-
Right turn in flow	0.127	0.0107	11.80	p < 0.001
Left turn in flow	0.186	0.0280	6.63	P < 0.001
Right turn out flow	0.046	0.0231	1.97	p = 0.049

Figure 2.4 Scatter plot of turn flows versus number of forced yields






Left turn out versus forced yield
Number of forced yields
Left turn out flow
0
5
10
15
20
25
0
20
40
60
80
100
120


Right turn out versus forced yield
Number of forced yields
Right turn out flow
0
5
10
15
20
25
0
5
10
15
20
25
30
35

The interpretation of the model suggests that for an increase in flow in a 15 minute period of 10 vehicles, there would be an increase in the number of forced yields, on average, for a right turn in flow of 1.27 forced yields, left turn in of 1.86 forced yields, and for a right turn out flow of 0.46 forced yields. It can be seen that while the coefficient for the right turn out flow is significant at the 5% level, the size of the effect is smaller compared to the turning in flows.

It is not surprising that the left turn out flow is the flow which has no impact on the number of forced yields, and this is because a driver turning out left will ned to focus on just the nearside main road flow, and the people crossing on the continuous footway. The attention of the driver turning right out has to also consider the off-side main road flow. Both of these flows have to yield priority to the main road flow.

The right turn in flow also has to yield to the main road flow as well as the people crossing the continuous footway, and the driver will be either moving slowly, or perhaps at a dead stop before driving over the continuous footway.

The flow of perhaps greatest concern is the left turn in flow, and drivers turning left in, were the junction to be a normal side road junction, would have priority if there were nobody crossing the side road.

Note that the junction with the highest turning flows was Southampton (Site 7). In order to check that this site was not having an in due effect in relation to the model, a model was created which excluded the higher Southampton flows. In this model, the coefficient for the right turn out flow was not significant, and the coefficients for the right turn in flow and the left turn out flow were both higher than in the model including the Southampton data (0.270 and 0.112 respectively). This suggests that the lesser volume of data from lower flow sites might have suggested a larger turning in flow effect size. However, the actual evidence available to us from Southampton suggests that the effect size of flow is less than might have been found to be the case with just lower flow sites.

We do not have statistical evidence that a threshold of flow exists above which it would be inappropriate to use continuous footways. If such a threshold exists, they are likely to depend on the balance of the flow for a certain turn and the flow of crossing pedestrians and cyclists. From the observation study we saw that:

a. With very low turn flow (<20 and hour) and crossing flows and less than 200 (and possibly up to 400), the continuous footways at junctions 1, 5 and possibly 4 functioned well for both turns in and out, with very low levels of interactions and forced yields.
b. With crossing flows elevated to a level so that turning vehicles interact with more than one crossing pedestrian and/or cyclist, the continuous footways at junctions 2, 3 and 9 functioned well for turns out, both left and right.
c. With numbers of turning vehicles elevated to a level that crossing pedestrians interact with more than one turning vehicle, the continuous footway at junction 7 (Southampton) functioned less well[iii].

2.5 Summary

Of the 4,583 interactions, the majority (91.3%) were interactions where the road user crossing the side road either did take priority, or could have taken priority. This is significantly different from control sites in a Transport Research Laboratory study where 59% of pedestrians crossing typically designed side roads had priority. There remain, however, a significant number of pedestrians and cyclists who are forced to yield (8.7%).

A design objective for continuous footways would be to ensure that for any given junction the proportion of interactions where the road user crossing the side road can take priority knowing that the driver will cede priority is very low to the point of being negligible. Beyond that, where drivers still force priority for themselves, the conditions would need to ensure extremely low vehicle speed to avoid contact.

The contingency coefficient (=0.415, $p<0.0005$) suggests there is a moderate relationship between the site and the yield type. Hence, this suggests there are differences between junctions in terms of their nature which may be creating different patterns of yielding. Edinburgh, Southampton and London

[iii] As noted in the description in the section after Table 2.9, the junction at Southampton was on a dual carriageway with the right turn into the side road being facilitated via a short section of access road across the wide central reservation with a give way marked at the point where is crosses the nearside two-lanes. At some points in the day, queues formed to make this right turn in movement as vehicles waited to cross two lanes of fast-moving traffic, and when a gap appeared drivers took the opportunity to accept the gap, often ignoring the presence of someone crossing on foot or cycle. In some ways therefore, this junction is an outlier.

Leyton, are the sites with the highest proportion of interactions leading to a yield by the people who were walking or cycling (between 38% and 45%). Other sites with relatively high proportions are London Walthamstow and London Clapham (11% to 25%).

As adjudged from the videos, in a majority of cases (89%), it was the action of the driver which caused the yield by the person crossing the side road.

Finally, a significant relationship has been found between the number of forced yields and the left turn in and the right turn in and the right turn out. This is unsurprising as the higher the conflicting flows, the higher the number of interactions and hence the higher the potential number of forced yields.

There is no evidence from this relationship that continuous footways should not be used above a certain level of turning flow. Design factors should be used to limit the number of forced yields, regardless of whether or not the number of turns is high. Issues here relate to the behaviour of drivers. For example, they may feel pressured to turn right in as a result of following traffic waiting behind them on the main road. The provision of ghost island right turns may be of value in some circumstances. Also, where the left turn in is across a nearside lane, such as a bus lane, there may be increased propensity to for assertive turning manoeuvres, as observed at some of the junctions.

3 COLLISION INVESTIGATION

3.1 Methodological approach

Detailed road safety data about the circumstances of personal injury road collisions in Great Britain, the types of vehicles involved and the consequential casualties has been compiled since 1979. The statistics relate only to personal injury accidents on public roads that are reported to the police, and subsequently recorded, using an accident reporting form known as STATS19. These data are shared with local authorities (and in the case of some roads in London, Transport for London). It is known that there is under-reporting in the collision record.

All of the local authorities (or Transport for London where appropriate) where the junctions included in the observational study were located were approached for their STATS19 data. Requests were made for the data for all personal injury road collisions for each junction for the five years prior to the continuous footway being completed and all subsequent available data. Similar requests were made for the 100m radius, along each arm of the junction.

3.2 Results

Table 3.1 shows the number of injury collisions that occurred at each junction for the five-year period before treatment and for a variable period after treatment. The period after treatment varies from a month to nearly four years from the dates of implementation of the change. The crossings became continuous footways approximately as follows: Leeds May 2017; Oval, London October 2015; Kingston, London May 2019; Stratford, London May 2017; Edinburgh June 2017; July 2019; Leyton, London March 2018; Walthamstow, London March 2016; Clapham, London March 2014; Nottingham January 2018. Note that no fatalities occurred at any of the junctions.

Table 3.1 Injury collision numbers at the junction

Location		Before			After		
		All road users	Of which cyclist	Of which pedestrian	All road users	Of which cyclist	Of which pedestrian
Leeds	Slight	4	0	0	0	0	0
	Total	4	0	0	0	0	0
	No. of years	5.3	5.3	5.3	2.7	2.7	2.7
	Mean	0.75	0.00	0.00	0.00	0.00	0.00
Oval, London	Serious	3	2	1	0	0	0
	Slight	4	4	0	3	2	0
	Total	7	6	1	3	2	0
	No. of years	5	5	5	3.7	3.7	3.7
	Mean	1.40	1.20	0.20	0.81	0.54	0.00
Kingston, London	Slight	4	0	0	0	0	0
	Total	4	0	0	0	0	0
	No. of years	5	5	5	0.1	0.1	0.1
	Mean	0.80	0.00	0.00	0.00	0.00	0.00
Stratford, London	Serious	3	0	2	0	0	0
	Slight	10	1	5	0	0	0
	Total	13	1	7	0	0	0
	No. of years	5	5	5	0.25	0.25	0.25
	Mean	2.60	0.20	1.40	0.00	0.00	0.00
Edinburgh	Serious	1	0	1	0	0	0
	Slight	1	1	0	1	1	0
	Total	2	1	1	1	1	0
	No. of years	5	5	5	2.2	2.2	2.2
	Mean	0.40	0.20	0.20	0.45	0.45	0.00
Southampton	Serious	2	2	0	0	0	0
	Slight	1	1	0	0	0	0
	Total	3	3	0	0	0	0
	No. of years	5	5	5	0.25	0.25	0.25
	Mean	0.60	0.60	0.00	0.00	0.00	0.00
Leyton, London	Serious	1	0	0	0	0	0
	Slight	5	4	1	2	0	1
	Total	6	4	1	2	0	1
	No. of years	5	5	5	1.1	1.1	1.1
	Mean	1.20	0.80	0.20	1.82	0.00	0.91
Walthamstow, London	Serious	0	0	0	1	1	0
	Slight	1	0	1	0	0	0
	Total	1	0	1	1	1	0
	No. of years	5	5	5	3	3	3
	Mean	0.20	0.00	0.20	0.33	0.33	0.00
Clapham, London	Serious	0	0	0	1	1	0
	Slight	2	1	0	3	1	2
	Total	2	1	0	4	2	2
	No. of years	5	5	5	2.58	2.58	2.58
	Mean	0.40	0.20	0.00	1.55	0.78	0.78

Note: if there were either no serious or no slight injury collisions, then that row has been omitted, and as a result of their being none at all in Nottingham, that location does not appear in the table.

Table 3.2 shows all of the collisions that occurred within a radius of 100m from each of the observed junctions for five years before treatment and after treatment. A pedestrian fatality occurred within 100 metres of the junction Stratford and Southampton in the period before continuous footway implementation.

Table 3.2 Injury collision numbers on approach arms within 100 metres of junction

Location		Before			After		
		All road users	Of which cyclists	Of which pedestrians	All road users	Of which cyclists	Of which pedestrians
Leeds	Serious	4	2	0	0	0	0
	Slight	9	8	0	5	4	0
	Total	13	10	0	5	4	0
	No. of years	5.3	5.3	5.3	2.7	2.7	2.7
	Mean	2.45	1.89	0.00	1.85	1.48	0.00
Oval, London	Serious	6	5	1	2	0	0
	Slight	26	17	0	20	7	1
	Total	32	22	1	22	7	1
	No. of years	5	5	5	3.7	3.7	3.7
	Mean	6.40	4.40	0.20	5.95	1.89	0.27
Kingston, Ldn London	Slight	9	2	0	0	0	0
	Total	9	2	0	0	0	0
	No. of years	5	5	5	0.1	0.1	0.1
	Mean	1.80	0.40	0.00	0.00	0.00	0.00
Stratford, Ldn	Fatal	1	0	1	0	0	0
	Serious	8	1	5	0	0	0
	Slight	36	1	14	3	1	1
	Total	45	2	20	3	1	1
	No. of years	5	5	5	0.25	0.25	0.25
	Mean	8.80	0.40	4.00	12.0	4.00	4.00
Edinburgh	Serious	2	0	1	0	0	0
	Slight	17	4	10	4	2	0
	Total	19	4	11	4	2	0
	No. of years	5	5	5	2.2	2.2	2.2
	Mean	3.80	0.80	2.20	1.82	0.91	0.00
Southampton	Fatal	1	0	1	0	0	0
	Serious	2	2	0	0	0	0
	Slight	2	1	0	0	0	0
	Total	5	3	1	0	0	0
	No. of years	5	5	5	0.25	0.25	0.25
	Mean	1	0.6	0.2	0	0	0
Leyton, London	Serious	6	3	3	2	0	2
	Slight	34	17	2	14	8	3
	Total	40	20	5	16	8	5
	No. of years	5	5	5	1.1	1.1	1.1
	Mean	8.00	4.00	1.00	14.55	7.27	4.55
Walthamstow	Serious	0	0	0	1	1	0
	Slight	12	4	2	2	0	2
	Total	12	4	2	3	1	2
	No. of years	5	5	5	3	3	3
	Mean	2.40	0.80	0.40	1.00	0.33	0.67
Clapham, Ldn	Serious	1	1	0	1	1	0
	Slight	4	1	0	8	5	2
	Total	5	2	0	9	6	2
	No. of years	5	5	5	2.58	2.58	2.58
	Mean	1.00	0.40	0.00	3.49	2.33	0.78
Nottingham	Serious	2	0	0	0	0	0
	Slight	6	1	2	1	0	0
	Total	8	1	2	1	0	0
	No. of years	5	5	5	1	1	1
	Mean	1.60	0.20	0.40	1.00	0.00	0.00

3.3 Data analysis and interpretation

The number of collisions were generally low and in some cases there were no collisions recorded. There were a total of 42 collisions before at the 10 junctions in a total of 50.3 junction-years and 11 collisions afterwards in 16.9 junction-years. Assuming no difference between the before and after situations, the expected numbers are 39.7 and 13.3 collisions. The value of the estimate of chi-squared is 0.03 which is less than $\chi^2(1) = 3.84$ at the 95% level of significance. There is therefore no significant difference across all the junctions in the number of injury collisions. Similarly, considering the approaches 100m from the junction, the number before were 186 and after were 63, with expected values of 186.4 and 62.5, and again the difference is not statistically significant.

Although completion of the continuous crossing was taken as the transition point for the before as compared with the after situation, not all of the junctions changed at a single point in time. Some junctions, such as Stratford, evolved over time with different iterations in its journey from a priority junction to a continuous footway and cycle track. Others, like Southampton, over a period of a few were.

Considering the junctions themselves, at the majority (five) there was a reduction in the mean annual number of injury collisions, but at four (Edinburgh, Leyton, Walthamstow and Clapham) there was an increase. There was no change at Nottingham (zero before and after). These increases are at the level of random fluctuation and the largest indicated increase is as a result of no collisions in five years before to two injury collisions in a two-and-a-half-year period after.

There was a reduction in the mean number of injury collisions per year at the majority of sites for the 100 metres on each approach to the junction. There were rises at three sites (Stratford, and again Leyton and Clapham. Edinburgh saw a very slight rise in cyclists injured (two slight in 2.2 years), but a bigger fall in the number of pedestrians injured.

It should be noted that, as well as these variations at individual junctions being very small, there is the possibility that the volume of people walking and cycling has changed and there is no data with which to moderate these collision numbers to convert them to rates.

3.4 Summary

There are no significant differences across all the junctions in the number of injury collisions before the continuous footways were introduced as compared with afterwards. This lack of significance in difference may reflect a true lack of difference, or may result from numbers too low in the before and after scenarios to demonstrate difference. The analysis takes no account of possible changes in pedestrian, cycle and vehicle flows.

4 FOCUS GROUPS

4.1 Introduction

This research investigates the opinions and behaviours of pedestrians, cyclists, drivers and other road users, including people with disabilities, in relation to different side road crossing configurations in UK cities. The broader aim is to understand which design factors influence the efficacy and safety of continuous side road crossings (or continuous footways) in the UK. We seek to answer the following questions:

1. How do different road users (i.e. pedestrians, cyclists, drivers) perceive different types of side road crossing, and why?
2. How do different road users think people should behave in those different types of road crossings, and why?
3. How do different road users actually behave in those different types of road crossings, and why?

This chapter summarises the results of the focus groups carried out to address the first two questions above.

Section 4.2 describes the methodological approach. Section 4.3 presents the data analysis and interpretation. Section 4.4 presents the results.

4.2 Methodological approach

To discover and understand people's perceptions, opinions and experience in relation to side road crossings and continuous footways, we adopted a qualitative methodology based on focus groups.

Originally developed for market research purposes, focus groups are widely used in many different disciplines within the social sciences, including transport studies. As the name suggests, a focus group involves a 'focused' discussion on a specific topic, facilitated by a trained researcher, among a number of people which normally ranges from a minimum of six to a maximum of ten. According to research practice, focus group participants are encouraged to share their views on the issues under investigation, however there is no expectation that participants have pre-established views on such topics, and that they will reach consensus.

Originally, the intention was to conduct focus groups in two or more cities where some of the side road crossings that are being analysed in the observational studies are located. These were planned for May 2020. As a result of the Covid-19 pandemic, we developed an alternative methodology for conducting the focus groups on-line.

Five online focus groups were conducted using Skype for Business, which allowed people to join either by using this application on an electronic device, or via a phone line (a mobile or landline). Most participants opted to use a phone line.

Participants were recruited through a variety of channels, including e-mails to personal and professional contacts, and social media (Twitter, Facebook and LinkedIn). We sought to recruit people aged 18+ from all walks of life and geographical locations across the UK. However, we had a special focus on recruiting from areas in proximity to the ten junctions that are considered in the observational studies.

Participants belong to one or more of the following categories:

- Cyclists;
- Pedestrians;
- Parents of young children;
- People with disabilities;
- Other road users, e.g. drivers.

As a result of our call for participants across multiple channels, Nottingham, Derby and Leicester City Council offered to promote our research, as did the following organisations:

- A community engagement organisation in Leeds;
- A sustainable travel charity in Nottinghamshire;
- Living Streets, the national charity supporting walking;
- Nine cycling groups in Dorset, Southampton, Leicester, London, Leeds, Dundee, Cambridge and Norwich;
- Four disability organisations in Bristol, London and Leicester;

Thirty-four people contacted us in response to our call for participation and were provided with all the necessary information. Twenty-nine people agreed to take part. Of these, twenty-six took part in the focus groups. Twelve participants reported having physical, sensory and learning disabilities or impairments affecting their day-to-day mobility.

Table 4.1 below provides an overview of the composition of each focus group.

Table 4.1 Summary of focus groups and their composition

Focus group	Participants details	Disabilities & children
Cyclists. Six participants. All those invited took part. Tuesday 26th May (pm).	Five men and one woman, aged 35 to 65. Geographical location: Dundee, London (2), York, Bristol, Cambridge.	No disabilities. One parent of young children.
People with disabilities. Five participants. One invitee did not take part. Wednesday 27th May (am)	Four women and one man, aged 21 to 71. Geographical location: Bristol (4) and Crewkerne.	One wheelchair user, three VI or blind (including one with learning and hearing disabilities) and one with learning and motor disabilities.
Mixed group. Three participants. Two invitees did not take part. Thursday 28th May (am)	Two men and one woman, aged 47 and 45. One of the men did not provide age details. Geographical location: Leeds, Bristol, Nottinghamshire.	One wheelchair user with cerebral palsy. Two parents of young children.
Mixed group. Six participants. All those invited took part. Thursday 28th May (pm)	Four men and two women, aged 30 to 66. Geographical location: Bristol (3), Dundee, Leicester, Southampton.	One wheelchair user with multiple sclerosis (MS). One parent of young children.
Mixed group. Six participants. All those invited took part. Friday 29th May (pm)	Four women and two men, aged 53 to 76. Geographical location: Bristol (3), Dundee, Leeds, Nottinghamshire.	One wheelchair user, two visually impaired (VI), two with long term disability impacting their mobility (need to use crutches, stick or mobility scooter).

Each focus group lasted about 90 minutes and was facilitated by Dr Miriam Ricci. The discussions were digitally audio-recorded and transcribed for analysis. Prior to the focus group, participants received an accessible non-technical document by email, outlining the topic of the focus group discussion. This included the picture and detailed description of two generic side road crossings (extracted from the Highway Code) and five examples of continuous footways in the following locations in the UK: Clapham and Kingston, London; Edinburgh, Scotland; Leeds; Southampton. These examples were selected because they provide a variety of design details on which we sought to elicit public opinions.

4.3 Data analysis and interpretation

The transcripts of the focus group discussions constitute our qualitative data, which have been organised, managed and analysed using NVivo (Version 12).

NVivo is a computer-based software that supports qualitative data analysis in a variety of disciplines from sociology, psychology to business and marketing research. It allows researchers to organise and manage a wide range of research material, including not only the data collected and/or generated, but also all the literature and contextual information gathered for the research project. In doing so, it allows to interrogate and gather insights from the data more efficiently and effectively.

NVivo has allowed and simplified the identification of key concepts and themes that emerged during the focus groups and stored the corresponding text in a thematic coding structure, which has been interrogated (using query tools in NVivo) according to the project's research questions. The coding structure has been developed consistently across all materials to ensure reliability of data analysis and interpretation.

4.4 Results

4.4.1 Public perceptions and experiences of crossing side roads

At the start of the focus group discussion, participants were asked to describe their experiences of crossing side roads in their daily lives, thinking in particular about what makes side road crossing safe, comfortable and easy for them, and what has the opposite effect. The analysis of participants' responses and comments, supported by NVivo, has allowed us to identify five broad factors, as follows:

1. Cultural norms and attitudes,
2. The characteristics and quality of road infrastructure,
3. Mobility practices of disabled people,
4. Parking and use of indicators by drivers, and
5. Weather conditions.

These factors are presented in more detail in the following sub-sections, which also include a number of quotes that capture the essence of the comments people made in relation to each of the factors.

Cultural norms and attitudes

General and often unspoken cultural norms and attitudes affect the daily experience of people with and without disabilities when crossing side roads. These include selfish and absent-minded behaviour, and the tacit presumption that motorised vehicles have more importance than, and priority over, other types of road users.

"I don't feel comfortable crossing a road without my personal assistant, because the road users are just focused on themselves and they don't think about other people." (Disabled M, Thu am).

"Pedestrians and cyclists are somehow viewed as less important than the motorist." (M, Tue pm).

"I think sometimes it can be dangerous when cars presume that you are going to wait for them all the time, rather than assuming that you will step out into the road" (M, Thu pm).

"Sadly, there are selfish human beings out there. Some of them are drivers, some of them are cyclists, some of them are pedestrians which means that if you're a person whether with any kind of disability who is trying to lead something like a normal life despite the disability and if you're literally knocked over by a passing person, that can seriously reduce your confidence." (Disabled F, Fri pm).

Characteristics and quality of road infrastructure

Specific characteristics and attributes of the road infrastructure, in terms of level of provision, design quality, and maintenance were mentioned as factors that can affect, positively and negatively, people's experience of side road crossing. These are as follows:

- **Sight lines and visibility at junctions:** visibility was considered an important factor affecting the experience of all road users, but especially those made vulnerable by poor design and incorrect behaviour of others.

"Sometimes you're crossing a side road and there'll be bushes or a hedge, so you don't actually get to see if it's safe until the last minute." (M, Tue pm).

"Sight lines, having enough clear space next to the junction so you know when maybe traffic's coming round the corner." (M, Thu pm);

- **Kerb radius:** the wider the mouth of the junction, the more dangerous the crossing is perceived and the more difficult the experience is, especially for those who cannot move quickly enough in response to danger.

"I'm thinking about being on foot, I think narrower junctions generally make things a lot easier. I mean, me, where I live there's quite a mixture, but generally they're quite wide sweeping bends, so

vehicles that are whizzing round at speed and it's quite difficult to be able to get across when the traffics quite busy, particularly if there's no kind of signalised crossings or anything like that. I'm fit and healthy and I don't have any mobility issues, but it takes me, even running across them." (M, Thu am).

"There's one that I go past every day, there's a really, really wide − is it called a wide sweep or something, so that anyone driving in or out of the side road from the main road does not even have to slow down at all, so they can just fly up at full speed" (M, Tue pm).

"What makes some of them dangerous, some of them have quite a big sort of angle for cars to swing round quite quickly, I guess designed to make it quicker for cars to make that turn." (M, Thu pm).

- **Degree of separation** between users of different transport modes: a few participants felt more comfortable and safer when crossing junctions where different road users have separate spaces, i.e. fully segregated cycle tracks and pedestrian paths.

"Especially at junctions, which is where these cyclists and pedestrians are being hurt and killed, I believe in having full segregation." (M, Tue pm).

"So there are a lot of competing road users like people with disabilities, emergency vehicles, buses, cyclists, pedestrians, cars, delivery vehicles, all with different needs and all with different priorities and our road network is very skewed towards priority for cars and everybody else is kind of shoehorned in along the side and what I would like to see is some of the routes being separated out." (F, Thu am).

- **Dropped kerbs:** several comments mentioned the need for providing dropped kerbs more consistently across urban areas and ensuring that these are aligned along the line of crossing. Wheelchair users and people who are unsteady when walking rely on dropped kerbs to cross the road independently. Poor provision and design, coupled with obstructions such as flooded road drainage or illegally parked vehicles, are key barriers.

"Certainly when my children were very little, drop kerbs were absolutely vital and since that experience of pushing my kids around in a pushchair, I've been really sensitive to noticing where drop kerbs are and where they aren't, and they are absolutely vital for anybody having to deal with anything that has wheels and they are like every part of our infrastructure, they're handled very patchily, there's no, the impression I get is there's no overarching governance concerning them." (F, Thu am).

"Sometimes when you cross the road, at the other end there's no dropped curb, so you can't get back up onto the pavement, it's just not really thought through very well." (Disabled M, Thu am).

"In some instances where there's not a dropped curb at the other end, I've had to go down the road to actually get to the end and that can be pretty dangerous because other road users aren't expecting to see a man with an electric wheelchair on the road because I'm low down anyway" (Disabled M, Thu am).

"Dropped kerbs help greatly with crossing the road and if there's no dropped kerb I'd be wheeling along for however long to find one of the dropped kerbs then cross at a different point. That's a massive one for me." (Disabled M, Thu pm).

"I'm a wheelchair user so my biggest problem with side roads tends to be lack of dropped kerbs particularly around where I live, or semi dropped kerbs where they've gone down a little bit but not all the way, so it looks like it's dropped but you still fall off the end and a lack of alignment." (Disabled F, Fri pm).

"The fact that dropped kerbs are quite often staggered so you have one on this side of the road but to get to the one on the other side of the road you have to cross a lot of road which is fine if it's a side road which is not used very often but if it's a side road that is used a lot that can create major problems." (Disabled F, Fri pm).

"There also seems to be a habit of the council around here having all the drainage points, drainage vents in the middle of the dropped kerbs around here, so the dropped kerbs flood and you can't use them to get onto the side road in the first place without going through a massive puddle." (Disabled F, Fri pm).

- **Tactile paving:** this was referred to as "knobbly pavement" by a few participants. Although there is a presumption that the provision of tactile paving may be helpful, in practice it may not be always used by visually impaired people when crossing side roads. Tactile paving has different colours according to its function, which can help people with residual vision.

"I find it quite hard to find the kerb and stuff like that, but different blind people, visually impaired people, are different. There's this tactile flooring, the little bumps. That shows blind people where the kerb is, if it's a flat kerb or something." (Disabled F, Wed am).

"Yes, it does [help], but when you are totally blind and you learn routes, you never actually cross on them. On side roads you are always, always taught to go into the road so then the traffic hopefully

has slightly slowed before your cross, and that's what you're taught. On certain roads you are never taught to use a tactile, you're only taught tactile when they're on zebra crossings or when they are specific crossing places within a road, not on a junction." (Disabled F, Wed am).

"There are areas where a person of limited vision can feel that some areas have bumps which lets the non-sighted person know there's a change coming up. It could be a junction, it could be a crossing etc., etc. For someone who's got marginally more vision but not a lot, there are changes in the colour of the bits with lumps on." (Disabled F, Fri pm).

It should be noted that it is already known that rarely would a blind or visually impaired person enter an area with which they lack familiarity or in which they have received no training (Parkin and Smithies, 2012). Any and all road features are used for navigation, including countable objects such as street lighting columns, and even serendipitously located linear features that can be tapped to followed. This work also found that demarcations for safe areas must be identifiable by means of a cane and change in feeling underfoot (i.e. different surface types). A particularly important area which has not been fully researched is the exact nature of differences in degree of tactility of areas (wider than simply delineators) and degree of contrast. Similarly, Methorst et al. (2007) suggested that boundaries that are safe for people should be clearly marked to drivers, that is to say the demarcation of the continuous footway should be clear to drivers. An interesting point is that, based on the teaching of the use of tactile, its use at a continuous footway would lead visually impaired people to search for the road edge, which will in fact not exist for them: the edge has been transferred to being a vertical delineator for drivers. Tactile at continuous footways on the line of route of the footway should therefore be avoided.

- **Type, quality and state of repair of the paving material** used for roads and footways:

"And when it's cobblestones like in the olden days – cobblestones, is that what they're called? They're quite difficult for balance and stuff because I struggle with balance a little bit as well, because I can only see a little bit out of one eye, I'm totally blind in my left eye, so balance when you can't see very well and you can see a little bit your balance is a bit more wobbly." (Disabled F, Wed am).

"I think sometimes the surfaces of side road pavements aren't as good as they could be. Often the repairs are done on the main roads so the side roads are often… the paving stones are a bit… there might be a slight unevenness, so that is difficult." (Disabled F, Fri pm).

- **Slope and camber:**

"Maintaining speed in a wheelchair particularly if it's on an uphill slope or if there's a camber can be really difficult" (Disabled F, Fri pm).

- **Degree of consistency in junction design at local and national level:**

"Local authorities have limited money and there's no national standard for how junctions are organised. Different councils let pedestrians and cyclists muddle along together on a single pathway or whatever. Some councils have different textures, some councils have different colours but there's no consistency which means a person who happens to be visually impaired and gets to know the physical alterations and physical colour changes around their particular area of say Bristol, could find a completely different system in a different city where things are done completely differently." (Disabled F, Fri pm).

- **Traffic volume and speed,** both on the main road and side road:

"I think for me the most important factor is how busy the road is and particularly the speed of the cars, particularly on the main road where the side road joins in. If it's a quiet road I can just have a quick look around, I can hear if there's any cars coming, it doesn't feel at all dangerous, but when there's lots of cars, lots of noise and they're going at a much higher speed, obviously it's a much more stressful situation, and that's where you have to take much more care." (M, Thu pm).

"So, for me I think the shorter the distance to cross the better. If it's very easy for cars to turn quickly into the side road then that obviously feels less safe and I think the volume of traffic." (F, Thu pm).

"As a cyclist, I know the problem as a car driver as well, that unfortunately in the darker time of the year many people seem to favour wearing black top to toe, so even with good lights and everything and most junctions are lit I suppose but still, having more time to actually see what is there and what might not be there and where it's going etc helps, but that opportunity to have the time to see and react to things is only there for motorised traffic if it is forced to slow down." (M, Thu pm).

Mobility practices of disabled people

- **Reliance on hearing:** Visually impaired participants reported having to rely on any residual vision, if available, and especially on their sense of hearing to gauge whether it was safe for them to cross a non-signalised junction. This was framed as an issue visually impaired people have to confront almost daily in their lives. Although participants offered many examples of their

personal strategies to deal with it, the underlying sense of anxiety and powerlessness felt by visually impaired people was a key feature in their accounts.

"I depend on my hearing. So, if I were to hear any traffic I would just stand and wait. You're always taught to wave traffic on until it's totally clear by your hearing, when you're totally blind, for you to move." (Disabled F, Wed am).

"I find it very difficult to cross roads. I go out on my own quite a lot walking, sometimes with my helpers or my family, but it is rather difficult to hear cars as well, due to me being slightly deaf. And bicycles I find very difficult. I've had nearly accidents where I've crossed the crossing and people have nearly crashed into me with a dog or with my cane because I haven't heard the cyclist come, and I've done that a couple of times with cars as well, misjudged crossings and they sound like they're clear but they're not, a car comes zooming round the corner and that was with a guide dog as well, I was within inches of being – and the car didn't stop." (Disabled F, Wed am).

"I don't use a white stick or a signal cane, so sometimes I ask for help or other times I just wait until somebody else comes along who's crossing the road and follow them across" (Disabled M, Fri pm).

"It's a lot of trust, you know, and confidence, and everything, yeah. And with the electric cars now with no noise, they're terrifying." (Disabled F, Wed am).

- **Guide dogs:**

"I certainly find it easier with a guide dog." (Disabled F, Wed am).

- **Unsteadiness:** several participants reported being unsteady when walking, which could make them vulnerable if other road users are inattentive or inconsiderate, or if the pavement or road have bumps or other obstructions.

"When I'm walking without a stick or a crutch, I'm quite cautious and a bit anxious about traffic and whether I'm going to be barged into by other people as well, some of it's about balance." (Disabled F, Fri pm).

- **Communication with other road users:** being able to communicate with other road users, in some way, was considered important by people with and without disabilities.

"As someone with some sight, I use my white stick as an alerting mechanism to cars, because I can vaguely hear something but I'm not really sure where it is. But I wave my stick furiously which makes them think, what's going on? And then they think, oh, white stick. But they often wouldn't have noticed it's a white stick first. They're not looking for that visual clue." (Disabled F, Wed am).

"I think if I was on my bike I would very definitely get eye contact with the driver or I would just wait. I wouldn't trust that they weren't going to drive into me, basically, and if I was a pedestrian, again, I would just wait." (F, Thu pm).

"I sometimes find that quite concerning wondering whether they're going to stop for me. Sometimes I think drivers signal to let you cross but sometimes it's not easy to see what they're gesticulating through a windscreen because the sun might be against them or so on, so that communication with a driver in a car to negotiate crossing a side road is sometimes complicated." (Disabled F, Fri pm).

Parking and use of indicators by drivers

- **Parking:** both legal and illegal parking was seen as key barrier to crossing side roads safely and comfortably.

"I find there's a real problem around here that there's parking right up to the corners on many roads. If I'm trying to cross in a gap between cars and drivers can't actually see you if you're at my height in a wheelchair. That's really difficult." (Disabled F, Fri pm).

"Some of the things that I've had difficulty with has been people parking selfishly. There is a dropped kerb, but someone has parked slap bang across the dropped kerb." (Disabled F, Fri pm).

"Parking restrictions being enforced such that there is actually a clear distance to the end of the road and to the crossing, so you've got greater visibility as you often get neither a dropped kerb or the other cars are packed right up to the very corner and that means your visibility's almost zero." (Disabled M, Thu pm).

"Where I live there are parked cars everywhere, we're talking really quiet roads, they're not busy, main roads, these are sort of quiet pedestrian residential roads, but because they are so full of parked cars and you literally cannot see if there is a car or more relevantly a cyclist, because a cyclist is silent, until you stepping out between the cars. You literally, you have to step right parallel to the edge of the cars before you can see, which is a complete nightmare when it comes to trying to teach kids to cross the road." (F, Thu am).

- **Use of indicators:**

"Sometimes cars don't indicate when they're coming in, so when I start crossing and they're coming in terms of a main road or a side road, they don't indicate, which is annoying." (Disabled F, Wed am).

This participant, who reported having learning and motor disabilities, indicated that she prefers to cross side roads away from the junction, to have more time to see incoming vehicles.

Weather conditions

"Even bizarre things have entered the equation for me. Things like weather conditions and things like that can make a big difference to how we cross the roads" (Disabled F, Fri pm).

"I like to try and be able to predict what… for instance if it's for a shower or not or if it's heavy rain or not, that kind of thing and what impact that might have on the situation." (Disabled F, Fri pm);

Overall, all of these factors can discourage disabled people from crossing unsignalised junctions:

"Whilst I'm quite mobile, my eyesight has got worse in the last few years and I suppose I'm quite nervous about crossing roads that don't have pedestrian signals and I think by choice I will choose routes even if they're a bit longer or less convenient that have pedestrian light crossings because that makes me feel less nervous." (Disabled M, Fri pm).

4.4.2 Public perceptions of picture illustrating Highway Code Rule 170 (Pedestrians)

This picture shows Rule 170 of the Highway Code, in particular the statement "Watch out for pedestrians crossing a road into which you are turning. If they have started to cross they have priority, so give way". It was shown to stimulate debate on what makes side road crossing safer or less safe for pedestrians.

The comments made on this picture highlighted the following issues:

- The design of this particular junction (i.e. the wide mouth of the junction) may encourage drivers to turn into it at speed rather than to slow down; for this reason, several participants were surprised the picture is used to illustrate the give way rule in the Highway Code:

"I would say that because the mouth is quite wide, the cars are very much encouraged to take the turning extremely fast, which could be bad news for a pedestrian who's already crossing." (M, Tue pm).

"It's the antithesis of safe crossing. There's not even a dropped kerb for pushchairs and wheelchair users. The pavement ends, drops off, it's kind of shocking that this is the official image of the Highway Code. But there is literally no way up that pavement. It's not what we want." (M, Tue pm).

- Not all drivers know or remember this rule. If junction design does not reinforce the rule, drivers may fail to follow it and engage in habitual behaviours that put the people who are walking at risk:

  "Well it sounds like [the rule] is clear but I don't think drivers would necessarily obey it." (Disabled F, Wed am).

  "I'm pretty sure, and certainly going by just experience, it seems that many drivers are not aware of this rule and, as it was said, you know, as a pedestrian you're always at the shorter end! So you'd rather hesitate, and I think that then maybe enforces the sort of belief, in some drivers at least, that they've got priority if they're nearing the junction so the pedestrian has to wait." (M, Thu pm).

  "Yesterday, I actually had a near death experience on a junction like this, where a driver indicated at the very last minute and then actually accelerated towards me to try and hit me, so I had to run as fast as I could out of the way but this kind of junction it enables people to do things like that, wide junctions – if they're narrow they have to slow down, they can't take them at speed." (M, Thu am).

- People who are walking, especially those with disabilities, would not assume they have priority once they have started crossing, even if they know this rule:

  "But no-one really just strolls across at a leisurely pace if a car's waiting to turn in." (M, Tue am).

  "I think a lot of people understand that cars have to respect pedestrians, however that's a very risky thing to rely upon when, it might not be the car's fault, but one mistake and it's the pedestrian that comes off worst. So I think, whether they know it or not, most people would

not cross the road until they're absolutely sure there were no cars likely to come round the corner." (M, Thu pm).

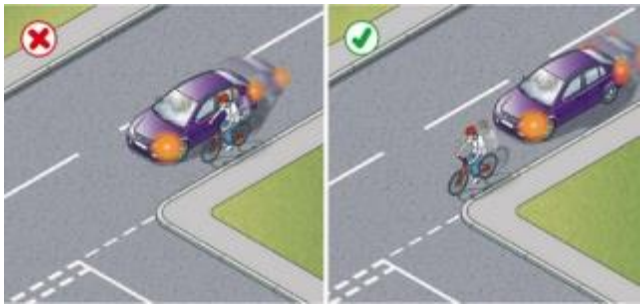
- There should be more emphasis on drivers' continuous education as well as better junction design:

  "The amount of times that people have been shown that they don't know this rule really concerns me, and one of the things I've been lobbying for is that people should have to take their driving test again every five years, because people forget or rules change, road markings are introduced, the psychology changes, and the conversations we're having just underpins that. It's part of the driving test to know this rule, but people don't." (F, Tue pm).

The only positive comments on this image were about the visibility across the whole junction.

"The sight lines are good, though. There's no trees, there's no bushes, there's no clutter, signage, bins, all the stuff I'm afraid we're used to at junctions now." (F, Tue pm).

4.4.3 Public perceptions of picture illustrating Highway Code Rule 182 (Cyclists)



This picture illustrates Rule 182 of the Highway Code: "Use your mirrors and give a left-turn signal well before you turn left. Do not overtake just before you turn left and watch out for traffic coming up on your left before you make the turn, especially if driving a large vehicle. Cyclists, motorcyclists and other road users in particular may be hidden from your view." It was used during the focus group discussions to stimulate debate on what makes side road junctions safer or less safe for cyclists.

Participants raised the following points:

- Being cut in by a left-turning vehicle was something most cyclists in the focus groups had experienced.

  "This happens to me all the time, and I'm sure to everyone on this call. Drivers actually accelerate then hard left, and they almost always cut you up by doing that." (M, Tue pm).

- Junction design can improve actual and perceived safety by slowing vehicles down before they turn left, for example if the mouth of the junction is as narrow as the one depicted above.
- However, even when junction design is good on paper, the complexity of real-world streetscapes means that people can still make mistakes or engage in dangerous driving, e.g. speeding when in a hurry. Cyclists felt they need to behave in a way that prevents being cut in as much as they can, for example by adopting the 'primary position' on the main road, whether alone or with children.

  "I would say that the main road is slightly wide and encourages the motorist to overtake, so one defence the cyclist can use is to adopt primary position to block the motorist until they get to the junction. It's a double-edged sword, that one, because it can also infuriate the motorist." (M, Tue pm).

  "What we do for those junctions and what we tend to do when we're cycling anyway is we'll dominate the whole lane, the kids will ride on my inside and we will take up the space of the car and it basically stops cars doing all sorts of evil things where they're not treating you like a vehicle. There is no junction in the world that exists that is as clean as that junction, where you're not bombarded with the three pedestrians on the street, the cyclist in the road, the delivery vehicles, the parked cars, the trees, you know, there's a lot to process on most junctions, there's a lot of things that you have to be aware of that might mean that you make honest mistakes." (F, Thu am).

- The vehicle in the picture showing the correct behaviour looks too close to the cyclist. A few participants were surprised this picture is used in the Highway Code and thought better images should be used to illustrate the correct driver's behaviour.

  "The car's also too close. The car should be 1.5 metres away from the bike and they're not, so that's why I would really not trust that they weren't just going to go into me." (F, Thu pm).

4.4.4 Awareness of continuous footways

Not all participants knew about continuous footways prior to the focus groups. A few had seen and used them in the UK and/or abroad, other had only seen pictures of them, others had never heard about them.

4.4.5 General views about continuous footways

The concept of continuous footways attracted positive comments overall. Most people acknowledged that the design makes people who are walking a priority and vehicles become "guests".

"Given my recent experience in the Netherlands, of continuous pavements and that sort of thing, I couldn't believe the difference that makes and I could see, sometimes when I'd get a hire car I'd be driving as well, I could also see as a car driver how different it is to stay on a typical current-state junction where really it's all wonderful for the car and there's not even maybe a dropped kerb for the pedestrians, so clearly the car by design has priority and everybody else has to wait before they step down into the road, whereas if you have this continuous pavement thing it's just the exact opposite, as I said earlier, you know, the car is the guest!" (M, Thu pm).

Most expected that the raised level would force drivers to slow down and that visual cues, e.g. the paving material being the same across the side road, would indicate to drivers that they are about to cross a pavement and they should give priority.

"We want to endanger motorists' suspensions if they hit them too hard, so that will slow them down! That's the reality. It's self-enforcement." (M, Tue pm).

"It makes a massive difference because, as a pedestrian, you ultimately feel, I don't know if it's a wrong sense of safe, it probably isn't because, as I said, the car drivers, unless they want to smash their cars of course, they have to slow down, and of course as a pedestrian you kind of know that, so even if someone was coming maybe a bit faster than they should, they would definitely have to slow down before they go up that ramp." (M, Thu pm).

Wheelchair users and those with physical impairments causing unsteadiness were particularly supportive of continuous footways that maintained the same level as the pavement.

"It's good for me because there are no kerbs, as I'm wobbly and I've got a sore leg now, and it's bad because you are less aware of traffic and it looks like a pavement, not a road, so it's dangerous as well, if a car comes around the corner." (Disabled F, Wed am).

A wheelchair user who had been on a continuous footway in Nottingham described his experience as follows:

"You feel safe, because they've got all the signage up and everything like that, because as long as everything's signed, made awareness that there are all sorts of people using it then it makes you feel really safe and secure." (Disabled M, Thu am).

Disabled people needed reassurance that drivers (and cyclists) would indeed stop for pedestrians over continuous footways.

"You never know if a car will stop for you, you just never know. When you're blind you just never know." (Disabled F, Wed am).

Visually impaired people expressed significant concerns about continuous footways because they would not recognise them as road crossing points and thought they would be put at risk.

"If it's something that we wouldn't be aware of by a kerb or an up and down of some description, then that sort of thing is always a problem because you're not alerted to the fact there's a possibility of traffic turning." (Disabled F, Wed am).

Visually impaired people reflected on what they would do if they were walking on a continuous footway without knowing. If they heard a vehicle approaching, they would stop, but if the vehicle was very quiet, such as an electric car or an electric scooter, or indeed a bicycle, they would be caught by surprise and possibly feel in danger.

"If you can hear their engine I think, being mostly blind, I would just stand still or bash my stick into them, basically. Because if you didn't see you wouldn't know where they were, would you? Because you do run the risk of walking into the car." (Disabled F, Wed am).

Visually impaired people were also very critical about shared spaces and shared pedestrian and cycling infrastructure. So far as shared space is concerned, this is likely as a result of some relatively weak shared space designs that have been constructed and which do not slow drivers. So far as pedestrians and sharing routes is concerned, this should be generally avoided at other than

extremely low flows of both pedestrians and cyclists, as might obtain for example in rural areas (See Parkin, 2018 chapter 3). The issues raised by the respondents in broad terms are likely also down to the portrayal of the type of infrastructure, and not always a reflection of actual experience.

"I would say any kind of shared footpath with cyclists is a nightmare for the visually impaired because they just are going too fast to really register us, quite often, and they just assume pedestrians will get out of their way. But any kind of shared space or continuous pathway, if they're not totally separate, is really, to me, very scary." (Disabled F, Wed am).

Visually impaired people would welcome a consistent approach to designing continuous footways. There is no indication from the focus groups that visually impaired people would demand tactile paving on the approach to continuous footways. However, there was consistency in the view that a clue of some kind may help, but there were no specific suggestions as to the nature of any physical interventions in that regard.

It should be noted that it would be counter-productive to use tactile paving on continuous footways. This is because tactile paving indicates a carriageway crossing, and that is what visually impaired people would expect to find if tactile paving were used. It will remain important for visually impaired people to learn and know routes that they use, and it could be that there is value in scheme implementers undertaking local action to disseminate knowledge about the form and function of continuous footways.

Participants who also drove were concerned that they, or other drivers, would be confused by the design and this could potentially cause risk to people who are walking and cycling. Drivers could become impatient if they are having to wait a long time to get in/out of the junction. It was also suggested they might also become a barrier for pedestrians and cyclists trying to cross, but this would be the case only if they were inappropriately designed.

"In Dundee itself they have got a continuous crossing, but it wasn't very well done. It's like old folk trying to cross the road and it's not highlighted enough that the pedestrians have the right of way, so you will go half way out and a lorry or a bus or something like that will come down the road, and they all back off and they go back to where they started and the lorry ploughs through. Then they try and do that two or three times before they get across, so there's a bit of experience of what the challenges are in getting across side roads and probably a bit of experience I've had but a bad way of implanting one continuous walkway." (M, Fri pm).

Based on personal experience, a woman suggested that drivers could be put off from using roads leading to continuous footways if they experienced such issues.

"In Norwich there is an almost identical layout and driving, even though it's allowed and permissible, you literally cannot turn off the main road into the road that's been demarked like that, even though it's permissible, and you also can't really turn out of it either, it's just not possible, the main road is so busy and now with the junction staggered thing, having to wait to get to the front. You're either waiting for like forty five minutes to come out of the junction to even get up to the junction to be able to turn out of it, or you're holding up all the traffic on the main road to be able to turn in, so it doesn't work. So when my parents and I are sort of driving around their house now we go a different way, we go to the main car junction which is traffic lighted and go round the back." (F, Thu am).

Support for continuous footways was conditional to the development of a consistent, unambiguous design, following national standards, easily understood by all road users including drivers, and achieved through consultation with road users with and without disabilities. Improving driver education and having practical experience of continuous footways were considered key in reducing safety risks on such junctions.

"You have to make it utterly, 100 per cent unambiguous so that people who are driving, people who are walking, everyone knows who has priority, and that's people walking and people cycling." (M, Tue pm).

"There's no standard, there isn't any sort of standard way of continuous walkways certainly in Scotland. If you could put in a zebra crossing, everybody know as soon as a pedestrian or a wheeler or whoever goes on a zebra crossing you have to slow down and let them cross and everyone is aware of that but on a bit of slightly different material or different texture." (M, Thu pm).

"We've had a few recently in Southampton, new ones put in, and people have been knocked off their bikes because the drivers don't stop. I'm sure some do panic but they just don't give way. Driver education is a massive thing in Southampton, we've got lots of things similar to this and they try to be really consistent by doing them all the same, whether the previous ones that were put in over three or four years ago have different colours and things, so now they're doing them all the same. But it's driver education, is the problem." (F, Thu pm).

"In my experience people are not used to seeing this infrastructure in our country and they expect to be able to turn round into the junction by default, so people generally don't stop on the main road,

there are some people that will obviously, but I think that's a behaviour change thing that would come if we had more and more people cycling and more infrastructure and better teaching of the rules and Highway Code. But it's the complexity and the number of things going on, so simpler is always better.

The following exchange between disabled participants in the Wed am group encapsulates much of the sentiment towards continuous footways:

M: Well I do kind of support them, but I think they just need to be looked at in terms of how they could make it easier for lots of people to cross, not just pedestrians who don't have a visual impairment. I think it needs to be looked at more carefully.

F1: Yeah, I would agree with that, and designing a world that suits cyclists, priority over pedestrians, let alone disabled pedestrians, feels very uncomfortable.

F2: I would have thought, essentially, it's good and it should, hopefully, encourage wheelchair users if they're done correctly, i.e. on the level as it were and no silly kerbs that you can't get up and down.

F3: Yeah.

F1: But for visually impaired/blind people they possibly could create a lot more problems and issues.

4.4.6 Comments on continuous footway in Clapham, London (site 10)

Overall this junction attracted positive comments regarding the pedestrian footway but was criticised for the poor provision for cyclists.

"I think that's a good example of what junctions should look like, pedestrians are the most vulnerable road users so they should be at the top of the hierarchy and when you look at that it just says pedestrians have right of way, anyone approaching that would instantly see that there's a break in the tarmac and the footway is continuing straight across, so it quite clearly says who it's intended to put first. There's a cycle lane, albeit it's not protected, it is still marked out so there's at least some visibility for drivers that there may be cyclists around and they've got some space so it may help to prevent those sort of left hooks. It's quite a narrow radius as well, so you're not going to turn in that particularly quickly, especially with the continuous footway and it's all at the same level, so for anyone using wheelchairs or pushchairs it makes that all a more pleasant experience, it's nice and wide and there's some nice features on there as well, like the trees which might prevent people parking on the mouth of the junction. Overall, that's pretty good." (M, Thu am).

"I don't think I've seen such a big continuous pathway as this, and ignoring the fact that yes, the cycling provision is lamentable here. It's an absolute clarity that pedestrians can walk, cars I would imagine, have to slow down there." (M, Tue pm).

"Looking at the Clapham picture, we can see that cyclists were an afterthought, but pedestrians are actually quite well treated there, and they stuck two trees there so that in the future you can't actually get a two-flow cycle lane, so no-one's thought that one through." (M, Tue pm).

One of the comments on the trees was about visibility.

"Nobody's mentioned sight lines. We've got two trees here. I would feel that these trees might impact on the visibility of people moving around, all users of the junction." (F, Tue pm).

Cyclists in the focus groups explained why the cycling infrastructure in this example looks poor.

"Painting lines on roads does not protect us. For an inexperienced cyclist, it gives a false sense of security a lot of the time. I think the pavement is good here, pedestrians are well served, but cyclists are poorly served here." (M, Tue pm).

"The advisory cycleways are more dangerous than not having one at all, so that aspect of it isn't very good. There's no physical… advisory means that cyclists are going to have to use them, but it also means that cars can drive and park on them. There are double yellow lines on bits of that but… so physically there's nothing to stop a car going on the cycle way and so it's not… and quite a lot of time

because the advisory… if you want to stop you van or something like that and do a 15 minute pick up you could do that right at that junction, so it's a little bit…" (M, Thu pm).

Whilst most comments suggest that the design of this junction would give cyclists priority on the cycle lane, because the raised level of the continuous pavement should force drivers to slow down, not all cyclists believed this would automatically make them feel considerably safer. Three issues were raised on this point. One concerned the behaviour of vehicles coming out of the junction after crossing the pavement, in particular whether drivers would still think they needed to give priority to cyclists as well as to pedestrians. The second was about the double yellow lines, whether they may confuse drivers turning into the junction, leading them into thinking they have priority. The third issue was about whether a high pedestrian flow would make cyclists feel safer because this would indicate to car drivers to pay attention.

"I don't think there's enough give way markings in the roads, so he could just assume that he can shoot out in front of me, there's nothing really ordering him to give way." (M, Tue pm).

"Again, like with the Edinburgh one, the way that the double yellows curve in to indicate the road, again, I think that's going to cause confusion for drivers driving in from the left − sorry, straight down the road as you see it from the picture, if they were turning left, or right from the other direction, they're going to think they have right of way over pedestrians and cyclists when they make that turn, I think. That little bit that goes in shouldn't be there." (M, Tue pm).

"I think I would feel safer but, like I said before, I still wouldn't feel safe. And actually, one of the things that would make more of a difference I think is how many pedestrians were crossing. If there were a lot of pedestrians crossing, I would feel safer that the car was not going to suddenly cut across, in that example, because I still wouldn't necessarily know or trust that the car would realise that the pedestrians had priority." (M, Thu pm).

Comments made by visually impaired and disabled people were mixed:

"From my perspective I probably wouldn't recognise it as a crossing, so I wouldn't be expecting a car or a cycle to turn unless there was something on the pavement that indicated that it was a crossing and so that's why I wondered if that's what that square was designed to do. If it was designed to show that that was where the road sort of started." (Disabled M, Fri pm).

"There's certainly no change of texture from the photo to indicate that there is likely to be traffic coming in from the left-hand side." (Disabled F, Fri pm).

"I think using it in my wheelchair I'd just be really confused by it. Unless I had looked round and seen the give way sign which is printed on the side road for vehicles coming onto it which suggests that I've got priority over them, I'd have no idea whether there would be cars turning in front of me from my right assuming I'm walking along in the direction the photo is going. I think I'm actually more confused as a car driver. I'd probably cause an accident on the road itself planning to turn up it and then wondering whether I've actually got access and looking for a no entry sign that isn't there because I have got access and being really confused." (Disabled F, Fri pm).

Wheelchair users were concerned about the change in pavement material shown at the bottom left of the picture, whether it involved a camber or slope, or a ridge on the pavement, which would be difficult to negotiate for them.

"If you're in a wheelchair and you're moving yourself anything that is a change of angle is very hard to achieve unless you've got a powered chair." (Disabled F, Fri pm).

Participants thought that priority for people who are walking would in practice depend on how busy the main road was, as this would mean that vehicles could block the continuous pavement while waiting for a gap in the traffic.

"I guess you wouldn't have priority at all, you'd just be waiting for traffic to go over it." (M, Fri pm).

Comments also suggest that disabled and non-disabled pedestrians would expect to stop and look at the junction just to be on the safe side.

Other comments and questions are as follows:

- How expensive it is to build a continuous footway like this one, can this be done everywhere?
- Lighter colour of the pavement may help drivers see people who are walking across:

  "What I just noticed only this moment, which I think would help also maybe when it's a little darker, because the continuous footway is paved in a lighter stone rather than black tarmac as a road would normally be, of course pedestrians usually clad slightly darker would be much more visible to anybody else, like a car approaching because there would be more of a

contrast between a likely dark-clad person and a light surface, rather than black tarmac." (M, Thu pm).

- Is the level raised enough to slow vehicles down?
- Is the junction too complex in trying to serve too many road users? Should it be one-way only to reduce complexity?

"You're trying to service to many users here and the users who are least well served on this are the car drivers, so they've left that side road open to cars, but where they have to stop to give way to pedestrians, gives no visibility of the traffic on the main road, they have to come all the way over that continuous pavement, so they actually get visibility of whether they can turn out onto the main road which blocks that continuous pavement and the cycle lane potentially. If it's like a continuous stream of pedestrians, the reason why it breaks and becomes complicated and becomes a huge cognitive load for the driver and pedestrians and the cyclists, is because it's trying to do too many things." (F, Thu am).

4.4.7 Comments on continuous footway in Edinburgh (site 6)

This design attracted the most positive comments across all the focus groups. People particularly liked the way different road users are separated from each other and the neat road markings which are very visible to drivers. The protected cycle track was also seen very positively.

"In Edinburgh, which I quite like, it's got a very tight turning circle, cars are definitely put in their place, it's almost a cul-de-sac, and that's not bad. I quite like that one." (M, Tue pm).

"It feels much more separate, distinct categories of spaces for pedestrians, cyclists and motorists, and the fact that there are the clear indications of a ramp and it feels it's a slightly sharper cut-in than the previous one (i.e. Clapham)." (M, Thu pm).

"So in the Edinburgh one, for instance, there's a couple of details, like the double red lines that curve up and show that a road is there, whereas continuous footways in the Netherlands, the red line would just go straight across, carry along the mouth of the road entrance. This corner kerb thing wouldn't be as obvious that as being an entrance to a road. From a driver's point of view, they'll be driving into it, and they will think it looks like a road where they have priority because of those visual cues. And pedestrians think they have full-on priority from their point of view as they can walk straight down it, and all they see is paving for the pedestrians. If you're cycling, you've got an uninterrupted cycle path that carries across the mouth of the road there as well. So pedestrians and cyclists think they have full-on priority, but drivers might also think they have priority, so it needs to be totally unambiguous as to who has priority, which should be pedestrians and cyclists. I think that's the best one." (M, Tue pm).

"I sometimes cycle with children, and if there's two of us, two adults, we can bookend them, but sometimes we can't do that. And I would feel even if I couldn't bookend the three kids on this stretch that we would all be fine." (F, Tue pm).

As in the previous example, participants were wondering about flows of pedestrians and cyclists, whether vehicles would have to wait long to get in and get impatient as a result.

"I do think when we're improving these things it probably is a really good idea to have the different people that use different modes all standing round together if they possibly could [laughs] and supporting each other over the best design, as long as that isn't about well car is king. But I just think there, there is potential for an accident just because people would be a bit confused about what they're supposed to be doing, all the different people." (F, Thu pm).

"I live next to a protected cycle lane here in Lambeth and we have junctions like the Edinburgh one all along it. Local communities adapt to that incredibly quickly." (M, Tue pm).

"I'm much happier on this style of cycle path where the cycle path's been separated completely from the road carriageway, they are just generally safer because people don't tend to park in them or they won't just suddenly come into your space because they're dealing with an oncoming car or whatever, they treat is a space that they're not allowed to enter. So this is exactly feeds into what I was saying

with the last example, this continuous walkway and cycle path work much better because they've made the road one way only, so you don't have the problem of the cars coming out and having to stop and give way, way back from the main road. You can only turn into that road, yeah, so that's just taken that extra level of complexity for one of the road users out of the equation entirely, I think this one is brilliant." (F, Thu am).

"I think this is a lot more compact as a junction, because it's only got one way and it's going up a hill and it's a tight bend for anyone entering it, I think it's much safer for everyone. That is a nicely designed junction and obviously it's got double red lines as well, so it'll prevent any parking, so yeah, I think that's a really good example. I think the previous (i.e. Clapham) is good as well, but obviously there's cars coming out, it's a lot wider and there's a lot more going on there so it's maybe not quite as good an example. Yeah, I think that's good, but if every junction was like that that'd be great and if we could turn all streets into one-way streets yeah, that'd be fantastic." (M, Thu am).

Other comments were about the need for the junction to be also clear at night-time especially if people who are walking wear dark clothes, and the benefit of having 20mph limits on main roads, which would make it easier for vehicles to approach the junction at a low speed.

4.4.8 Comments on continuous footway in Kingston, London (site 3)

Comments on this junction were mixed.

The separated cycle track and footway look wide and safe, which people liked. It was also noted that the design seems to prevent vehicles to park or stop near the junction, which again was considered a positive.

The deviation in the footway and cycle track was a source of concern.

"The cycle path and the pedestrian footway should be straight, they should carry along straight, without any deviation over the mouth. So there's still problems with them, but I think they're the best ones (i.e. Edinburgh and Kingston)." (M, Tue pm).

Because the photo shows a busy main road and a vehicle blocking the footway, people were concerned about this happening frequently and pedestrians having to wait and potentially breathe exhaust fumes. As a consequence, a question was raised about the risk of encouraging pedestrians to use the cycle track to cross when vehicles block the footway.

"From the pedestrian perspective I really don't like this, and I'm imagining how often you might get a car waiting there and I'm now imagining pushing a child in a buggy or something just at the right height to breathe in the exhaust fumes at the back of a car, or if you use a wheelchair, if that's on a slope, I have a friend that uses a wheelchair, that's dangerous because you could tip. I'm just wondering how steep it is behind that car and whether to get round you're going to have to be on an angle, so I'd be interested to hear how that would be to negotiate. But again, you're breathing in exhaust fumes as well." (F, Thu pm).

People could not see give way markings before the junction and were concerned about how clear it was for drivers to understand they need to give way.

4.4.9 Comments on continuous footway in Leeds (site 1)

This example attracted some criticism concerning two issues. First, a few participants thought the pavement should have been of a more distinctive colour and material to differentiate it from the tarmac road. The second issue was whether the level of the crossing was sufficiently high to provide a cue to drivers to slow down and give priority.

"They've cobbled it together from bits of old Tarmac, but it's not bad, but it's hardly a big statement to motorists, saying, 'Look, you're in the bottom of the feeding chain here, because everyone else is more vulnerable'. The Leeds one could be tarted up to give much more priority visually to pedestrians and cyclists." (M, Tue pm).

"This one says the traffic engineer is more worried about the motor transport than they are about the cyclists and pedestrians." (M, Tue pm).

"But it does look unambiguous. I agree that the people who have to put maximum effort into moving around shouldn't have to go up and down slopes, but I think for me, I would feel safe as any kind of user of this junction, even as a motorist, a pedestrian, I think it's unambiguous. The sight line appears to be good as well, as far as we can tell." (F, Tue pm).

"I think the paving helps a lot, to show when you're in a car, what is a pedestrian path, but I imagine for councils paving is a lot more expensive, like that Kingston picture, there's a lot of paving there which is probably very expensive. I think that it looks like it's been a sort of attempt to do it quickly and cheaply, which is fine sometimes but maybe if they were to go back at this they'd put in a little bit more of a ramp or change the colour of the paths or something. It's also a very narrow cycle path, I assume it's only going one way but it's still narrow" (M, Thu pm).

"It's great that the cycle track is separated from the road, it's raised off the road, I agree with what [other participant] was saying about the lack of colour differentiation." (F, Thu am).

The slight dip in the level of the pedestrian footway could be misinterpreted by visually impaired people.

"It would just feel like you're walking along, like we've got lots and lots of driveways round where we live, I say 'we', I live with my blind partner as well, and you would just feel you're walking over someone's driveway." (Disabled F, Wed am).

4.4.10 Comments on continuous footway in Southampton (site 7)

As in the previous example, this junction attracted some criticism because of the perceived lack of differentiation in colour and paving material, concerns over vehicles having to block the footway to turn on the main road because of lack of visibility, and the unprotected cycle lane along the main road at the top of the picture.

"I think it's the surface material. Here it's all tarmac, isn't it? There's nothing to say 'actually, this is a pedestrian area'." (F, Tue pm).

"I'm looking at the sight lines as well. There's the edge of the car park wall with a bush which, if you're coming along the bike route, you wouldn't be able to see left until you were right up at the junction, it seems to me." (F, Tue pm).

"Putting my driver's hat on, and I'll be very interested to see what your observations are. A driver's come out of there, has to stop, I think those lines are clear that you stop there, and then you can't see very well. There's a bush there, so you're looking to the right and looking desperately for a gap in the traffic and the tendency, I think, would be to zoom across that [laughs] bit quite quickly, to get into the road. It will be interesting to see how drivers behave, or whether they just come in and actually park again across there because they need to see, they need to look right and make sure nothing's coming before they turn into the road." (F, Thu pm).

"For a car driver come off the side road, I think the problem is the stopping line, the dashed line just in front of that car, obviously it's so far back that the car driver, from their potentially stopped position, wouldn't be able to see left or right because of that stopping line being that far back. So I wonder whether anybody would actually stop there or rather actually continue till they can see? I think what would probably be more helpful in this place, if the pedestrian path wasn't the double

width it is at the junction but actually continues the same width as it is either side of the junction, then bring the stop line a bit further forward so it makes it clear for the pedestrian that their way, where they're supposed to cross over, is at the point where everybody can see everybody, rather than being just behind the corners?" (M, Thu pm).

"A painted cycle way like that I feel is quite dangerous for small children who are cycling. I prefer to see a protected verge, a little hedge, or a strip of grass, obviously away from the junctions, just to give the vulnerable users a bit more protection so that they don't stray onto the main busy road." (M, Tue pm).

One of the participants was from Southampton and provided more context and information on the picture:

"The only reason [the cycle lane] is like that is because, just out of sight, is a big building site so they didn't put the kerb in, because that building site was meant to be being developed so they thought the kerb could get damaged. So the whole rest of that route has got kerbs on it and that is going to have kerbs on it. And the way the traffic swings round into a U-turn, that's the only bit that's like that, and that's been discussed quite a lot because cars can kind of U-turn and go into the side road, so that has come up a few times, should they be allowed to do that, because they can sort of do a, not a U-turn, but if they keep going off to the top of the picture it's like a massive big roundabout, so there has been talk about closing that, just because cars could try and zoom straight across." (F, Thu pm).

A few people commented on the position of the woman crossing the side road in the picture. Two possible explanations were offered. One was that the woman thought the crossing point was at the point of the ramp, the other that the woman was trying to cross behind the silver vehicle exiting the side road, which could have been blocking the pavement.

"Just very quickly, in the picture you can see the lady there is doing what I would often do, a lot of people do, is not crossing at the actual junction but going round into the side road, down where it feels safer because there's obviously less cars, and that's actually quite common, isn't it, people do that?" (M, Thu pm).

4.5 Summary of focus group findings

Awareness and knowledge of continuous footways varied greatly across our focus groups, with only few participants indicating they had experience of using one in the UK or abroad. A few people had never heard of the term or the concept of continuous footway prior to the focus group discussion.

Overall, continuous footways were perceived favourably as a design concept. To ensure that continuous footways receive support from a broad spectrum of roads users in practice, they need to be designed in a way that maximises the actual and perceived safety, ease of use and comfort of people with and without disabilities.

Drawing on the comments expressed by the participants on the five continuous footway layouts discussed in the focus groups, we have identified the following factors which may reduce actual and perceived risk, thus increasing the effectiveness of continuous footway design:

1. The use of a distinctive paving material for the footway, ideally in a different colour from the dark tarmac used for the road. This highlights who has priority on the junction.
2. Raising the level of the footway crossing well above the main road and side road carriageway level, to effectively slow down any vehicles approaching and passing though the junction.
3. The absence of gradients and obstructions on the footway throughout the crossing, which helps, in particular, people with reduced mobility, wheelchair users and people carrying children on pushchairs.
4. The use of tactile paving would be counterintuitive and should not be used.
5. Actions to explain to local visually impaired people the nature and design of continuous footways may be appropriate.
6. The provision of separated and protected cycle tracks rather than cycle lanes, ideally in a different colour than the footway and carriageway.
7. The use of unambiguous and well-maintained road markings and colour patterns for the various elements of the crossing (footway, carriageway and cycle track), implemented consistently at local, national and international level. This would help all users of the junction, including drivers.
8. The introduction of continuous footways in areas where traffic speed and flow are already low and where there are one-way systems, to minimise conflict between motorised vehicles turning in/out and pedestrians crossing the continuous footway.
9. Maximising visibility for all users of the crossing, through enhancing visual contrast and removing potential obstructions such as parked vehicles near the junction.
10. Meaningful and timely engagement with a broad range of road users with and without disabilities when developing and testing the design of continuous footways before they are introduced in a specific location.

5 KEY INFORMANT INTERVIEWS

5.1 Introduction

This research investigates the opinions of eight key informants each with a working knowledge of continuous footways who either are currently employed in local authorities or who work for consultancies in the UK. The aim is to understand which design factors influence the efficacy and safety of continuous side road crossings (or continuous footways) in the UK. We seek to answer the following questions:

1. Do UK examples of continuous side road crossings match good (Dutch/Danish) practice
2. What leads to this difference in the UK context?
3. What are the implications of any design 'compromises'?

This chapter summarises the results of the key informant interviews carried out to address the questions above.

Section 5.2 describes the methodological approach. Section 5.3 presents the data analysis and interpretation. Section 5.4 presents the results.

5.2 Methods and analysis

5.2.1 Methodological approach

To discover and understand the perceptions of professionals, their opinions and experience in relation to side road crossings and continuous footways, we adopted a qualitative methodology based on key informants. A semi-structured interview template was used that allowed some flexibility to account for the specific knowledge of each individual.

Originally, the intention was to conduct the interviews face to face where possible in May 2020. As a result of the Covid-19 pandemic, we developed an alternative methodology for conducting all of the interviews on-line.

Eight online interviews were conducted using Skype for Business, which allowed people to join either by using this application on an electronic device, or via a phone line (a mobile or landline).

A shortlist of participants was identified by the research team through their professional network in consultation with Sustrans Scotland. The list reflected a broad range of different experiences,

regions and that included both women and men. A longer list with possible substitutes should some people not be available was also drafted.

The final eight key informants were:

1. [KI1 - local authority], Assistant Manager in the roads design section in Glasgow City Council.
2. [KI2 - local authority], Project Lead for the City of Edinburgh Council's City Centre West Way Cycle Lane and Street Improvements project. He is responsible for the roll out of Edinburgh's largest cycle scheme which aims to install segregated cycle ways along various main roads in Edinburgh, cutting from the west to the east, with a level of design and intervention for cycling that has never been done before in the city, which seeks to be national best practice. There are lots of areas where they are redesigning uncontrolled junctions to prioritise movements by people on cycles and on foot. The local authority has adopted a presumption in favour of continuous footways, where they are resurfacing or installing new transport schemes. They consider various criteria including vehicle movements and pedestrian numbers across a side road. To date one 'proper' continuous footway and cycle track has been installed on Leith Walk, which was one of the junctions that was included in this study. The wider scheme will take a wholesale approach and install numerous continuous footways along its length.
3. [KI3 – consultancy], Transport Planner with Phil Jones Associates, who is also involved in writing design guidance for local authorities and national government.
4. [KI4 – consultancy] , Director of Local Transport Projects in a private sector practice that is involved in a lot of work for local authorities designing and implementing cycling structure throughout the UK, including a lot of work in Scotland on active travel. While working on the Quietways in London they did about 120 safety audits and encountered quite a lot of footway crossings, including blending footways.
5. [KI5 - local authority], Healthy Streets Programme Director at Enfield Council. He leads on a range of projects including mini-Holland work. He also leads on liveable neighbourhood projects and they have one in Enfield Town, with a bid in for another area. He is not an engineer, but has an interested in continuous footways from leading these big projects. They have implemented a couple in the borough but they found that there was a lack of guidance. In the light of implementation they have learned a lot and now have an idea what the guidance might include and look like.
6. [KI6 – consultancy], Technical Manager, Sweco UK specialising in walking and cycling design with responsibilities as a specialist in those two fields for the company and the projects that they do.
7. [KI7 – consultancy], Principal Design Engineer, Urban Movement, an urban design and transport consultancy. He does many jobs as a consultant but has a few semi-permanent roles including advising the mayor of Leicester on healthier streets for walking and cycling design and assisting Chris Boardman in Greater Manchester and checks the design quality on behalf of Transport for Greater Manchester for all their schemes that are associated with the Bee Network to support walking and cycling. He writes a lot of design standards and guides.
8. [KI8 – consultancy], Senior Transport Planner at Arup who leads on walking and cycling in the North West of Yorkshire but also has a national role.

Each interview lasted between 30 to 50 minutes and was facilitated by Jonathan Flower. The discussions were digitally audio-recorded and transcribed for analysis. Prior to the interviews, participants received a brief summary of nine of the ten junctions (Stratford was excluded due to the different nature of this junction) that had been part of the observational study. This included a photograph of each junction along with peak turning counts and crossing pedestrian and cycle flows.

5.2.2 Data analysis and interpretation

The transcripts have been organised, managed and analysed manually. An inductive approach was used for the identification of key concepts and themes that emerged during the interviews. Most of the themes were identifying features that made continuous crossings function well. Many echoed themes that independently emerged from the focus groups.

5.3 Results

5.3.1 Key informant predictions of the best and worst performing junctions

At the start of the interview, each of the key informants was asked to identify the junctions (based on some basic data on traffic, cycle and pedestrian flows, along with a photograph of the junction) that they thought would perform best for pedestrians and cyclists (that is to say would lead to the lowest percentage of pedestrian and cyclist yields to turning vehicles) and those that would perform worst. They each identified their top three and their bottom three as shown in table 5.1.

Table 5.1 Predicted performance of junctions for pedestrian and cyclists

KI ID	Top three	Bottom three
KI 1	Clapham; **Oval**; Walthamstow	**Edinburgh**; Leeds; Nottingham
KI2	**Oval**; Clapham; **Kingston**	Leeds; Nottingham; **Leyton**
KI 3	Clapham; Leyton; Nottingham	Leeds; **Southampton**; Walthamstow
KI 4	Clapham; Leyton	Leeds; **Edinburgh**; Oval
KI 5	Clapham; Edinburgh; **Oval**	Leeds; **Leyton**; **Southampton**
KI 6	**Kingston**; **Oval**; Leyton	**Southampton**; Nottingham; Leeds
KI 7	Leyton; **Oval**; Edinburgh	Kingston; Clapham; Nottingham
KI 8	**Kingston**; Edinburgh; Walthamstow	Nottingham; Leeds; **Southampton**

The junctions highlighted in bold in the table are the ones where the prediction corresponded with what was observed in the observation study. In the study junctions with the lowest percentage of pedestrian and cyclist yields to turning vehicles were deemed to be performing the best for people walking and people cycling. Those with the highest percentage of yields to turning vehicles were deemed to be the worst performing.

- Five of the eight key informants correctly identified the Oval and three identified Kingston as junctions that would perform well for pedestrians and cyclists, but none identified Leeds
- Six key informants thought Leyton and Edinburgh would both work well, but they were the bottom performers for pedestrians and cyclists
- None of the key informants thought Southampton would work well
- Four of the eight key informants correctly identified Southampton and two identified Edinburgh and another two Leyton as junctions that would perform badly for pedestrians and cyclists
- Six key informants thought Leeds would perform badly, but it was actually in the top three; the other top performers, Kingston and Oval were also mentioned by one key informant each as likely bad performers

Overall, the best and worst performing junctions do appear generally to have been appropriately identified by the key informants. However, there is not a great deal of consistency in this selection across all informants. The three that worked for local authorities generally made more realistic predictions than those that worked for consultancies (but many people in the consultancies are former local authority officers).

5.3.2 Design features that make it good for people walking and cycling

The interviewees identified a number of design features that they felt helped continuous crossings to function well. These are highlighted along with a sample of comments.

Continuity of kerb line along main road

By continuing the kerb line along the main road, the design appears to be a footway and cycle track rather than a side road.

"There is a clear kerb that cuts across the carriageway." "It does kind of support what I was saying about the consistent kerb line continuing through, which are the things that are good about this one." (KI2).

"A nice continuous kerb line to the main road as well which really reinforces that it is changing from a carriageway into a footway and cycleway area." "We ensured that the kerb line along the main carriageway remained straight as well. We didn't have anything that looked like a side road. We didn't want any blurring between being, whether it's a side road or a raised table or a continuous footway so it was very much a straight line and clear that it was a continuous footway and not to give any mixed messages to drivers." (KI 8).

No visible radii

By removing visible radii, not only does the side road treatment no longer look like a conventional junction, but it also withdraws the invitation to turn in at speed and makes it more difficult to do so.

"I'm just wondering if they'd have kept that kerb line straight on because you are inviting the turn in aren't you with this curved you know the way that the kerb line curves in (which indicates a side road and invites turning vehicles to turn in at speed)." (KI 5).

"You've got a radius so it looks a bit more like a conventional junction… that is contributing to that sort of behaviour and lack of yielding (by drivers)." (KI 3).

Continuity of mainline road markings

Continuity of markings indicating waiting restrictions provide another visual indication that the treatment is a footway and cycle track rather than a side road.

"I would have kept I think the double yellows (across the side road)." "I don't know why they've broken the double yellow line." (KI 5).

"Critically, I think the no-stopping markings, the double reds, also continue unchanged across the side road. I think that's really important." (KI 2).

"Waiting restrictions are obvious. I'd like to see those on the main road continue straight past the side street." (KI 6).

Vertical upstands to slow traffic

Ramps serve to physically slow turning vehicles and provide comfort to people crossing on foot or cycle. Appropriate specification kerbing is now available to provide a Dutch style ramp for the UK context.

"A ramp (sharp level change between carriageway and cycle track/footway to help slow turning vehicles down)." (KI 5).

"Another really important feature is a vertical change, so I think a relatively steep ramp is really important, because it means it's not optional to slow down when taking that side road." (KI 2).

"Yeah, so maybe it needs that kind of going up and down movement for the vehicles to sort of reinforce that point at which they cross the footway." (KI 3).

"And staying at the same level because you've got that ramp; so the ramp both keeps the footway and cycleway perfectly level but also means that drivers have to slow down to go to that ramp to turn into the main road." "*We worked to develop a new Dutch ramp kerb that can be used in the UK to slow drivers turning into side roads and provide a nice steep ramp to really slow them down."* (KI 8).

Continuity of materials and colours

Continuity of materials and colours visually distinguish what is footway, what is cycleway and what is carriageway. This invites people walking and cycling to take priority across side roads and warns turning drivers to proceed with caution.

"Most important thing is that the footway, and if there is one the cycle way, the materials palette continues as far as possible unhindered, and that that materials palette is distinct from the carriageway. So, it needs to look like the road breaks either side of the crossing. And supporting that, there's other visual features, other than just the materials palette of the cycle way and footway which aid that." (KI 2).

"There is a very marked continuation of exactly the same materials for the cycle track and the footway straight through the junction. It's more clearly sort of straight up and down, more obvious that you are as a motorist sort of crossing the footway and cycle track." (KI 3)

"We continued the red cycleway colour across the side roads." (KI 8).

Continuity of level for footway and cycle track

Keeping the footway and cycle track at the same level provides comfort and convenience to people crossing on foot or cycle.

"As far as possible, the footway and the cycleway should not only continue materially unchanged, but they should continue at the footway level." (KI 2).

"And staying at the same level because you've got that ramp; so the ramp both keeps the footway and cycleway perfectly level but also means that drivers have to slow down to go to that ramp to turn into the main road." (KI 8).

Good sight lines and visibility at junctions

Good sight lines are important for safety. Poor sight lines may mean that the junction is not used in the way that it was intended.

"Visibility is good (for crossing pedestrians and vehicles turning into the side road)." (KI 4).

"The one real drawback of this one is the sight lines that a vehicle is going to have from that Give Way. It kind of looks like, even in this image, that van has had to nose forward onto the footway in order to actually be able to see when there's a gap in the cycle way and the main traffic lane." (KI 2).

Features to constrain drivers to their route

With the removal of corner radii and visual clues for turning vehicles, some drivers may be tempted to overrun a wider area of footway. Physical obstacles such as plantings are sometimes used to prevent this.

"Why they planted the trees is the overrun." (KI 5).

As wide a footway as possible

When a continuous footway extends deep into the side road it does give users space and time to work out how they function. However, it does also tend to mean that vehicles, especially when exiting, end up lingering on the footway.

"Plenty of space for people to understand what's going on." (KI 4)

"I like how much the footway kind of extends over to the back you know into the side road." (KI 5).

Design priority for people walking or cycling should be self-evident

The interviewees made a number of other more general comments about design that they felt affected the effective function of continuous footways and cycle tracks. These are highlighted along with a sample of comments. When the design anyone looking at that junction should assume that people crossing on foot or cycle have priority.

"They should be legible themselves in how they work. I think it's about making sure the design very clearly creates an assumed priority for crossing users." (KI 2)

"Gives visual priority and legal priority to the cycle lane and visual priority to the pedestrians. I'm sort of strongly influenced by the sort of Copenhagen style, where it's a very visual thing." (KI 3)

"In practice if you can get the design right and the traffic flows and everything else the design probably does most of the work there." (KI 6).

" The things I like about continuous footways is you've got the potential to really infer a priority for pedestrians it's not currently possible in the UK legal regs if you really get into it, it's like an infer priority for pedestrians but it gets pretty close that continuation of the footway and the lack of instruction to a pedestrian to stop is kind of what makes them reasonable and also what makes cars slow down." "So there's different ways of doing it but the main one is for the driver to feel like they're going onto the footway. That's the fundamental design element that I'm looking for. If they're turning off the main road into the side road and I want them to feel like they're driving across a footway and so to do it like they were driving onto a drive across like a standard footway that's what I'm looking for." (KI 7).

5.3.3 Non-design features that make it good for people walking or cycling

The interviewees identified other features that help continuous footways and cycle tracks function effectively. These are highlighted along with a sample of comments.

Low turning count

Although there is agreement that low turning counts are more conducive to be used with continuous crossings, there was no agreement among interviewees about the cut off points for this. Their suggestions ranged from 60 to 300 turns an hour at peak.

"The flow there turning in and out (need to define how many vehicles turning in and out of a junction is too many for a continuous footway). So I've got a rule of thumb that I've just made up, I've had discussions with other people that it shouldn't be a continuous footway if there's more than 60 movements across it in the peak hour. So that obviously does okay in that respect." (KI 5).

"We've been wondering for some time about where the cut off is for this and it looks like we might have found it, that it's somewhere between 200 and 300 (turns in/out of the side road) where it becomes so busy with turning movements that people stop observing the behaviour, so I think it's maybe evidence that at busier junctions where there are large – you know, regardless of design, that this solution of priority might not work very well." (KI 3).

"Entering exit flows are low so you don't have sort of 100 plus an hour vehicles going in and out of there. Because then the motorists who are trying to change the behaviour of on these kind of junctions if they see that on a junction that the designs not warranted they will just ignore it." (KI 4).

"I suppose the ones that are more successful are where you're not having side streets taking a huge volume of traffic because if you've got lots of turning movements it's just going to get very complicated. There's probably a cut off limit between the amount of side road traffic mainly going in I think is the limiting factor because coming out you can take priority quite easily as a walker or a cyclist. Certainly turning in if it's very heavy turns then it's difficult to get across and drivers will just take priority themselves." (KI6).

"We had a debate of how many vehicles turning in and out to would you accept before like it doesn't really work. I was on a slightly different opinion to most of the experts in this area so I'm like anything that makes cars more likely to yield must be good for safety. Then the other argument is that anything that makes pedestrians feel confident to step out if the cars aren't going to yield or if there's lots of them coming across there could be a problem for safety as well. I have seen it used on some quite busy roads with some quite high turning particularly in Waltham Forest quite large numbers of vehicles turning out there and they were all looking to yield and give way to pedestrians but they're still getting through. So I'm not sure I quite believe in upper limits. There's probably like a

sensible point you've got like over 4,000 vehicles a day turning into it you might be getting to a point where you know maybe we need to do something a bit significant." (KI 7).

"It's a dead end so you've got very low traffic movements going into it." (KI 8).

One way operation of side road

One-way operation reduces conflict and exiting vehicles are more likely to give way to crossing pedestrians and cyclists. This means that for two-way operations other mitigating features need to be considered such as road narrowing at the exit, point closures to reduce turning volumes by preventing through traffic, and pockets to help facilitate turn in right movements.

"You've got the no entry in. It does reduce conflict even though it's a two way cycle route." (KI 1).

"I think in general, these are going to be more successful on one-way streets. That doesn't mean they can't be used for two-way, I know they can, but it is going to make it more challenging." (KI 2).

"Shows very much in favour of walking and cycling across it and you've got the no entry in. It does reduce conflict even though it's a two way cycle route." (KI 6).

"The side road being narrowed and it only being one way and it being out of the junction for cars where I think they're more likely to yield to pedestrians and cyclists using the continuous footway and cycle track." (KI 8).

Reducing traffic volume by area wide traffic management

As mentioned in 5.4.6.2 filtering a side road is a way of mitigating some of the conflicts raised by allowing two-way operation.

"A low traffic neighbourhood which is going to filter all those roads which is therefore going to drop the volume." (KI 5).

Lower flows on the main road

When the traffic volumes on the main road are too high it makes it difficult for vehicles to exit safely or to turn in, especially from the right.

"I can see people not keeping the track clear as they try to get out onto that very busy road. So that feels slightly problematic." (KI 5).

"If there was significant flow off a dual carriageway then really say like there was over 8,000 vehicles a day on the road that were turning into I'd want something signalised then I wouldn't be happy with that and that kind of 8,000 to 4,000 I'm probably going to be pushing more for a parallel crossing something a little more formal. But below that level even in those contexts it's definitely worth considering from my point of view." (KI 7).

High numbers of crossing pedestrians and cyclists

A critical mass of people crossing on foot or cycle helps them establish priority over turning vehicles and makes drivers more alert.

"The number of vehicles is really quite low, and the number of pedestrians and cycles is quite high. So obviously that's really important because people aren't going to give way unless there's a perception that there's a good number of pedestrians and cyclists." (KI 2).

"I think having decent numbers of pedestrians and cyclist using them as well so that drivers don't get complacent about thinking I don't really need to look because it's never got anyone crossing anyway. It's useful if it is a place of high footfall and cycle usage so that drivers are used to seeing people." (KI 8).

A critical mass of people walking helps them establish priority over turning vehicles.

"There's very dominant pedestrian movement there so I like that one. There's lots of pedestrians going across that." (KI 5).

High ratio of non-motorised users to turning vehicles

When more people are crossing on foot or cycle then turning in a motor vehicle it helps to establish the continuous crossing as a place that drivers enter as a guest.

"Ratio between NMUs (non-motorised users) crossing and vehicles turning in our out, I can't remember what the ratio is that you want, but you'd want a significantly greater number of NMUs than motorised vehicles. Because that establishes that the main use of that space is pedestrians and cycles. I think you'd want it to be a fairly busy main drag, in terms of pedestrians and cycles, so you

want quite a high-frequency of crossing movements being undertaken. I think that will be quite important." (KI 2).

Using continuous footways as network transition points

Continuous crossings work well as transition points from faster to slower environments, but the differential in speed should not be too great.

"Got to be an area that they're entering that is somehow different." (KI 4).

However: *"You probably wouldn't want to be connecting this kind of side road to a really big through road or a big dual carriageway or something like that. You might have an issue where the local road network tries to force a very low class of street or in terms of traffic flow a low class of street, to a very high class of street for movement and it doesn't quite work at that interface. The Dutch would tend to try and step it down between the two."* (KI 6).

Uni-directional cycle tracks

The interviewees identified other features that help continuous cycle tracks function effectively. These are highlighted along with a sample of comments. Uni-directional cycle tracks reduce the likelihood of drivers encountering an unexpected conflict with a crossing cyclist. Where bi-directional cycle tracks are deemed necessary for network reasons other mitigating features need to be considered to ensure that drivers expect cyclists to approach from both directions.

"If possible having the cycling one way so, on the side of the road if you've got somebody coming contraflow drivers don't necessarily expect them to be in that position." (KI 6).

5.3.4 Design challenges

The interviewees identified other design challenges that could hinder continuous tracks from functioning effectively. These are highlighted along with a sample of comments.

Lack of guidance

National and local guidance on continuous footways and cycle tracks is largely missing.

"Continuous footways guidance is lacking." (KI 5).

Apparent obligations relating to tactile paving

Tactile paving was a topic that concerned many of the key informants. Generally, they felt that their presence would undermine the effective performance of continuous footways. However, some still felt under some obligation to consider them. None of the junctions in the study had tactile paving.

"One of the big things, debate we've had around is tactiles you know so from a pedestrian point of view that looks like the pavement does continue but should we from a visually impaired users point of view they're not going to recognise they're actually crossing a road." (KI 5).

"Some comments from visually impaired groups that we haven't gone far enough in terms of what they're looking for where we have this sort of arrangement with the side streets and in that example, we tried to make a tonal difference between the roads and the footways and the cycle ways. We introduced tactile paving for the cyclists and for the pedestrians, things like that." (KI 1).

*"There's a big difficulty around how tactiles should be used at these, how we should indicate to blind and partially sighted users that they're using a crossing. I think that's been very, very difficult to get right." "We've made the decision to include – above a certain threshold, I think it's 20 vehicles per hour, we do include tactile paving, but we include it set back at the building line, so that it doesn't define the carriageway with the intention being that you're highlighting to a visually impaired users that they're entering a space where there's a hazard. That's kind of how we've dealt with it, but I've always felt like that's still not quite in the spirit of what's being attempted here, I'd be really interested to learn how your research there goes." (*KI 2).

"Cyclists themselves and probably pedestrians are more likely to give way the more it looks like a junction. There is obviously pressure from blind and partially sighted groups to put in tactile paving so that they know that they are crossing a junction mouth, but again that means that they are then likely to stop and pause which may give motorists the idea to sort of continue, so the loss of priority, and there is reluctance to have vehicles bumping up and down the kerbs so you end up with something that is nearer to carriageway height than the rest of the footway and cycleway so, again, it's kind of adding in the inconvenience and the discomfort to pedestrians and cyclists rather than making – reinforcing the traffic calming effect on the vehicles." (KI 3).

"One of the real design worries for me is like on the use of tactile. I don't mind tactile being on them but if the tactile is put in any kind of radius then effectively it looks like a side road entry treatment in which case cars will slow down but they won't be looking to yield priority so that's the kind of key

one." "The other kind of it's not regulatory it's kind of strongly inferred through the Equality Act on the use of tactile. That's a big issue for a lot of areas because you get visually impaired groups saying how are you supposed to know it's a side road. We need to listen out for cars they're turning in there, how could you expose us to such risk. But you want to say well the onus is on the more dangerous one to look out for you and this design solution slows them down and makes them think to be wary of you. If it wasn't there then how would you know to cross anyway, how do you know a cross is ever going to indicate, you're not set back into the junction so any passing car that you hear could turn in there and you've got no protection whatsoever you're just having to try and judge or maybe walk 20, 30 metres into the side road before you can hear whether actually there is an approaching car. With this kind of approach it's just keep walking, dangerous ones look out and it does seem to be very effective in doing that although it's not perfect." (KI 7).

Over complicated junctions

Continuous crossings work best on simple priority junctions and more complex set ups can interfere with this and so alternative arrangements may need to be considered.

"So much going on and you've got these conflicts coming from unexpected directions including the slip road opposite." (KI 6).

"Yes, so it's like one way gyratory system isn't it I think. I think drivers will be looking to speed up at that point." (KI 8).

Poor sight lines and visibility at junctions

Poor sight lines can introduce unnecessary danger and undermine the effective performance of a continuous crossing.

"Possibly for the cars edging forward it's because of the visibility with that very high – there's a wall at the other end. Because the give ways are set so far back, and the visibility even looking both ways would be effected but more so if you're coming from the left." (KI 1).

"The only other thing I've come across is visibility, so there are one or two where the cycle track was given priority over the side road or over a private driveway and the visibility splay wasn't very good and so even if drivers were kind of willing to yield the – didn't always get the chance because they couldn't see sufficiently far in advance before they approached the junction. I think if you look at the

one at the Oval you can probably see that, that anybody who wants to kind of join the traffic from there is going to have to pull out onto the footway and block it in order to join the road." (KI 3).

Two-way cycle tracks

Where bi-directional cycle tracks are deemed necessary for network reasons, other mitigating features need to be considered to ensure that drivers expect cyclists to approach from both directions.

"It appears to be like a two-way cycle route as well - you're having to look in two directions for both pedestrians and for cyclists bearing in mind that cyclists will be coming in faster and the thing is that could make things more difficult and possibly lead to more points of conflict." (KI 1).

"I think my main concern with a bidirectional track would be probably if there is more free flowing traffic on the main road that anybody turning out would probably be looking to their right for a gap in the traffic and not necessarily anticipating a cyclist coming from the left so there's potentially a safety issue there." (KI 3).

"The two ways are a real tricky one for me to combine with the continuous footway." (KI 7)

"One slight niggle which would take a point or two off is that it's a bi-directional cycle track. It's quite a nice wide one but it just means that cyclists might be coming from a direction that a driver isn't quite expecting so I thought there might be an issue there with drivers not necessarily seeing some cyclists. Hopefully they're looking in both directions for pedestrians." (KI 8).

Raised tables creating impression of shared space

Raised tables over several junctions instead of ramps at each continuous crossing can make people treat the whole area as shared space and do not slow vehicles turning into a side road.

"Raised tables at the junctions as well and again I've had a few adverse comments about them because people tend to take the entire raised table as a shared surface so because of the way the set-up of Sauchiehall Street we had to make the tables much larger than we would originally because some of the junctions are off-set from one another. It's not a set of crossroads as such, they're just off-set junctions. Which made them bigger and that gives it more of a, from our experience, more of an issue with people potentially crossing over a greater area, greater length of the street than what is maybe preferred if you know what I mean." (KI 1)

Narrow continuous footways can be ignored by drivers

If a continuous footway is too narrow it may just be ignored by drivers turning out.

"The actual distance from the Give Way to the carriageway is so low that it would just be really tempting for a motorist to just immediately straddle that." (KI 2).

Set back hard to achieve

Set back continuous crossings may give drivers the time and space to be aware of cyclists crossing from both directions on a bi-directional track. They also mean that vehicles turning out are less likely to straddle the crossing.

"Project I'm working on has a lot of bi-directional continuous footways. I think that enhances the need – if you've got turning in movements, that enhances the need for that bend in and that waiting space where someone can give way, because a motorist isn't necessarily going to be expecting bike movements from both directions when they decide to make that turning movement." (KI 2).

"One other thing, so between the carriageway and the cycle track it's having a decent amount of space for a driver to stop. If they are pulling into the side road there is stopping space. If they are pulling out of the side road they can stop before the join the main road otherwise they'll just hover around the cycle track or the footway." (KI 6).

Two key informants provided counter views: "*I think the cycle track continues in a straight line so there isn't a setback into the junction like the Kingston one. It's more clearly sort of straight up and down, more obvious that you are as a motorist sort of crossing the footway and cycle track."* (KI 3).

"I remember early on people saying how are drivers supposed to even know there's a side road. Well great if they don't then maybe they shouldn't be going down there and then that's people safe again. So that's the way I want it to look. The more there's an indent the more it feels like a side road and the more it kind of gets to a kind of side road entry treatment approach that's when I get worried." (KI 7).

Avoiding misleading road markings

Great care should be taken so that road markings at continuous crossings are not ambiguous

"A big part of why it doesn't work, the one on Leith Walk, is that we've turned the double-reds in to the ramp, and we've put the big white triangle, dragon's teeth, on the ramp as well, which signals to motorists that it's still a bit of carriageway, and I think that is a big part of why a lot of them aren't quite right." (KI 2)

"It's also got the double yellow lines that go around that junction radii as well so it sends slightly mixed messages about whether that is a continuous footway or whether it's just a normal side road which might confuse drivers when they're turning in and make them think that they've got priority over pedestrians and cyclists using it." (KI 8).

Choice of materials

Care is needed when choosing materials for construction as for example they may look very different in different weather conditions which may affect use.

"No you're absolutely right like if you go to like it's not Edinburgh like Glasgow and they use the rock that they use in all their paving it's got quite a low polystone value particularly when it's wet it's a real difficulty getting around there so you really worry about bikes, motorbikes, anybody kind of skidding and slipping over these things and yeah it does just look completely black when it's wet like the road so yeah you have to think about the different conditions." (KI 7).

5.3.5 Legal and regulation challenges

Legality of some road markings

Some continuous cycle tracks misuse road markings such as elephant footprints. Either the regulations should change or other design alternatives should be found.

"One thing we don't have but possibly has been misapplied in Waltham Forrest are the elephant's feet across the side roads on the cycle tracks. Waltham Forrest have done a few of those which are not lawful in this country. You don't tend to see that in the Netherlands but you do find it in Denmark sometimes. I'd rather design in the layout so the junction does the job than having to resort to markings and signs." (KI 6).

Legal status of continuous footways

The key informants were unsure as to the legal standing of continuous crossings, particularly whether or not the law would consider them to be part of the carriageway, or part of the footway.

"So I'm just concerned because I'm not clear you know it's not actually footway space (legally) I don't see anything that stopped it from being carriageway space." (KI 5).

"The other thing I would note is there is lack of clarity about how these designs should be captured under traffic regulation order and redetermination order processes. For example, there's a big question about whether or not you can fine someone for parking immediately on top of a continuous footway, given that it is not determined as footway under the redetermination order, it's determined as carriageway, and if it has been designed properly there are no parking markings. So, the double yellows should not continue over the footway area. But that means that if someone wanted to park there and got ticketed, they would have an unsettlingly strong claim against the council that it was not indicated to them that they shouldn't be parking there. And it's definitely not an option that we should be drawing double yellows over these things, because that just establishes where the carriageway/ footway division is." (KI 2).

Marked priority may be better than priority by design

Some informants felt more comfortable with road markings that provide marked, or legal priority to crossing cyclists, rather than relying on the priority through design approach of continuous crossings.

"Some people want to go further than others are prepared to go because obviously as part of the CDM 2015 regulations (The Construction (Design and Management) Regulations 2015, health and safety regulations), we as engineers are required to design out risk and my worry is that if we've put in shared surfaces without clear and defined priority and legally binding priority at that, then we're opening ourselves up to basically failing in terms of the CDM regulations." "Yes. I think that one, I do like the fact that they've got the markings across the cycle lane (Elephants' Footprints), an emphasis of there's a potential here for something to occur. It makes it – it stands out and makes the cyclist more wary and I would imagine it makes drivers more wary as well." (KI1).

Turning regulation ambiguity

Turning regulations are ambiguous in the UK. Set back junctions that are often used with continuous footways are a grey area as in the regulations there is no intention that give way markings should be used to require drivers to give way to people on foot. However, they are being effective used in this way.

"I think the left turning law in Denmark works well as well, that it's very clear that whenever you are turning across any other traffic lane, whether that's a cycle lane or a cycle track or another all-purpose lane, that you must give way to anybody who's coming along that lane. I think the UK law is quite ambiguous about what's the correct thing to do and there is a general perception amongst the public that cyclists are kind of moving up the inside when they shouldn't be, even if it is a cycle track, so I think there is that kind of reinforcement in law that helps." (KI 3).

"Well yeah there are a few cheeky things about it that don't quite break the regulations but are like still in a grey area and I almost don't really don't want to get into these because you don't want to stop them because they've been so effective but the setting back of the give way before the mouth of the junction is an interesting one because legally that give way is not for the pedestrians it's for the cars on the surrounding road so you're kind of dragging it back and telling them to give way to the cars before the actual conflict point, in some cases 10, 12 metres before the conflict point. Gets a little bit like weird in the regulations because we're effectively like legally misrepresenting what's going on in order to get a road safety result and that was a painful sentence for me to say and I almost didn't want to say but it is the truth, we're implying to drivers that they give way to pedestrians and those markings which are only used to give way to other vehicles be it cyclists or cars we're kind of implying that those give ways are for the pedestrians crossing when actually that's not what they're prescribed to do. So regulatory it's a little bit iffy and lots of authorities are seeing the huge benefits of these things but the ones that really get into it are still worried about aspects like that, who are they giving way to you can't do that, is this legally possible, what happens, how do the kids know how do the cars know and certainly there's a lot of engineers that think given that cars turn in and out of side roads at speed we shouldn't be giving anything to give any confidence to a pedestrian but then with that many people walking, so it's a tricky one." (KI 7).

5.3.6 Other challenges

The interviewees identified other challenges that could hinder continuous tracks from functioning effectively. These are highlighted along with a sample of comments.

Competing needs of different users

"But as I say we are trying to – I mean there has been a significant amount of consultation with the vulnerable user's groups like RNID and other visually impaired groups as well as the mobility impaired, etc. I'm trying to strike a balance between the needs of the visually impaired and the mobility impaired. It's quite difficult 'cause it seems that they want totally different things." (KI 1)

High speeds, volume and turning traffic on main road

"Cause for concern: high speed road." (KI 1).

"I think you know one of the issues for me is probably the volume of traffic along the road contributes to this kind of staged give way behaviour." (KI 3).

"A high number of right turn vehicles into side streets then that's more problematic so agree with that as well. It's one of these things." (KI 1).

Need for public familiarisation

"Needs to be a period of time for pedestrians will have to get use to this sort of arrangement and if that's indeed the way that we're moving in terms of road design. Yes it's a change for pedestrians, cyclists and for car drivers as well." "Just basically the top priority for me is safety and it will take time, I would imagine for cyclists, pedestrians and vehicle drivers if these schemes become widespread to get used to it and that's a concern for me to be perfectly honest and the potential for people to be injured and it would be cyclists or pedestrians that would get injured obviously." (KI 1).

Professional tensions

"There is a lot of caution amongst the profession to try and make it look a bit more like a conventional junction but I think the more junction-like features that you put in, the more it reduces the sort of visual effect of continuation for pedestrians and cyclists so it's probably counterproductive." (KI 3).

5.4 Summary of key informant interview findings

The key informant interviews confirmed a number of design features that enhance the design for pedestrians and cyclists including the following:

- Continuity of kerb line along main road
- No visible radii
- Continuity of mainline road markings
- Vertical upstands to slow traffic
- Continuity of materials and colours
- Continuity of level for footway and cycle track
- Good sight lines and visibility at junctions
- Features to constrain drivers to their route
- A footway as wide as possible
- Design priority for pedestrians and cyclists should be self-evident

Non-design features that make it good for pedestrians and cyclists are as follows:

- Low turning count
- One-way operation of side road
- Reducing traffic volume by area wide traffic management
- Lower flows on the main road
- High numbers of crossing pedestrians and cyclists
- High ratio of non-motorised users to turning vehicles
- Using continuous footways as network transition points
- Uni-directional cycle tracks

Remaining design challenges were identified as being the following:

- Lack of guidance
- Apparent obligation to use tactile paving
- Over complicated junctions
- Poor sight lines and visibility at junctions
- Two-way cycle tracks
- Raised tables creating impression of shared space

- Narrow continuous footways may be ignored by drivers
- Set back hard to achieve
- Avoiding misleading road markings
- Choice of materials

There are a series of concerns around the legality of /regulation challenges as follows:

- Legality of use of some road markings
- Legal status of continuous footways
- Marked priority may be better than priority by design
- Turning regulation ambiguity

Other challenges include rationalising the competing needs of different users, high speed and high volume roads with a high volume of turning traffic. There are the issues of the population becoming familiar with new designs and using them appropriately, and also the issue of differences of opinions within the professional community.

6 CONCLUSIONS

Of the 4,583 interactions, the majority (91.3%) were interactions where the road user crossing the side road either did take priority, or could have taken priority. This is significantly different from control sites in a Transport Research Laboratory study where 59% of pedestrians crossing typically designed side roads had priority. There remain, however, a proportion of pedestrians and cyclists who are forced to yield (8.7%).The contingency coefficient (=0.415, $p<0.0005$) suggests there is a moderate relationship between the individual site studied in this research and proportions of yields by type. Hence, this suggests there are differences between junctions in terms of their nature which may be creating different patterns of yielding. Edinburgh, Southampton and London Leyton, are the sites with the highest proportion of interactions leading to a yield by the people who were walking or cycling (between 38% and 45%). Other sites with relatively high proportions are London Walthamstow and London Clapham (11% to 25%).

As adjudged from the videos, in a majority of cases (89%), it was the action of the driver which caused the yield by the person crossing the side road. There is no relationship between main road flow and the number of forced yields, and neither is there a relationship between the crossing flow and the number of forced yields. A significant relationship has been found between the number of forced yields and the flows turning left in, turning right in and turning right out of the side road. This is unsurprising as the higher the conflicting flows, the higher the number of interactions and hence the higher the potential number of forced yields. There is no evidence from this relationship, however, that continuous footways should not be used above a certain level of turning flow. Design factors should be used to limit the number of forced yields, regardless of whether or not the number of turns is high.

There are no significant differences across all the junctions in the number of injury collisions before the continuous footways were introduced as compared with afterwards. This lack of significance in difference may reflect a true lack of difference, or may result from numbers too low in the before and after scenarios to demonstrate difference. The analysis takes no account of possible changes in pedestrian, cycle and vehicle flows.

Overall, continuous footways are perceived favourably as a design concept by members of the focus groups. A key message is that they need to be designed in a way that maximises the actual and perceived safety, ease of use and comfort of people with and without disabilities. Issues raised

concerning design include distinctiveness of the paving material, having the footway at a level above the carriageway, avoiding level differences on the footway and cycleway, separation of cycleways from footways, unambiguous road markings, having low motor vehicle speeds, maximising inter-visibility for all users, having meaningful engagement of users in the design. It was also found that having clues present, especially to help visually impaired people, concerning the presence of a continuous footway may be helpful. These clues should not include tactile paving, because this would be counter-productively suggest there is a carriageway crossing.

The key informant interviews confirmed a number of design features that enhance the design for pedestrians and cyclists including the following:

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Non-design features that make it good for pedestrians and cyclists are as follows:

- Low turning count
- One-way operation of side road
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- High ratio of non-motorised users to turning vehicles
- Using continuous footways as network transition points
- Uni-directional cycle tracks

Remaining design challenges were identified as being the following:

- Lack of guidance

- Apparent obligation to use tactile paving
- Over complicated junctions
- Poor sight lines and visibility at junctions
- Two-way cycle tracks
- Raised tables creating impression of shared space
- Narrow continuous footways may be ignored by drivers
- Set back hard to achieve
- Avoiding misleading road markings
- Choice of materials

Concerns also exist around the legality of use of some road markings, the legal status of continuous footways, and the ambiguity of turning regulations. There was also contention as to whether marked priority may in fact be better than the inherent 'priority by design' of continuous footways. Other challenges include rationalising the competing needs of different users, high speed and high volume roads with a high volume of turning traffic. There are the issues of the population becoming familiar with new designs and using them appropriately, and also the issue of differences of opinions within the professional community.

There are implications for the design of continuous footways arising from the research. Overall, designs need to aim at creating a situation where the turning vehicle driver does not give way are negligibly small. In circumstance where the driver does not give way, the design should ensure that the vehicle speed has to be low and such that contact between different road users can be avoided by the driver. These conditions can be achieved by the principles of having: distinctive difference in paving material between the carriageway and the continuous footway in all lighting conditions; ensuring distinctive height difference across the whole continuous footway that is not compromised by the effects of longfall and crossfall; clear separation of cycleways from footways; ensuring well maintained and unambiguous road markings; having radii and height difference that create low motor vehicle speeds; maximising inter-visibility between all road users.

Specific design features include: continuity of kerb line along main road; no visible radii; continuity of mainline road markings; vertical upstands to slow traffic; continuity of materials and colours that are different for the different areas within the scheme (footway, cycle tracks and carriageway); having a wide continuous footway and cycleway extending at least from the main road kerb line to the building line.

Continuous footways will work best where there are higher pedestrian and cycle flows; low vehicle turning counts; lower flows on the main road; for outward turning movements from the side road (on both two-way and one-way out operation); for inward turning flows to the side road where there are mitigating factors; ; uni-directional cycle tracks reducing traffic movements at the junction by area wide traffic management. More examples of good practice continuous footways should be constructed to enable further study of the which design factors and flow patterns work best.

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Appendix A Camera locations for observational studies

Each of the site diagrams for the observational study shows the position of the cameras used by TRACSIS, indicated as A, B and C. All were mounted with permission from the relevant local authority or Transport for London on street furniture such as lampposts.

Figure A.1 - Site 1, Leeds

Figure A.2 - Site 2, Oval, London

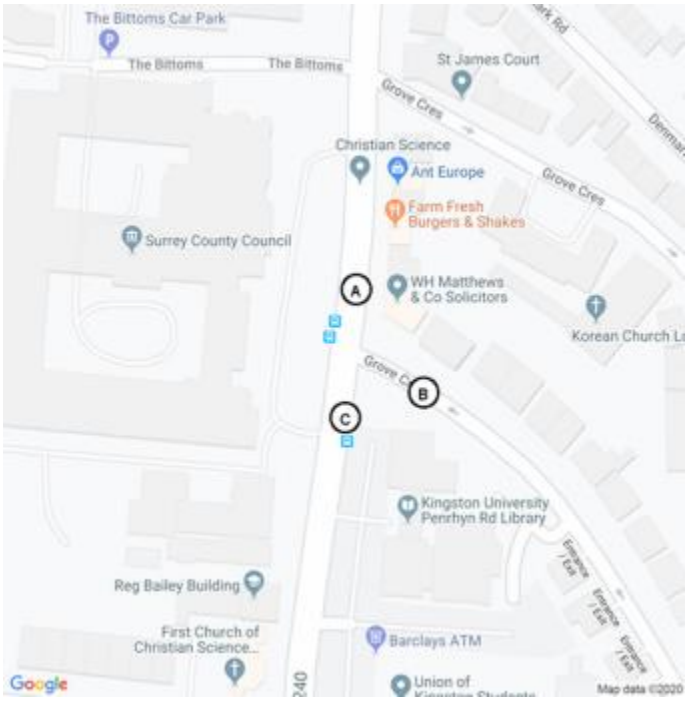

Figure A.3- Site 3, Kingston-upon-Thames

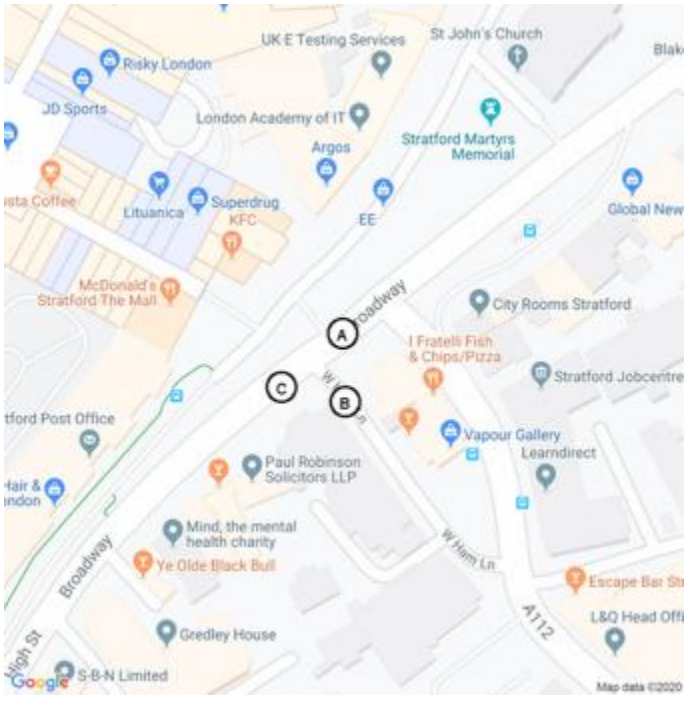

Figure A.4 - Site 4, Stratford, London

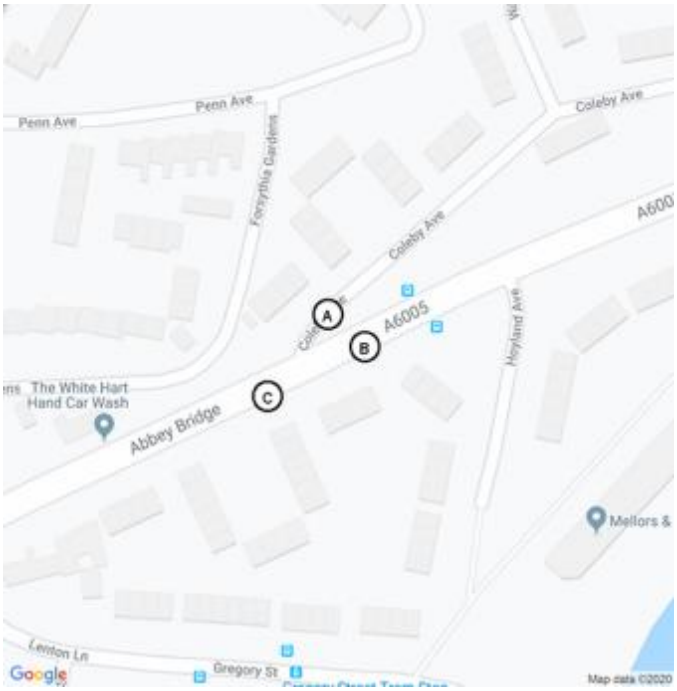

Figure A.5 - Site 5, Nottingham

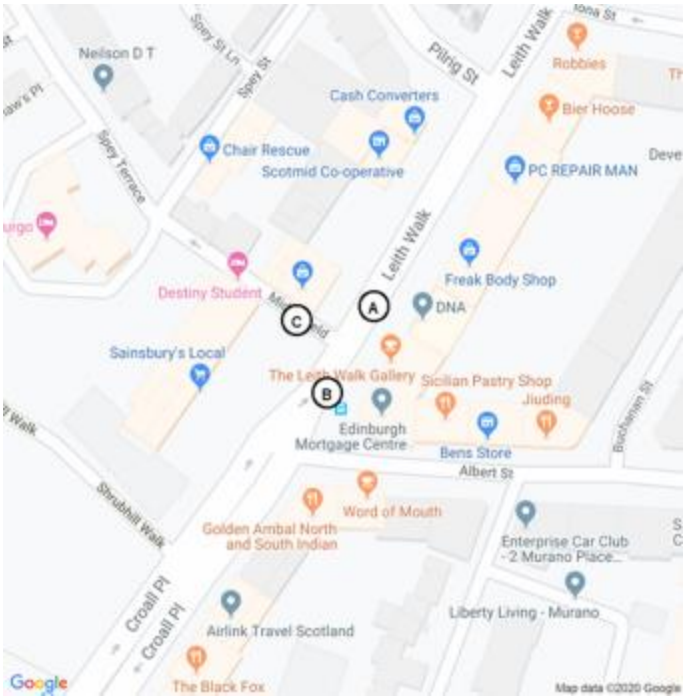

Figure A.6 - Site 6, Edinburgh

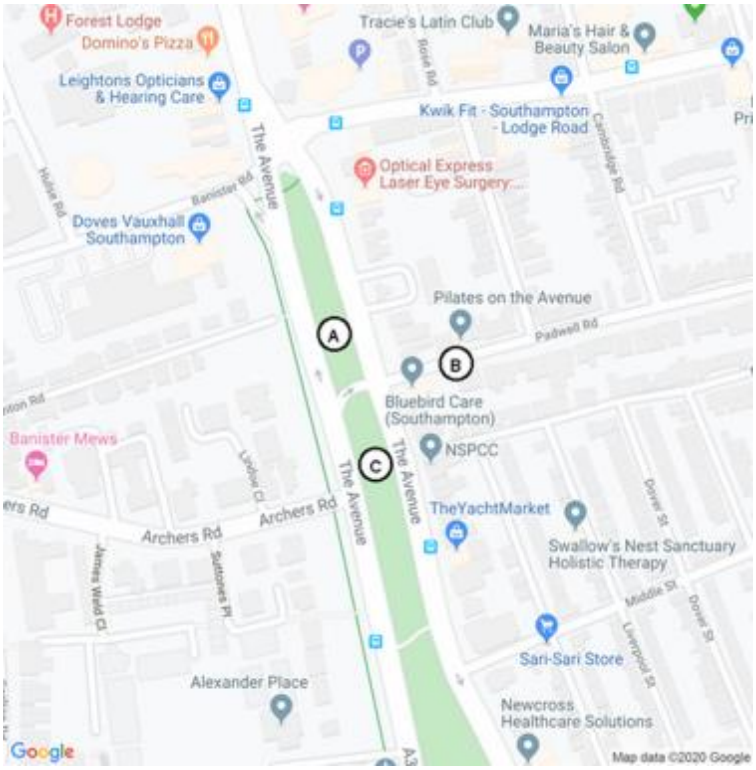

Figure A.7 - Site 7, Southampton

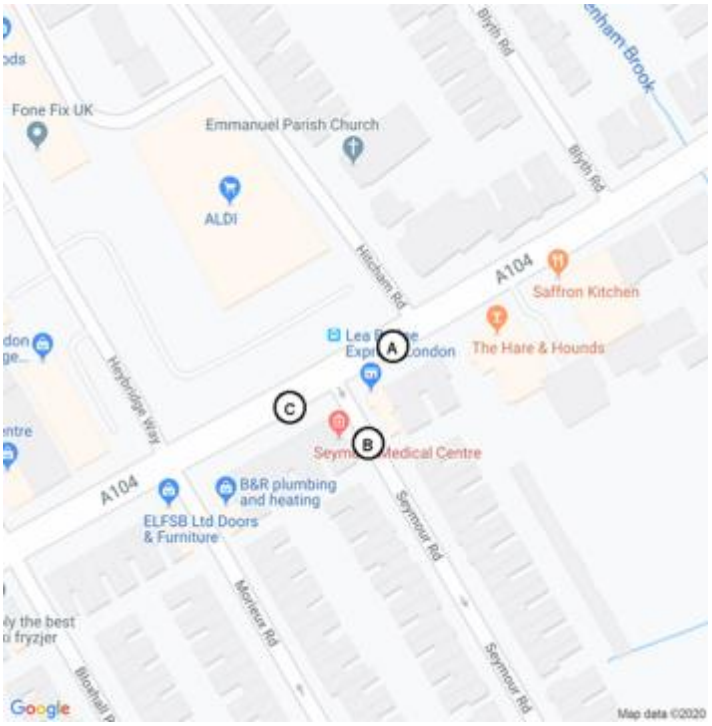

Figure A.8 - Site 8, Waltham Forrest

Figure A.9 - Site 9, Walthamstow

Figure A.10 - Site 10, Old Town Clapham