Transport Research Laboratory
Creating the future of transport

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Off Street Trials of a Bus Stop Bypass

Appendices

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Quality approved:

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Disclaimer

Contents amendment record

This report has been amended and issued as follows:

Version	Date	Description	Editor	Technical Referee
V1	18/12/2014	Final version	SG	MJ

Appendix A Main Trial Details

A.1 Actual flow rates used

The actual flows of pedestrians and cycles associated with these rates are summarised in Table 1.

Table 1: Pedestrian and cycle flow rates

Flow rate	Pedestrian Flow (per minute)			Cyclist Flow (per minute)		
	Min	Max	Average	Min	Max	Average
None				0	0	0
Low	0	20	5	0	9	2
Medium	0	39	9	0	14	4
High	0	46	14	4	19	9

A.2 Participant recruitment

Participants were recruited either as cyclists or pedestrians from a database of volunteers held by TRL. Participants had a choice of whether to attend, and (if they had registered as being able to cycle) a choice of their attendance as a cyclist or pedestrian. Participants were chosen randomly from the database to avoid potential bias.

A.3 Trial sessions

Participants were invited to attend on one of the twelve survey days. Each day was split into nine sessions with two groups of participants (both pedestrian and cycle) each taking part in 6 sessions:

Table 2: Groups and Sessions

Session	1	2	3	4	5	6	7	8	9
Group 1	Group 1 Takes Part								
Group 2				Group 2 Takes Part					

This approach permitted a range of flows to be tested in a day with the same participants. So, for example, a low flow in sessions 1 to 3, a medium flow group in sessions 7 and 9, would test a high flow in sessions 4 to 6.

A.4 Cyclist only sessions detailed information

The same sequence of sessions and runs were performed with each type of designated crossing point for consistency. The sequence of runs used on each trial day is summarised in Table 3.

Table 3 Cycle only sessions and runs

Session	Trial Day 1	Trial Day 2	Trial Day 3
B1	**Cycle Group 1**	**Cycle Group 1**	**Cycle Group 1**
Run 1	Cyclists overtaking bus	1 cyclist in bypass	Cyclists overtaking bus
Run 2	1 cyclist in bypass	2 cyclists in bypass	5 cyclists in bypass
Run 3	2 cyclists in bypass	Cyclists overtaking bus	10 cyclists in bypass
B2	**Cycle Group 1 & 2**	**Cycle Group 1 & 2**	**Cycle Group 1 & 2**
Run 1	5 cyclists in bypass	Cyclists overtaking bus	5 cyclists in bypass
Run 2	10 cyclists in bypass	3 cyclists in bypass	Cyclists overtaking bus
Run 3	Cyclists overtaking bus	5 cyclists in bypass	3 cyclists in bypass
B3	**Cycle Group 2**	**Cycle Group 2**	**Cycle Group 2**
Run 1	2 cyclists in bypass	10 cyclists in bypass	3 cyclists in bypass
Run 2	Cyclists overtaking bus	Cyclists overtaking bus	5 cyclists in bypass
Run 3	1 cyclist in bypass	5 cyclists in bypass	Cyclists overtaking bus

A.5 Cyclist Bus Bypass route

In all sessions (see Table 2, excluding 1, 4 and 7), cyclists started at the same start point as in the cycle only sessions and were individually set off at a fixed gap interval that varied in "1 minute time segments". Cyclists had to use the bus stop bypass: route through bypass, see Figure 1.

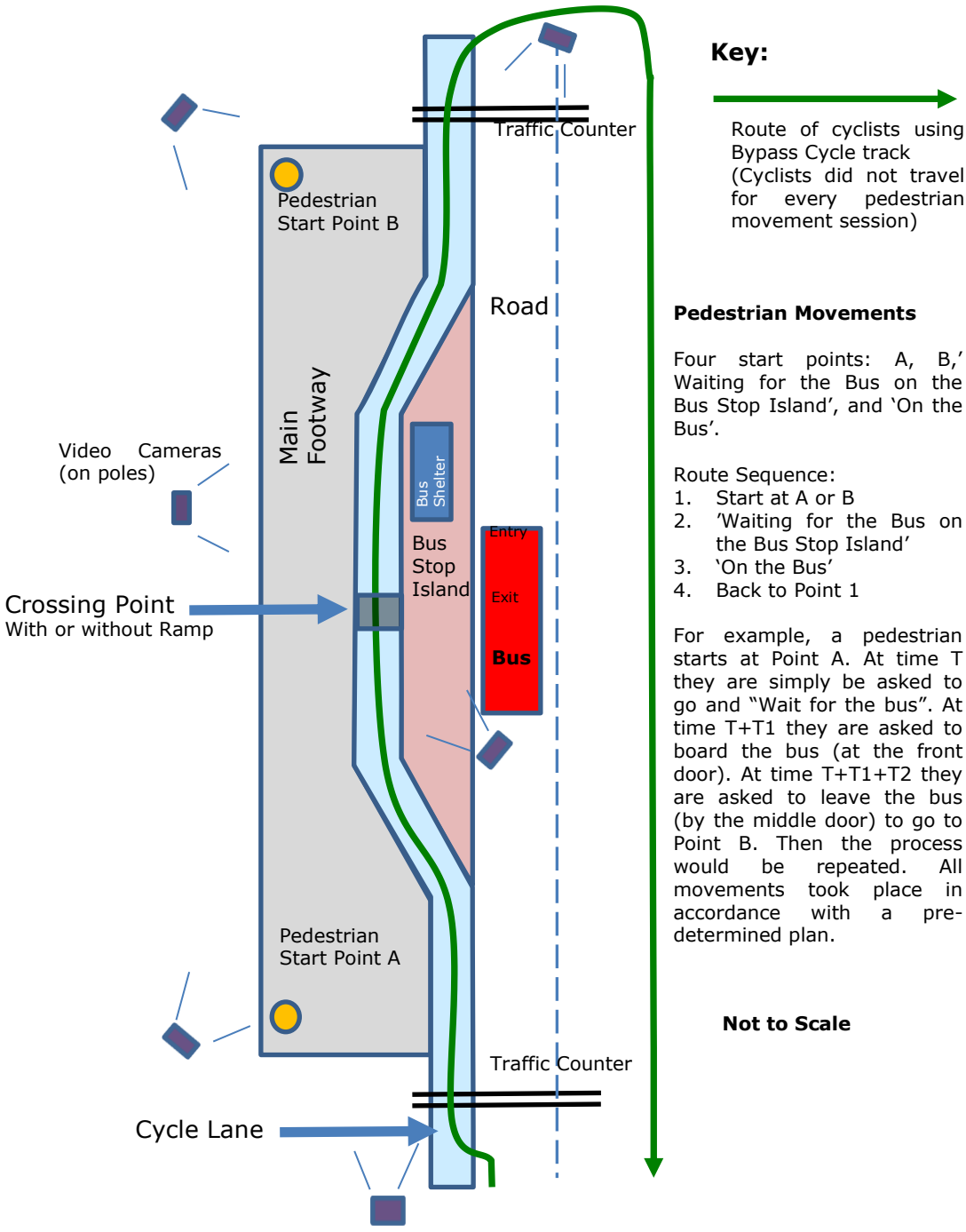

Figure 1 Plan of Bus Stop Bypass and cycle route

Appendix B – Accessibility trial details

Participants were invited to attend in separate groups of eight people per disability type. On arrival at TRL, the following procedure was followed for each group:

1. A health and safety briefing was provided followed by trial instructions.
2. The group was escorted to test track where they could experience the bus stop bypass facility. A member of staff accompanied each participant to offer assistance if required and make observations.
3. Participants began the trial on the footway adjacent to the bus stop bypass facility. Each group of eight participants was divided equally with four people at one end of the footway (point A) and the other four at the opposite end (point B).
4. Participants were asked to cross to the bus stop island using whichever route they preferred and then board the bus through the front door.
5. Once on board, participants were asked to alight from the bus through the centre door (which had the accessibility ramp deployed) and return to the opposite end of the footway from which they started.
6. Participants completed this activity at the same time, except the groups of wheelchair users, who were asked to proceed individually to reduce congestion at the crossing point, when using the accessibility ramp and when on-board the bus.
7. The process of moving from the footway to the bus and back to the footway was repeated twice.
8. Participants were then asked to go to the bus stop island and wait for a service without boarding. They were encouraged to exhibit behaviour that was typical of what they would normally do at a bus stop, such as look for information on the services or find a safe and comfortable place to wait. Participants in each group were asked to do this together, including wheelchair users.
9. After the practical trial, participants were invited to complete a questionnaire about their experience of using the facility before participating in a facilitated group discussion.

This procedure was replicated on four different trial days for each of the four crossing.

Appendix C – Capacity trial details

C.1 Capacity trial procedure details

The trial day was structured so that:

- The trial day was split into sessions that each contained one pedestrian flow rate.
- A number of runs were completed in each session, where a run comprised of all pedestrians starting at one of the two start points and ended when all pedestrians had been asked to wait for a bus.
- Each run contained up to 20 time periods. A time period was when a pre-defined group-size of the pedestrians was asked to leave each start point and wait for a bus. The group sizes were determined by assuming Poisson arrival times at the bus stop.
- A questionnaire was distributed to pedestrians leaving the starting points every 5th time period in nearly all the runs.

C.2 Details of areas used in the capacity trial

The areas coned off in the different sessions within the capacity trial are identified with an "**X**" in Table 4, and are defined in Figure 2.

Table 4: Session Numbers and Taped off Areas

Session	Areas In Use		
	A	B	C
1	√	√	√
2	√	√	X
3	X	X	X
4	X	√	X

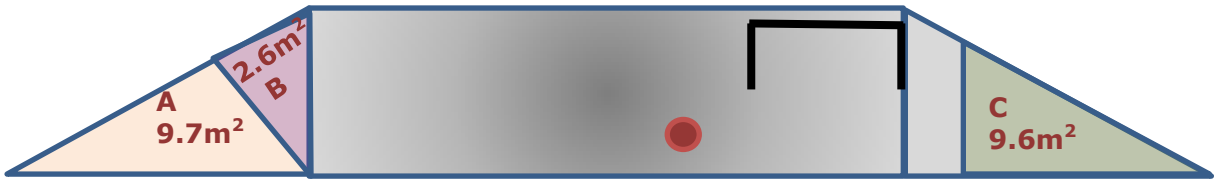

Figure 2: Diagram of BSI showing taped off areas and different sections

Appendix D – Sample compositions

D.1 Main sample composition

In each of the main trials of each type of pedestrian crossing, between 228 and 240 pedestrians and between 111 and 121 cyclists took part over 3 days. The age profile of the pedestrians and cyclists by gender, age and cycling frequency is summarised in Figure 3 to Figure 8.

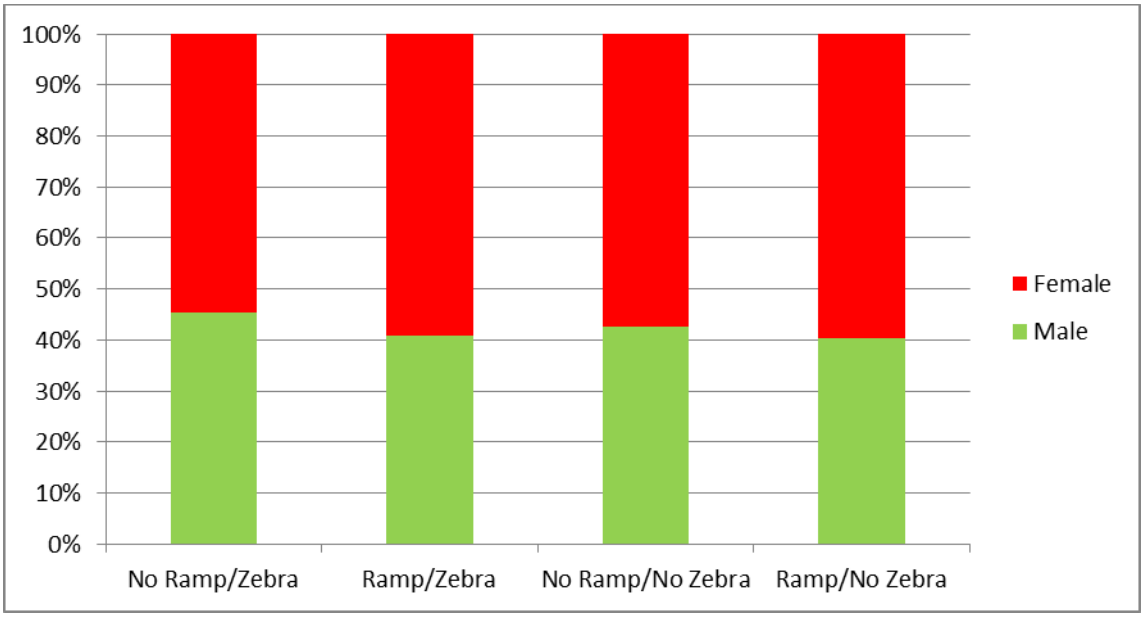

Figure 3 Pedestrian gender

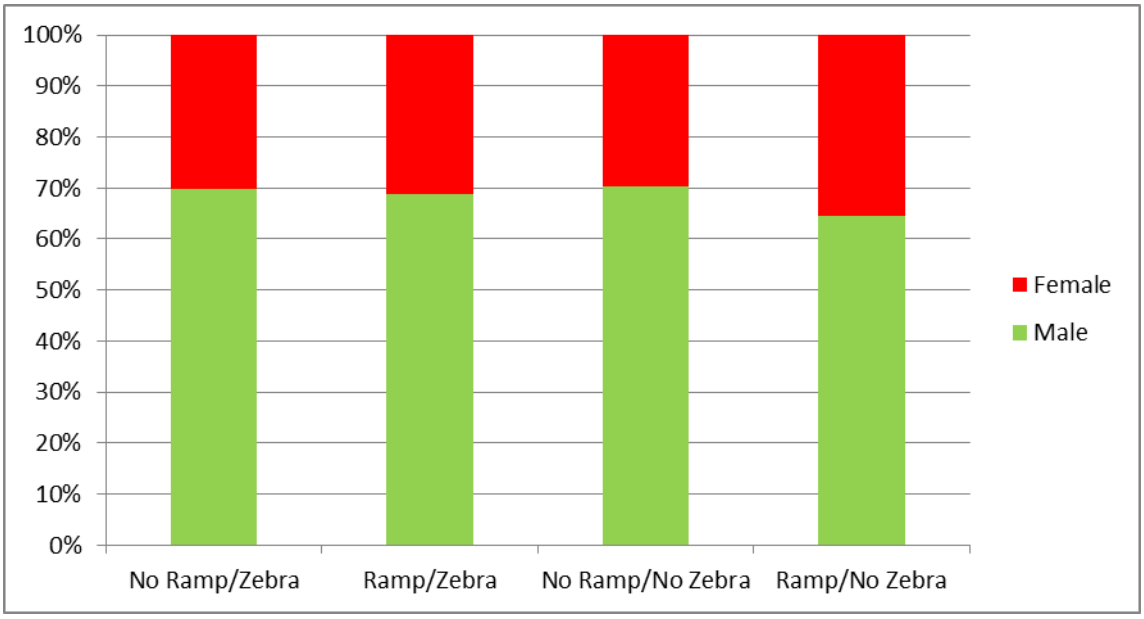

Figure 4 Cyclist gender

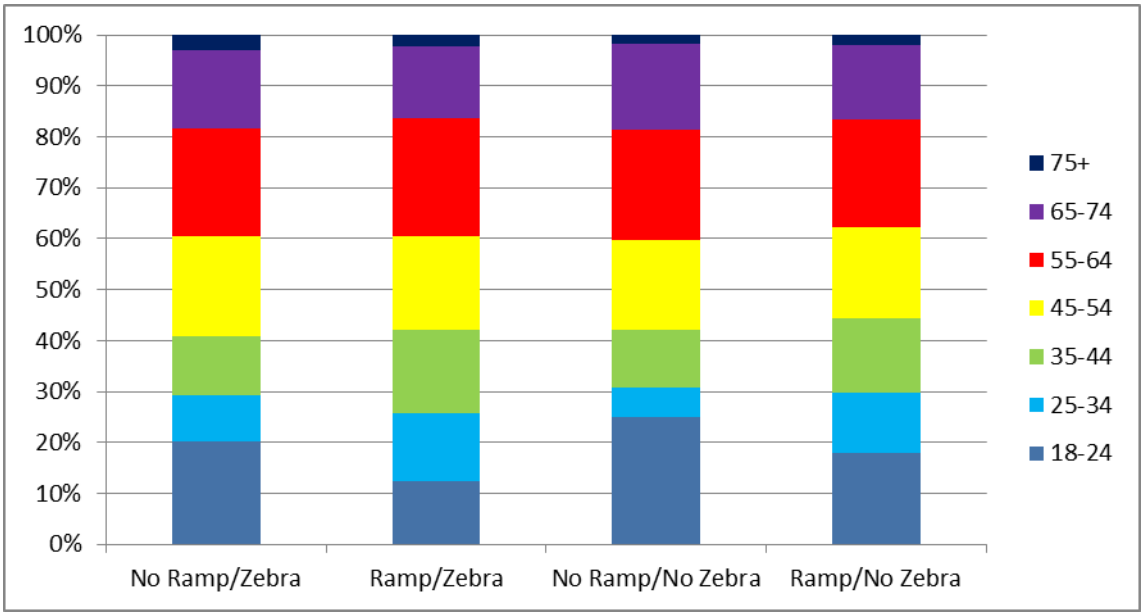

Figure 5 Pedestrian age composition

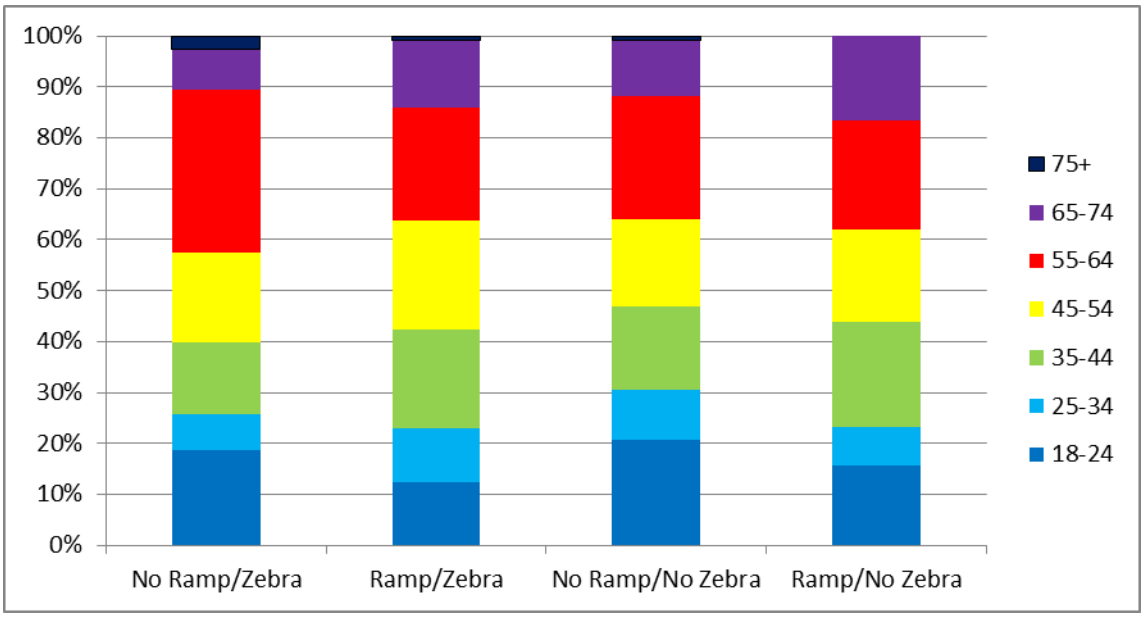

Figure 6 Cyclist age composition

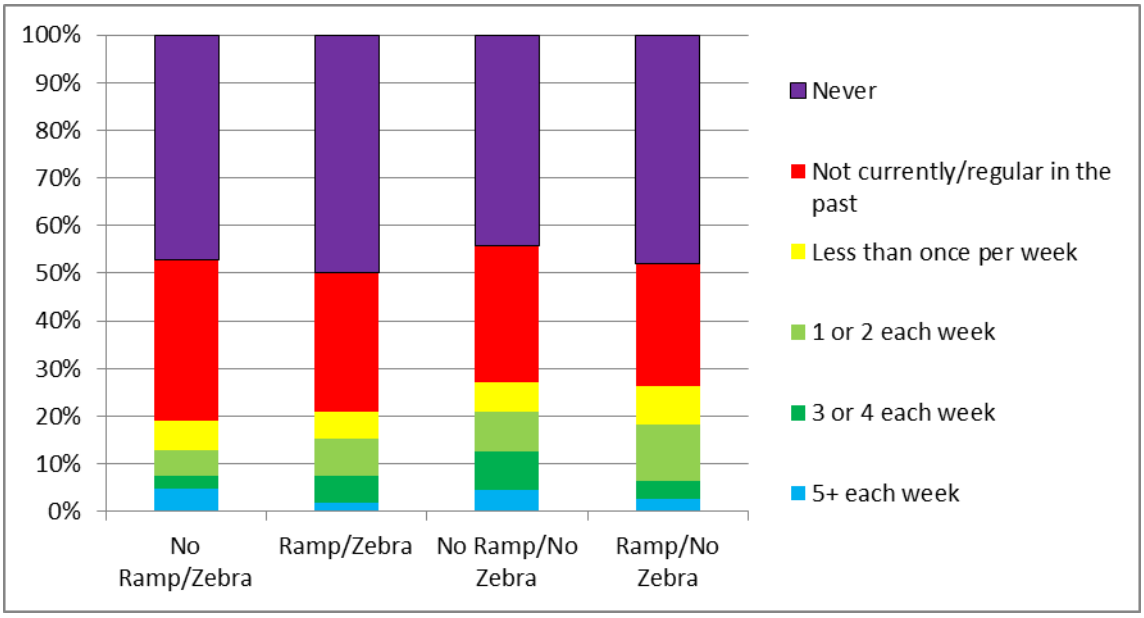

Figure 7 Pedestrians' cycling experience

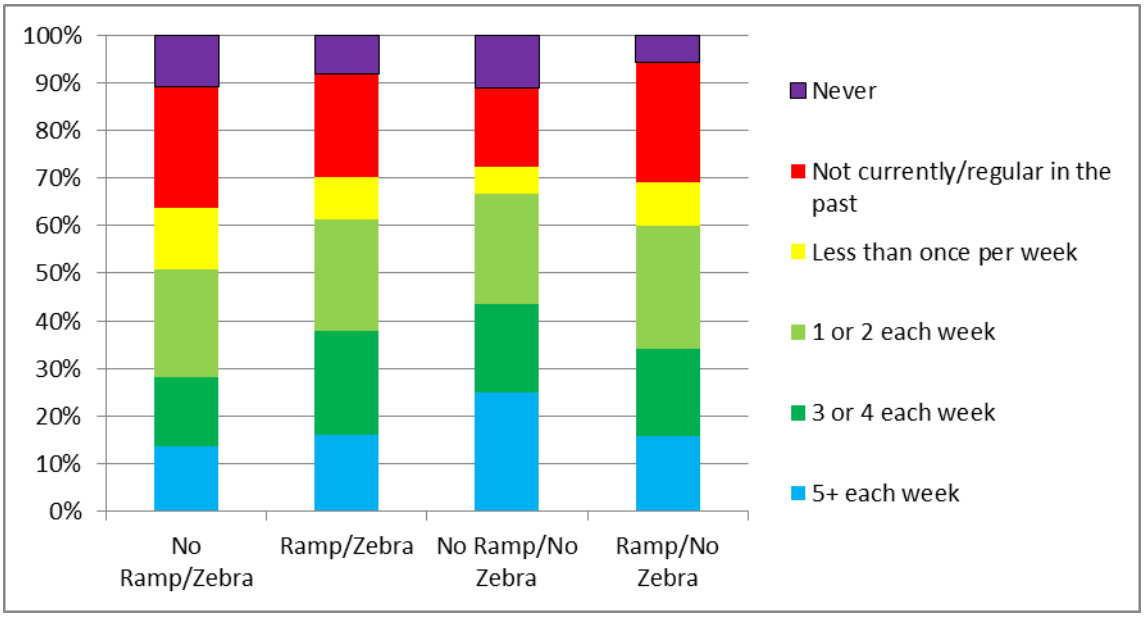

Figure 8 Cyclists' cycling experience

Participants were chosen randomly from a participant database. However, their participation was dependent on their availability to attend a trial. Their allocated role within their trial (cyclist/pedestrian) depended upon those that were unallocated and their capabilities (ability to walk, or cycle, for the required length of time). This approach would be expected to produce samples that are representative of the cross-sections in the database, and therefore only be subject to any biases inherent in that database; which are generally through the categories of people available to take part in a trial on a weekday.

Participant pedestrians were fairly evenly split between the genders: 40% to 45% were male. This is representative of London bus users: 46% of day time users of buses were male1. In contrast, participant cyclists were mainly male: 64% to 70% were male. This is reasonably representative of London cyclists: 53% of infrequent cyclists, and 67% of frequent cyclists, were male2.

The trial's pedestrian sample was clearly biased towards older people, the 18 to 25 year old age group accounted for 30% of those in the trial, but 52% would be expected on London's buses. Also, the 25 to 44 year olds were under-represented: constituting 17 to 30% in the sample compared with 50% in the bus population. This bias was expected owing to the availability of such people during a weekday.

Similarly, the cyclist sample in the trial was biased towards older people, with 45 to 64 year olds over-represented: 40 to 50% in the sample compared with 19 to 27% in the cycling population. This bias was exacerbated by the fact that 12 to 22% of cyclists in London are less than 15 years old and such young participants could not be included in this trial.

At least half the cyclists taking part were regular cyclists and, as expected, less than 21% of the pedestrian participants were regular cyclists. Pedestrian participants' experience of using buses was also collected and is summarised in Figure 9.

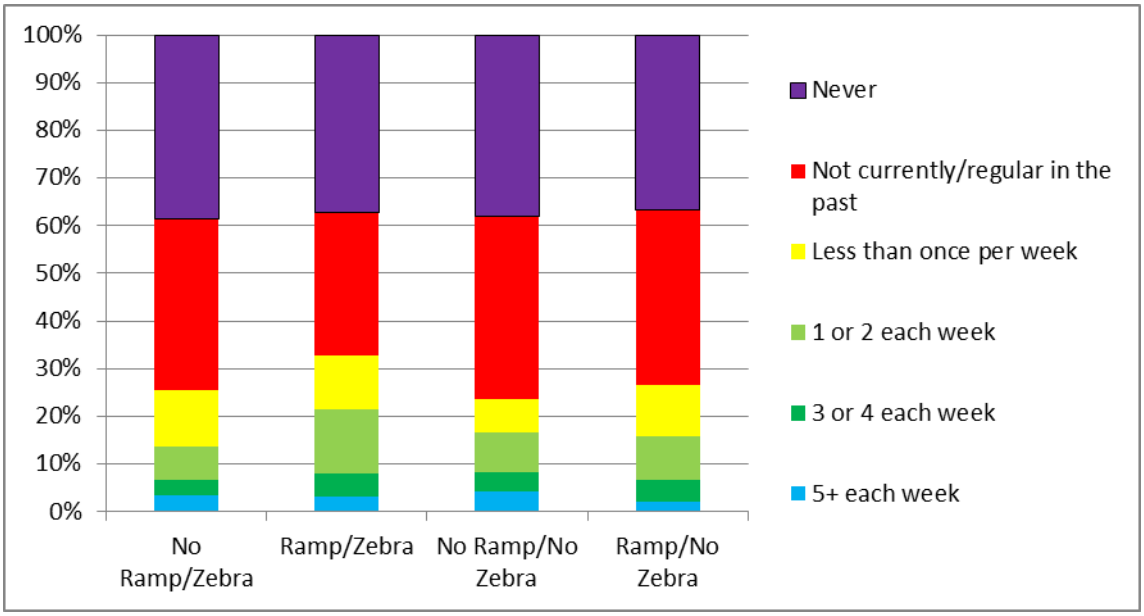

Figure 9 Bus usage by pedestrian participants

The participant pedestrians in the trials were generally inexperienced in using bus services. This was expected as participants were locally recruited, and bus modal share in Berkshire is smaller than London. However, this was consistent between the four

[1] http://www.tfl.gov.uk/assets/downloads/customer-research/bus-user-survey-report.pdf

[2] http://www.tfl.gov.uk/assets/downloads/analysis-of-cycling-potential.pdf.pdf

trials. All participants, both pedestrians and cyclists, were requested to behave as if they were encountering the Bus Stop Bypass facility on a busy road in London.

D.2 Second Trial Composition

D.2.1 Sample size

The number of participants from each disability group who trialled each of the crossing designs is shown in Table 5. Typically, participation rates were good except for just two wheelchair users attending the trial of the No Ramp/No Zebra crossing design.

Table 5: Number of participants in each disability group attending trials

Disability	Crossing design				Total
	No Ramp/No Zebra	Ramp/No Zebra	No Ramp/Zebra	Ramp/Zebra	
Deaf/hard of hearing	8	8	8	8	**32**
Blind/partially sighted	8	8	7	7	**30**
Wheelchair user	2	8	7	6	**23**
Mobility impaired	8	8	8	7	**31**
Total	**26**	**32**	**30**	**28**	**116**

The trial was a mixed design of repeated measures and independent sample. A total of 48 different people with disabilities participated: 33 experienced more than one crossing type, 15 experienced one crossing type. The data and analyses are therefore presented as if the study was an independent sample. When presenting the findings from some question items, lower sample sizes may be quoted if the question was not relevant to all participants, or if some participants chose not to provide an answer.

D.2.2 Sample demographics

The total sample represented all adult age groups (but was skewed towards older participants aged 45 years and over, with under-representation of those aged 35-44 years). The majority of participants (54%) used a bus at least weekly. Very few participants (8%) had never used a bus, with the remainder having some experience but not on a regular basis. Frequent bus users were more commonly blind/partially sighted or deaf/hard of hearing. Buses were most often used by participants for shopping and commuting.

Overall, participants most frequently walked outside of London. However, more than two-thirds of the sample (71%) had at least some experience of being a pedestrian in London (for 25% of the sample, this was at least weekly).

D.3 Third Trial Composition

Participant pedestrians were fairly evenly split between the genders: 49% male and 51% female. This is representative of London bus users: 46% of day time users of buses were male. The age distribution of the participants and how this compares to actual populations is summarised in Figure 10.

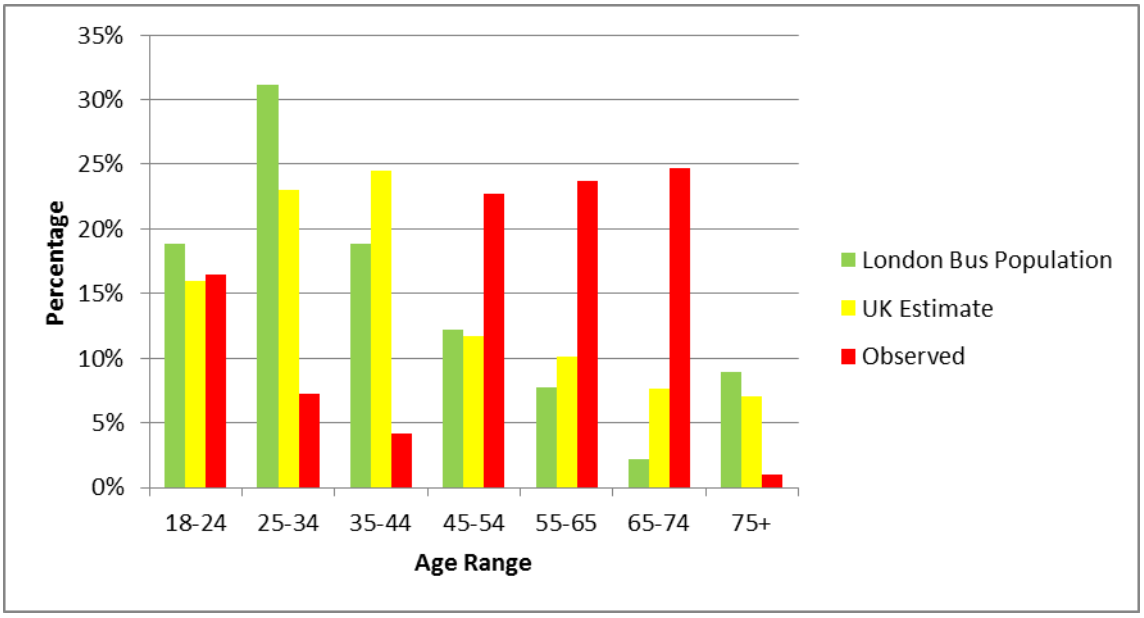

Figure 10: Age distribution of sample[3]

The sample in the trial was clearly biased towards older people, with 25 to 44 year olds severely under-represented: constituting 11% in the sample compared with 50% in the population. This bias was expected owing to the availability of such people during a weekday.

A bias was also evident in the participants' experience of using buses. Only 22% used a bus at least once a week, and 32% stated they never use a bus. Also 47% stated they had never cycled regularly, and only 9% stated they cycled at least one a week.

[3] References for UK age distribution estimate and London bus user age distribution estimate were:

http://www.ons.gov.uk/ons/publications/re-reference-tables.html?edition=tcm%3A77-269171

http://www.tfl.gov.uk/assets/downloads/customer-research/bus-user-survey-report.pdf

Appendix E - Accessibility Trial Detailed Results

E.1 Ease of moving around the bus stop facility

Participants were asked to rate the ease with which they were able to move around the bus stop facility and locate the crossing. Higher scores indicate that the task was easy and lower scores indicate that it was difficult. Significant differences were identified in how easy it was for participants with different disabilities to use the bus stop facility in general, see Figure 11. Please note that in the following charts "At grade" refers to the "No ramp" crossing, i.e. the crossing is at the same level as the cycle track and main carriageway.

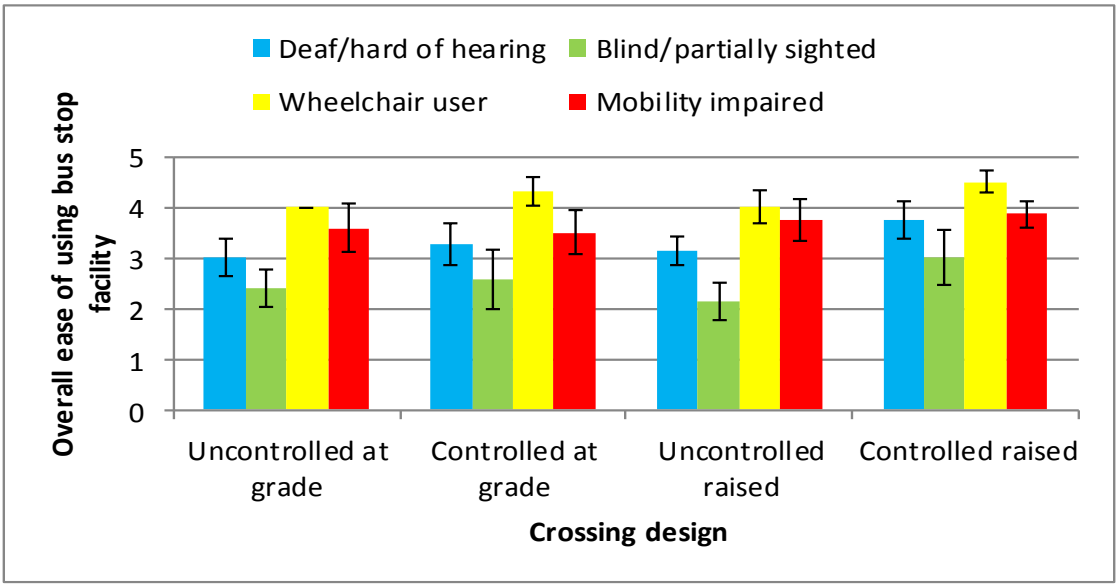

Figure 11: Ease of using the bus stop facility

Post hoc tests[4] showed that wheelchair users and mobility impaired participants both found it significantly easier in general to use the bus stop facility with the Ramp/No Zebra crossing than did participants with sight loss. However, there was no significant difference between any of the four crossing designs in how easy it was to use the bus stop bypass facility.

The scores for ease of moving from the footway to the bus stop are summarised in Figure 12.

[4] Post hoc tests refer to additional statistical tests performed after an Analysis of Variance (ANOVA). In this context, the mean scores for each crossing design were compared with each other to identify any significant differences, as were the mean scores for each disability group.

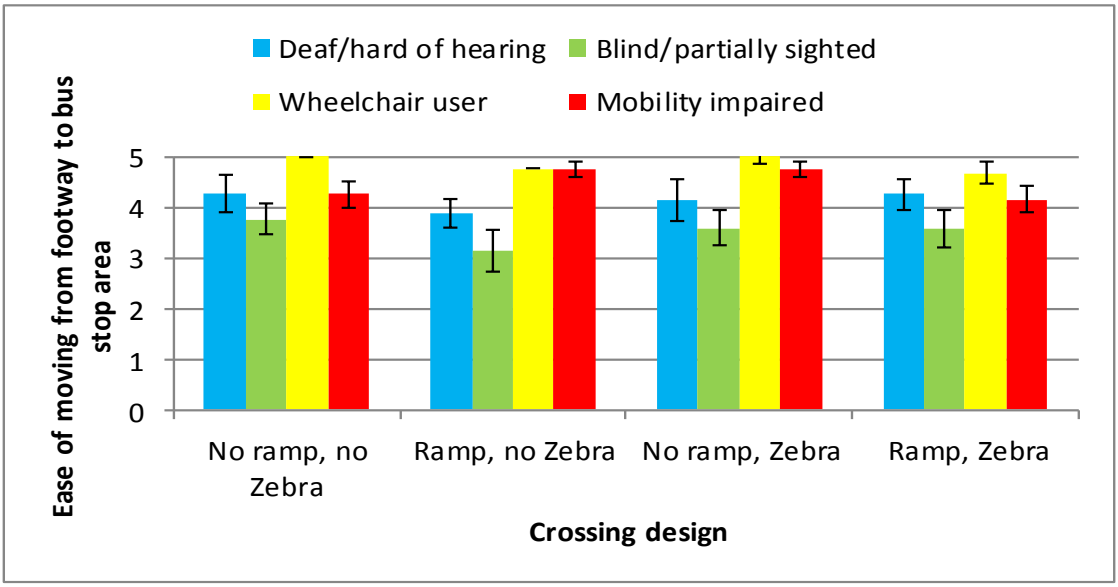

Figure 12: Ease of moving from the footway to the bus stop area

Wheelchair users and mobility impaired participants both found it significantly easier to move from the footway to the bus stop using the Ramp/No Zebra crossing design than did participants with sight loss. However, there was no significant difference between any of the four crossing designs in how easy it was to move from the footway to the bus stop island.

The scores for ease of moving from the bus stop to the footway are summarised in Figure 13.

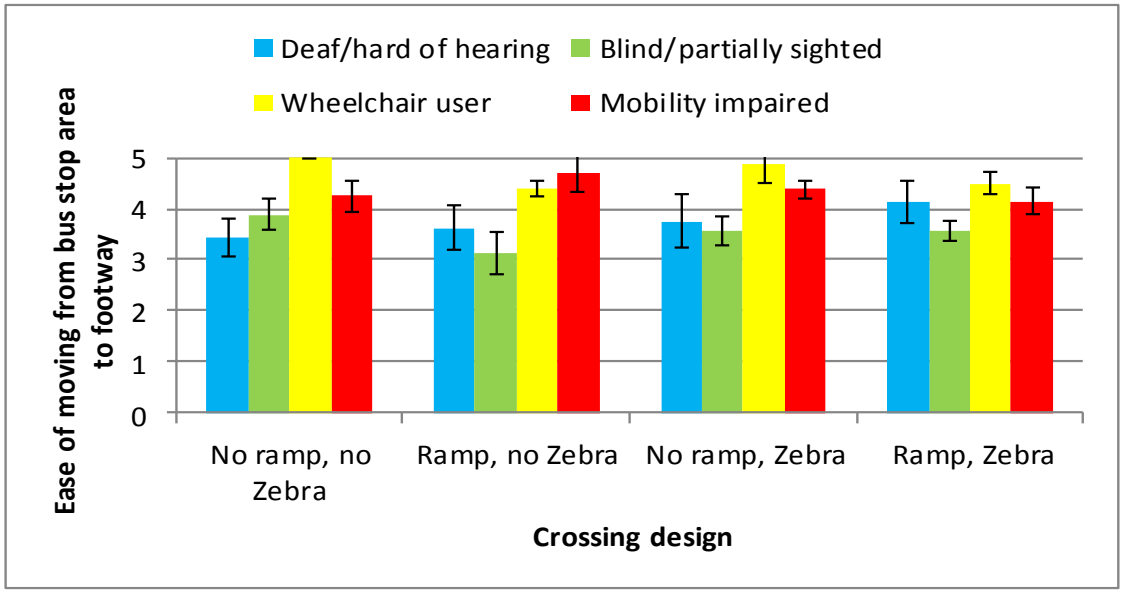

Figure 13: Ease of moving from the bus stop area to the footway

Mobility impaired participants found it significantly easier to move from the bus stop to the footway using the Ramp/No Zebra crossing design than did participants with sight loss. However, there was no significant difference between any of the four crossing designs in how easy it was to move from the bus stop island to the footway.

Blind and partially sighted participants commented on the significant difficulties they experienced when moving around the facility using the Ramp/No Zebra crossing. Specifically, they had problems navigating:

> *"I am very unclear as to the layout of this bus stop (e.g. the line the cycle path takes along the sidewalk and where the designated crossing points are)."* (blind/partially sighted participant)
>
> *"Because of lack of sight I could not see contrast of colours (e.g. tactile paving) as it blended in with the pavement. Did not think it was a designated crossing."* (blind/partially sighted participant)
>
> *"Lack of contrast. Lack of bright markings (these help to get around and see better)."* (blind/partially sighted participant)

In contrast, wheelchair users and mobility impaired participants found it significantly easier than blind and partially sighted participants to use the Ramp/No Zebra crossing design because it offered level access to the bus stop island and had minimal tactile paving (tactile paving can cause discomfort and impede progress for people with mobility problems, and can destabilise the castor wheels of wheelchairs).

Although no crossing design contributed to it being significantly easier to move around the facility, the most positive comments on this issue were received for the Ramp/Zebra crossing design. For example:

> *"Its usability is excellent."* (deaf/hard of hearing participant)
>
> *"The strong visual cues meant that I could understand clearly what the situation was, where the traffic would be coming from and where I needed to be."* (deaf/hard of hearing participant)
>
> *"Even on a bad day for my disability, it would still be easy to use the crossing because it is raised to pavement level."* (mobility impaired participant)

1. Crossing design did not appear to affect ease of movement at the facility.
2. When using the Ramp/No Zebra crossing, participants with sight loss experienced significant difficulties in general—and specifically when moving to and from the bus stop island when compared with some other disability groups.
3. Participants with sight loss commented on the poor visual contrast at the crossings with no Zebra.
4. Positive feedback was received on the usability and comparatively better visual contrast of the Ramp/Zebra crossing design.

E.2 Ease of identifying the crossing point

The ease of identifying each type of crossing point is summarised in Figure 14: higher scores indicate that the task was easy and lower scores indicate that it was difficult.

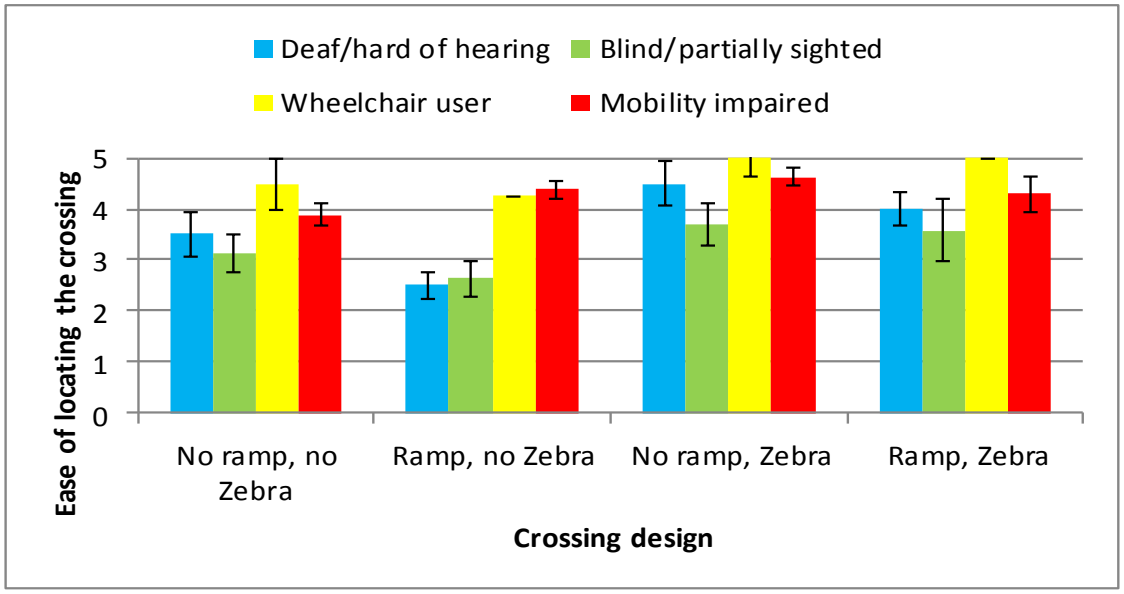

Figure 14: Ease of locating the designated crossing point

There was a significant difference in the ease of locating the different designs of crossing only for deaf participants, and they considered both Zebra crossing designs significantly easier to locate than the Ramp/No Zebra crossing design.

There were significant differences in the ease with which participants with different disabilities were able to locate the Ramp/No Zebra crossing design. Wheelchair users and mobility impaired participants both found it significantly easier to locate this crossing design than did participants with hearing or sight loss.

Participants suggested that the two no Zebra designs may have been more difficult to identify than the No Ramp/Zebra crossing because they lacked visual clarity, as described by the following comments:

> *"Did not realise at first that there was a designated crossing."* (mobility impaired participant)
>
> *"It was not clear it was a cycle way, if there was a designated place to cross or what the layout was. Very confused. Caused anxiety."* (deaf/hard of hearing participant)
>
> *"There was no actual markings on road to say 'cross here' (i.e. pedestrian crossing markings)."* (mobility impaired participant)
>
> *"Dropped kerbs not bright enough, couldn't tell from a distance where the drop kerbs were."* (wheelchair user focus group participant)
>
> *"Not easy to see difference between pavement and cycle lane (same colour, same level). I never saw the crossing point."* (deaf/hard of hearing participant)

Both no Zebra designs also lacked extended, contrasting tactile paving (in line with design guidance), which made it difficult for several participants to identify the crossing point:

"Needs to be brighter tactile, more contrast." (blind/partially sighted participant)

"Grey [tactile paving] on grey [footway] so no contrast. Had to wait to feel the [tactile paving] blisters. No markings to indicate where crossing was." (blind/partially sighted participant)

"Tactile pavement same colour as pavement. Not a designated crossing: no Zebra crossing, assumed did not have right of way." (blind/partially sighted participant)

"No tail [for tactile paving] make it difficult [to identify], needed to hug kerb to find it. Crossing fairly level. Crossing less apparent in normal use." (blind/partially sighted participant)

"If walking in the centre of the pavement you wouldn't know where the cycle crossing was." (blind/partially sighted participant)

It should be noted that, in line with design guidance, crossing points with no Zebra do not have the 'tactile tail' that extends across the footway (as at Zebra crossings). This helps people with sight loss identify the crossing point when walking along the footway without walking near to the kerb. In situations where people with sight loss are attempting to find a bus stop that is situated on an island for the first time, the typical cues for the bus stop are not present. For example, guide dogs or cane users will search for the bus, the bus stop flag or the shelter – at the bypass facility, none of these cues are readily accessible from the main footway. If users with sight loss are aware that the bus stop is on an island, they can seek out a crossing point to the island (or instruct their guide dog to do this), which some participants suggested would be simpler if the crossing point had extended tactile paving.

The pedestrian crossing markings at the No Ramp/Zebra crossing appeared to be the key reason for participants finding this design easiest to identify:

"Because of the better marking of the crossing it was easy and the cyclist is forced to stop." (deaf/hard of hearing participant)

"The crossing was much more visual and the beacons made it a lot easier to see." (deaf/hard of hearing participant)

"Easier… as designated crossing point was marked. Tactile strip was different and much more helpful as longer." (blind/partially sighted participant)

"Having tactile 'tail' on footway helped avoid using kerb edge for guidance." (blind/partially sighted participant)

Similar comments were received for the Ramp/Zebra crossing design; even though the results showed that statistically it was not significantly easier to identify than the crossing designs with no Zebra, participants still commented on the visual appeal of the design:

"It was much easier to identify where the crossing was, what the set up was and what was expected of me. Everybody understands the Zebra crossing rules and how they are expected to behave. Clear visual cues to what was happening." (deaf/hard of hearing participant)

"The belisha beacons, zig-zag markings and Zebra stripes made a big and positive difference. Plus the textured paving." (deaf/hard of hearing participant)

"Clearly marked; easy to see. Good - felt confident." (wheelchair user)

"It was clearly marked. It was a little hard in manual wheelchair without help." (wheelchair user)

"Very clear from a distance – well-defined crossing marked out – zig-zag Zebra markings, beacons, tactile paving in different colour. Due to the well-defined markings – very clear where to cross and very clear for cyclists to see." (wheelchair user)

The unconventional design of the bus stop bypass facility created some difficulties for blind and partially sighted users when trying to locate the bus. As this is different to finding the crossing and the two are not ordinarily directly related:

"With a dog the mission is finding the bus, not finding the crossing. The dog has no reason to guide me to the crossing point." (blind/partially sighted participant)

"How do you know the tactile paving is just for a cycle lane and floating bus stop and not a road crossing." (blind and partially sighted participant)

This raises an important point about the information provided to blind and partially sighted people. The crossing point, however it is designed, connects the footway to an island and not to a footway on the opposite side of the main carriageway, which is what an uninformed person with sight loss might reasonably expect. The narrowness of the bypass lane was reported to help distinguish the bypass crossing from other crossing types because it clearly did not span a standard carriageway width but there remains the potential for confusion. None of the proposed designs address this specific issue.

1. Overall, the No Ramp/Zebra crossing was easier to locate than both no Zebra designs (particularly for deaf participants).
2. When using the Ramp/No Zebra crossing, participants with sight or hearing loss found it significantly harder to locate than did other disability groups.
3. In general, the Zebra crossing points had more useful visual cues for identification.
4. A bus stop on an island provides few location cues to pedestrians with sight loss who are searching for the facility without prior knowledge of its location.

E.3 Perceptions of safety when using the bus stop bypass

Participants were asked to rate their feelings of safety when using the bus stop facility. Higher scores indicate that the task was safe and lower scores indicate that it was unsafe, see Figure 15.

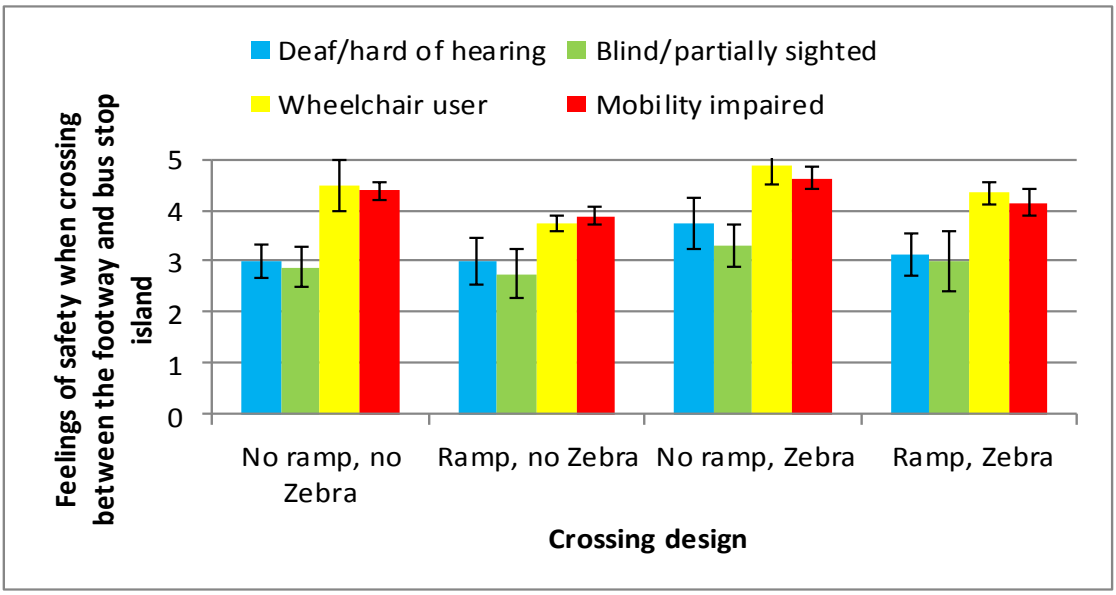

Figure 15: Safety when crossing between the footway and bus stop island

Overall, participants' feelings of safety when crossing between the footway and the bus stop island differed significantly by crossing design and by disability.

In general, it was considered to be significantly safer to cross between the footway and the bus stop island when the bus stop facility included a No Ramp/Zebra crossing than when there was a Ramp/No Zebra crossing.

Wheelchair users and mobility impaired participants both found it significantly safer to cross between the footway and the bus stop island than did participants with hearing or sight loss when using the facility with a No Ramp/No Zebra crossing. Comments indicated that this was primarily because participants with a sensory impairment found it more difficult to make safe decisions about when to cross without having right of way.

Also with a No Ramp/Zebra crossing, wheelchair users reported that it was significantly safer than did participants with sight loss. Blind and partially sighted participants commented that although they had right of way, they still did not feel safe because *"cyclists here are not behaving as they would in London"* (i.e. trial cyclists were more compliant).

Participants were also asked to report their general feelings of safety when using the facility. These findings followed a similar pattern to how safe participants felt when specifically crossing between the footway and the bus stop island. Comments regarding the general safety of the bus stop bypass drew attention to how the cycle bypass lane was not clearly defined and separated from the footway:

> *"The cycle* [bypass] *lane is new so I would probably not notice it if I was in London as I cannot hear any traffic noises etc. I will likely walk on the cycle path in crowded situations!"* (deaf/hard of hearing participant)

"I cannot hear well so need lots of visual cues for hazards around me. It was not clear to me it was a cycle lane..." (deaf/hard of hearing participant)

Other comments about the general safety of the facility were often negative. They were typically made by people with sight or hearing loss, and tended to focus on how such pedestrians may not be aware of cyclists and vice versa:

"I rate it unsafe because I do not trust cyclists to obey the rules." (deaf/hard of hearing participant)

"I think impatient cyclists will expect people to stop if cyclist is going fast. They may use bells or shout, and deaf people will not realise especially if they are in a hurry themselves." (deaf/hard of hearing participant)

"The whole bus stop design is predicated on the assumption that the pedestrian can identify the layout, and where the crossing is in advance while approaching it. It is fundamentally a visual design. Vision impaired people often can't assess a situation until we are actually experiencing it." (blind/partially sighted participant)

"Feel that inability to hear cyclists coming mean that it feels unsafe when crossing. Crossing point doesn't feel like it's designed for this purpose and lacks direction. Very difficult to find the bus." (deaf/hard of hearing participant)

"Again, I'm having to rely on sight rather than hearing. Designated crossing not visible enough so I do my own thing and cross elsewhere (and feel ok about it)." (deaf/hard of hearing participant)

"I cannot see oncoming cycles and with this configuration of bus stop am very unclear where I should anticipate a cyclist." (blind/partially sighted participant)

Many comments were received regarding the lack of island space to the rear of the bus shelter. The shelter used in the trial had timetable and route information on the rear of the shelter which prompted participants to stand in this area to read the information. Often, due to the lack of space, participants would stand in the cycle bypass lane. This contributed to several participants feeling unsafe. In addition, the opening to the rear of the shelter was criticised for inviting pedestrians to cross away from the crossing point.

More positively, it was noted that *"the raised section of the cycle track would cause cyclists to slow down for the bump"*, which was seen as a safety benefit of the ramp crossing designs.

E.4 Perceptions of danger to pedestrians

Safety concerns directed at the cycle bypass lane were reinforced further by reports of how dangerous participants felt the bypass lane was for pedestrians. Higher scores indicate that the task was dangerous and lower scores indicate that it was not dangerous, see Figure 16.

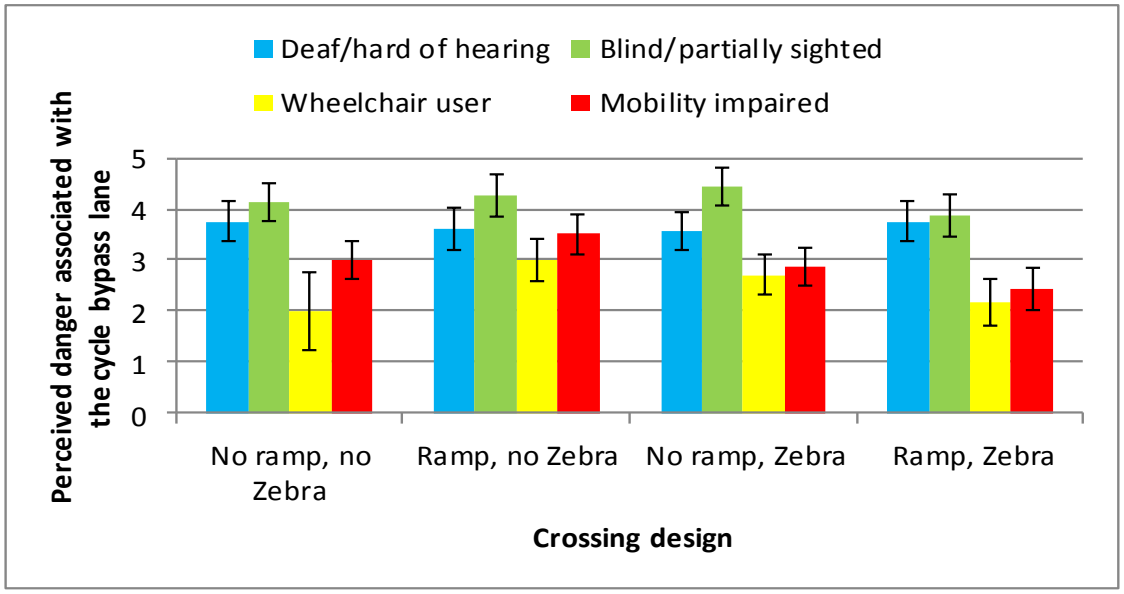

Figure 16: Perceived danger to pedestrians associated with the cycle bypass lane

Perceived danger was not significantly different across the four crossing designs but it was significantly different across different groups of disabled participants, using pooled data across all designated crossing types.

Blind and partially sighted participants felt that the cycle bypass lane was significantly more dangerous for pedestrians than did wheelchair users and mobility impaired participants. Deaf and hard of hearing participants felt that the cycle bypass lane was significantly more dangerous for pedestrians than did wheelchair users.

The consensus from people with disabilities across all four focus groups was that, irrespective of the crossing type, *"the whole design is unsafe"*. This view was based on improved safety for cyclists but reduced safety for pedestrians:

> *"The problem has been transferred from cyclists to pedestrians"* (deaf/hard of hearing focus group participant)
>
> *"Safer for cyclists but have increased the risk for pedestrians"* (deaf/hard of hearing focus group participant)

Safety was thought to be compromised most when passengers were exiting a bus and the bus stop island, primarily because the crossing point was in close proximity to the exit doors and some pedestrians would not expect it:

> *"I think it is very dangerous… to get off the bus with a pushchair and small children could be dangerous if you were not expecting the cycle path"* (deaf/hard of hearing participant)

This concern was raised by participants after experiencing the no Zebra and Zebra crossing designs, which suggested that it was not simply a function of having priority. Indeed, some participants lacked confidence in the Zebra crossing in this context because they were concerned that cyclists may not always yield.

Other reasons for feeling unsafe were related to the restricted space and the conflicting flows of pedestrians boarding and alighting from buses in close proximity to the cycle bypass lane:

> *"Safer for cyclists but have increased the risk for pedestrians."* (deaf/hard of hearing participant)
>
> *"…pushing, rushing to get across, not safe at all."* (deaf/hard of hearing participant)
>
> *"…really confusing when exiting the bus to access the cycle lane as can't hear them and if it was busy difficult to see."* (deaf/hard of hearing participant)

Comments were also received about the *"isolated"* feel associated with the island and its detachment from the main footway.

However, not all participants shared this point of view. One participant commented that the separation of the bus stop provided greater feelings of safety:

> "…preferred being on the island as then located away from the other pedestrians." (deaf/hard of hearing participant)

There was also common agreement that the facility did address the safety concerns for cyclists associated with having to manoeuvre around buses at the stop. However, there was disagreement regarding the relative safety impacts for pedestrians, with some participants suggesting that the bypass lane design was deflecting the risk towards pedestrians and *"fixing the wrong problem"*.

1. In general, participants felt safer using a No Ramp/Zebra crossing than a Ramp/No Zebra crossing.
2. Generally, at both no ramp crossings, participants with mobility impairments and wheelchair users found it significantly safer to use than did those with sight or hearing loss.
3. Participants with sight or hearing loss reported that the cycle bypass lane was significantly more dangerous than did participants with mobility impairments and wheelchair users.
4. Participants typically felt that the cycle bypass lacked sufficient contrast with the adjacent footway/island and this contributed to some participants with sight or hearing loss feeling unsafe.

E.5 Awareness of cyclists

Participants were asked to judge how easy it was to see cyclists coming, judge their approach speed and distance: a high rating indicates that the task was easy, a low rating indicates that it was difficult, see Figure 17.

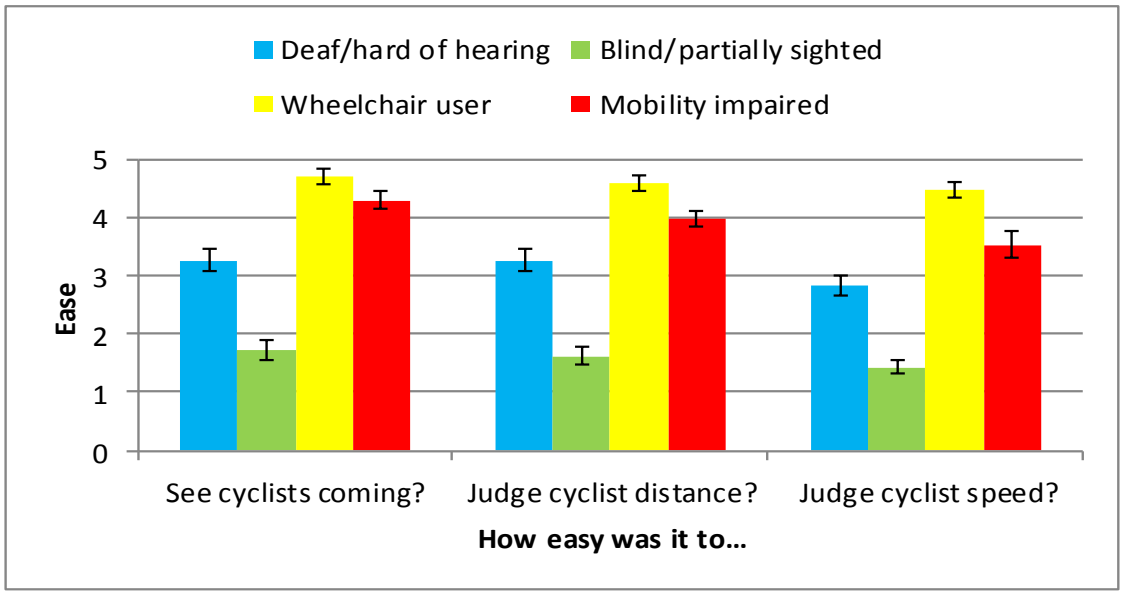

Figure 17: Ease of seeing cyclists, judging their approach speed and distance

The designated crossing design did not appear to affect participants' ability to see cyclists approaching, or to judge their speed and distance. However, participant disability did have a significant effect on all of these assessments.

Wheelchair users and mobility impaired participants reported that all these tasks were significantly easier than they were for participants with hearing or sight loss.

There were several explanations for the poor awareness of cyclists reported by some participants. For participants with sight loss, the difficulties of not being able to make a visual check for cyclists were compounded by the minimal noise that cyclists create. With little background noise during the trial, some participants with sight loss did hear cyclists approaching; however, this would be unlikely in real world conditions:

> *"Can't see cyclists and can't hear them, especially with bus engine running."* (blind/partially sighted participant)
>
> *"The noise of the bus meant you couldn't hear the cyclist at all."* (blind/partially sighted focus group participant)

Several participants commented that looking for cyclists when entering or exiting a bus stop was contrary to their expectations for such a situation:

> *"I'm not normally expecting to watch out for cyclists when getting to a bus stop (as am already on the pavement) so find it difficult to watch out for them and see them."* (deaf/hard of hearing participant)

> *"I'm used to looking for cars at a Zebra so difficult to look out for cyclists only. Need more indicators to warn pedestrians that cyclists are using the lane."* (deaf/hard of hearing participant)

> *"Didn't expect there to be cyclists or for them to be so close and in front of the bus stop."* (mobility impaired participant)

Likewise, some participants suggested that cyclists might not be sufficiently aware of pedestrians, particularly with the no Zebra designs where there is little visual indication of the facility:

> *"It needs to be more visual… they* [cyclists] *could come flying round thinking they are avoiding the bus… if it was more visual then they should be more aware people are crossing."* (R/nZ, wheelchair user focus group participant)

E.6 Cyclist visibility in the bypass

The design of the facility meant that if the bus stop island was approached from the same direction as the cycle traffic, cyclists were unsighted unless participants made a clear effort to turn and check behind. This was particularly relevant if participants chose to follow their desire line directly to the bus stop, rather than go to the designated crossing point. It was also noted that the same was true for cyclists approaching the end of the bypass lane: any pedestrians in the cycle bypass lane at or near the shelter were in a potential blind spot for cyclists:

> *"…the overflow of people* [at the shelter] *will file onto the cycle path and this is in the blind spot for approaching cyclists."* (nR/nZ, mobility impaired focus group participant)

Related to this, several participants commented that when leaving the bus stop island at the crossing point, approaching cyclists were not immediately visible to the left as the angle of the bypass lane meant that they were approaching from behind. This required participants to turn their heads quite substantially to check for cyclists, which was a challenge for those with restricted neck or trunk movement, as reported by some wheelchair users.

Participants were concerned that in real world implementation, crowding and environmental conditions would be critical factors affecting awareness of approaching cyclists. It was suggested that cyclists using the bypass lane could 'merge' visually with pedestrians on the footway and island, particularly in poor light or crowds. Many participants noted that cyclists in the trial wore hi-vis jackets, which was reported to help awareness but it was suggested that not all cyclists would do so in real world conditions. In addition, wheelchair users commented that they were positioned at a lower level than most other pedestrians which, in a crowded street environment, would

make it difficult to identify cyclists using the bypass lane if their view was obstructed by other pedestrians.

1. Crossing design did not affect participants' awareness of cyclists but disability did: participants with sight or hearing loss were significantly less aware than participants with mobility impairments and wheelchair users.

Poor awareness of approaching cyclists was attributed to background noise, the novel situation of a cycle track dividing a pedestrian area, and the lack of visual clarity associated with the features of the facility.

E.7 Waiting for a bus

The ease for different disability groups to decide where to wait for a bus is summarised in Figure 18. Higher scores indicate that the task was easy and lower scores indicate that it was difficult.

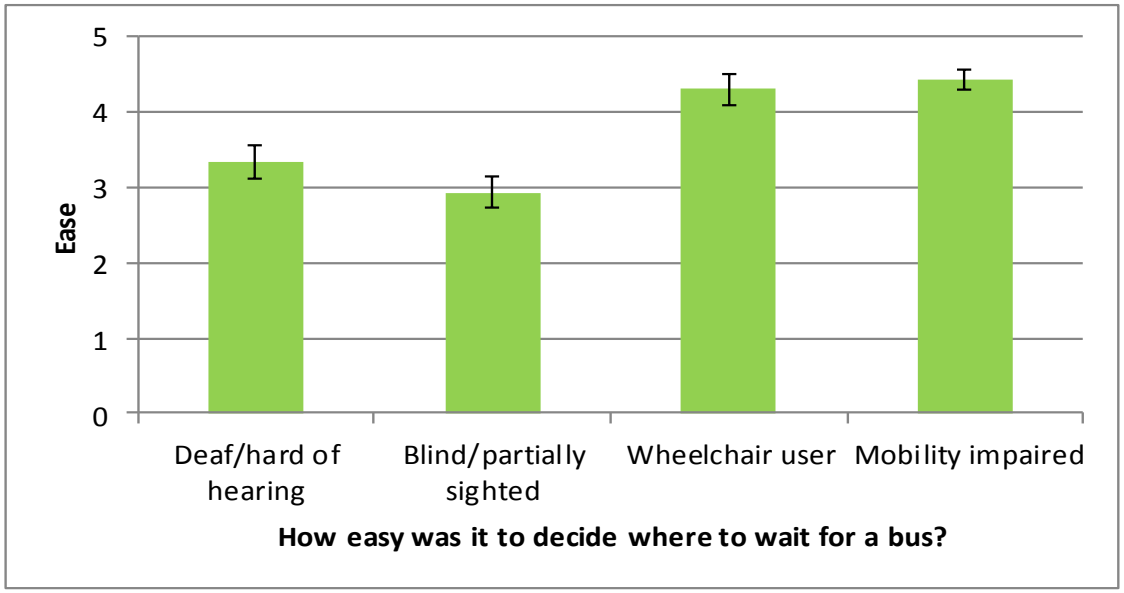

Figure 18: Ease of deciding where to wait for a bus

There was a significant difference between how easy it was for different disability groups to decide where to wait for a bus. Both wheelchair users and mobility impaired participants reported that this task was significantly easier than it was for participants with hearing or sight loss.

There were mixed opinions regarding the positioning of the bus stop flag and shelter. For some participants it was an obstruction and not in an optimal position. It was suggested that the flag be combined with the shelter, and that the bus should stop adjacent to the shelter.

> *"Separate bus stop flag and shelter made it difficult to decide where to wait."* (blind/partially sighted participant)
>
> *"Move the bus stop flag to the shelter as it gets in the way on the island."* (blind/partially sighted participant)

Other comments indicated that the bus shelter was situated too close to the end of the island and was perhaps too small.

> *"Why is the bus stop so far down the island? There is not enough room for people to queue. If the bus is late, where are people to stand safely if the island gets overcrowded?"* (deaf/hard of hearing participant)

Further concerns focused on the number of buses that might use the island:

> *"Would this island be for just one bus or would you have several bus stops on that island… could be really confusing."* (blind/partially sighted participant)

The trial design had a single bus stop cage: several participants suggested that a second service stopping at the same time at the island would lead passengers towards the tapered ends of the island where they would be at greater risk from the traffic streams either side of the island.

E.8 Use of the bus stop island

When choosing where to wait for a bus, the size of the facility was a common theme in the comments received. Several participants reported that the island felt too narrow, offered limited space inside the shelter (especially for assistance dogs and wheelchair users) and tempted them to stand in the cycle bypass lane, especially when parts of the island became crowded. In particular, many participants noted that the narrow strip of island to the rear of the shelter was of insufficient width to enable people to stand and read information posted on the rear of the shelter (and certainly too narrow for wheelchair users to access) without encroaching on the bypass lane. (Indeed, some participants even commented that it was a deterrent to have to cross over to the island to obtain timetable information from the shelter.) However, it should be noted that placement of such information on the rear of the shelter is not necessarily standard practice and may not happen upon implementation of a bus stop bypass design. It was also noted that the gap between the *front* of the shelter and the kerb was not likely to be sufficient for some users:

> *"The gap between the shelter and pavement edge was fine for me as I have a standard wheelchair and no cognitive problems but for others with larger wheelchairs and difficulties judging gaps and distance, it may be more difficult."* (wheelchair user)

Such factors may deter people from waiting on the island, as one participant explained:

> *"Not sure if I should be waiting on the* [footway] *area or at the bus stop itself. Feel tempted to wait until I see my bus arriving and then cross over to the bus stop."* (deaf/hard of hearing participant)

However, these opinions were not shared by all participants. To some, the island was a suitable size and configuration, and helped them find their ideal place to wait for a bus.

> "*The island was large. I could move to where I felt safest and most comfortable."* (deaf/hard of hearing participant)
>
> "*The island is self-defining and therefore obvious."* (Deaf/hard of hearing participant)
>
> "*The bus stop was the obvious place to wait and this was where the bus stopped."* (deaf/hard of hearing participant)

Wheelchair users also commented that it was helpful to have some of the island open and exposed to approaching buses as it provided an ideal area in which to wait:

> *"I always go to an open part of the island so I can get the driver's attention that I want him to stop."* (wheelchair user)
>
> *"I always stand at far end of bus stop so driver likely to see me first and through crowds. Given the tight proximity of bus stop/shelter/pedestrian crossing point, I would be even more inclined to do this for space/visuals."* (wheelchair user)

1. It was significantly easier for participants with mobility impairments and wheelchair users to decide where to wait for a bus.
2. Some participants with sight loss felt that the position, size and location of the bus stop flag and shelter was atypical and confusing.

E.9 Use of the designated crossing point

The extent to which the participants used the designated crossing point when they crossed between the footway and the bus stop island was recorded, see Figure 19.

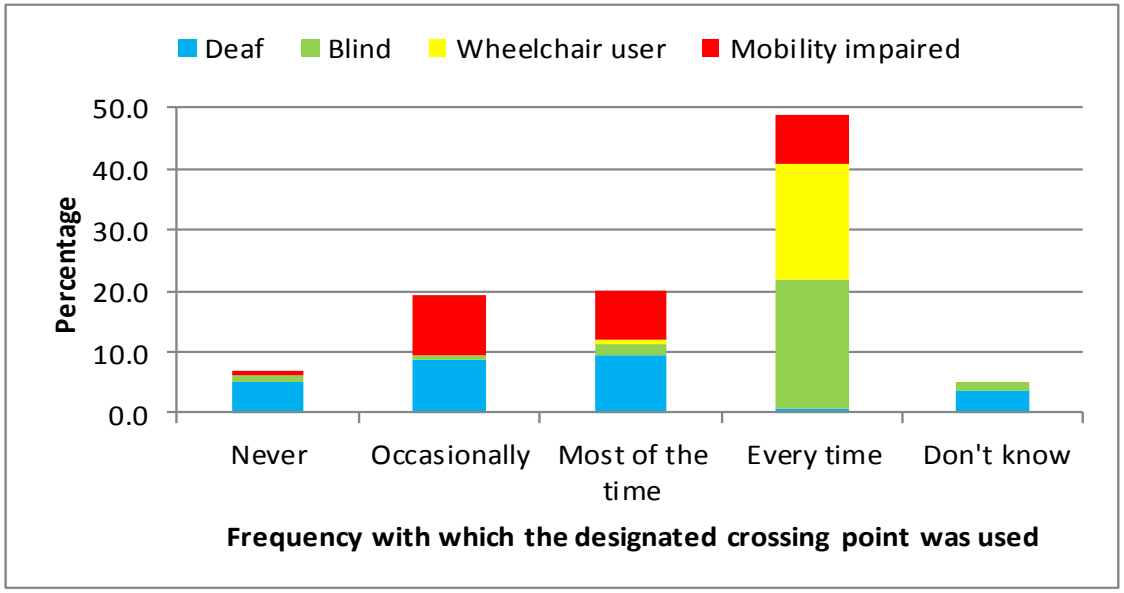

Figure 19: Frequency with which the designated crossing point was used

Almost half of all participants (49%) used the designated crossing point every time they crossed between the footway and the bus stop island. A fifth (20%) used the crossing point most of the time, and a similar proportion (19%) used it occasionally. Just 7% of participants never used the crossing point, and 5% did not know how often they used it.

How frequently the designated crossing point was used did not differ substantially according to the type of crossing design, but it did differ by disability. Specifically, participants with hearing loss used the designated crossing less frequently, as did participants with mobility impairments. In the focus group, one participant with mobility impairments reported that, *"I felt safe so didn't need a crossing"*. Participants with sight loss or those using wheelchairs almost always used the designated crossing point.

E.10 Anticipated use of the bypass crossing in London

Participants were asked to state how likely it was that they would use the designated crossing point at a bus stop bypass facility in London during different levels of pedestrian and cyclist congestion, see Figure 20. Higher scores indicate that it was likely participants would use the crossing and lower scores indicate that it was unlikely.

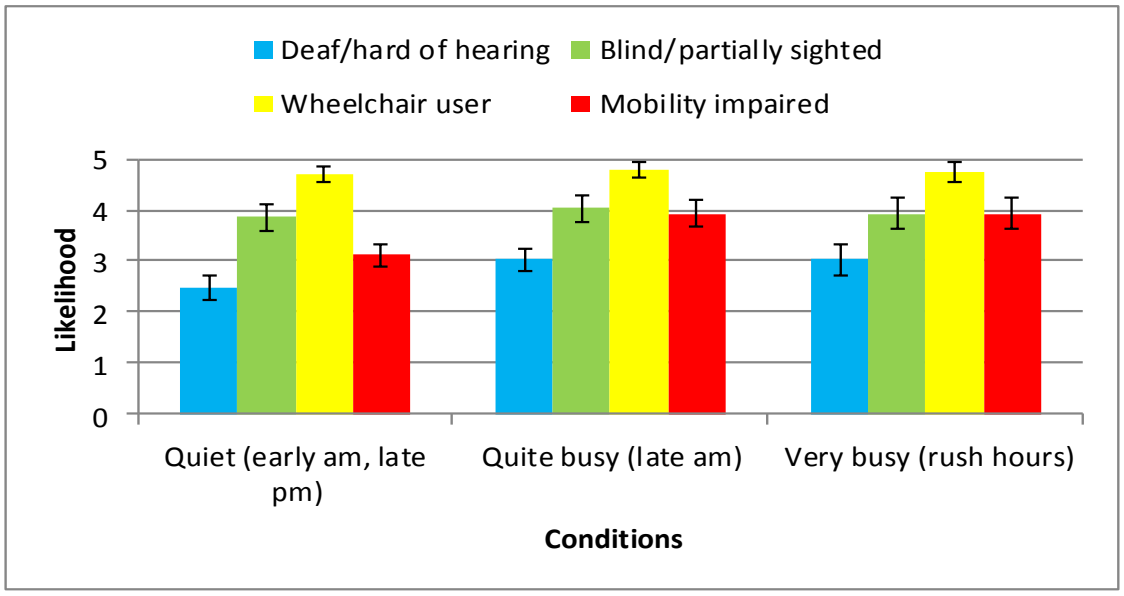

Figure 20: Likelihood of using the designated crossing point in London

They reported that the chances of using the designated crossing point at a bus stop bypass facility in London would not vary much according to how busy it was, but would vary (consistently) by disability. In all conditions, wheelchair users would be more likely to use the designated crossing point than participants with hearing loss. In quiet conditions, wheelchair users would also be more likely to use the designated crossing point than mobility impaired participants.

Participants were also asked whether lots of cyclists would deter them from attempting to use the bus stop. It was found that participants with sight loss and mobility impairments were significantly more likely to be deterred than wheelchair users. This finding could be attributed to wheelchair users having a greater need to use the dropped kerb or level access provided at the crossing point.

E.11 Willingness to use the bus stop bypass facility

Participants stated that they would be wary of using the bus stop bypass facility as pedestrians, in part due to the concerns about safety and other matters (discussed elsewhere) and also because the island was considered too small to accommodate the passenger volumes they anticipated in London.

Specifically, blind and partially sighted participants were deterred by the *"intrinsically visual"* layout and the majority of this group stated that they would be deterred from using buses on routes where there were bus stops with a cycle bypass lane.

The majority of participants attended more than one trial and so had an opportunity to experience more than one of the four crossing designs. In addition, participants were provided photos and descriptions of the different designs during the discussions. On this basis, it was found that participants expressed a majority preference for the Ramp/Zebra

crossing design. A number of positive experiences were reported when using this crossing design, including participants being drawn to the crossing point rather than following an alternative desire line onto the island:

> *"It* [cycle path awareness] *got into my subliminal conscious better than previous trials."* (deaf/hard of hearing participant)
>
> *"When I am out and about I am on high alert trying to work out what is happening. Found I was much more comfortable, completely changed my behaviour, in the previous trials I didn't use the crossing but here I did use it."* (deaf/hard of hearing participant)
>
> *"With the crossing I thought the cyclist would expect me to be there, I stayed on the pavement until I reached the crossing."* (deaf/hard of hearing participant)
>
> *"I would go out of my way to use this bus stop."* (wheelchair user participant)
>
> *"Would feel safer to use a bus in London."* (wheelchair user participant)
>
> *"Taking into account disabilities and able bodied people then this is the best."* (wheelchair user participant)
>
> *"This is the best option so far…good to have definite markings and the beacons helped to make it more visual."* (wheelchair user participant)

For people with mobility impairments (including wheelchair users) the Ramp/Zebra crossing not only offered the reassurance of priority, it also provided much needed level access:

> *"Easier flow as I walk on crutches… liked the same level and the priority."* (mobility impaired participant)
>
> *"Safer with the Zebra crossing and with the raised hump to slow the bikes down."* (mobility impaired participant)

The exception was approximately half of the blind and partially sighted participants, who stated that they would rather use a No Ramp/Zebra crossing because the dropped kerb acts as an extra wayfinding cue for the crossing point (when compared with a Ramp/Zebra design). Specifically, guide dogs were said to focus on finding a dropped kerb, which at a ramp crossing can cause difficulties:

> "[Guide dog] *found the tactile paving but then found it hard to detect the edge of the kerb as there was no drop down."* (blind/partially sighted participant)

E.12 Key factors affecting use of the crossing point

It is evident that type of disability is one of the key factors affecting whether people use the crossing point or not, with some disabled groups (e.g. wheelchair users and blind people) reporting that it would have been too difficult to cross away from the designated crossing point. However, for those participants whose disabilities did not make it a physical necessity to use the crossing point, there were a range of reasons as to why the crossing was used or avoided. These can be summarised as follows:

- **Location** – the crossing at the centre of the island was not ideally located in pedestrians' desire lines when approaching from the footway or for the bus driver to view approaching passengers:

  > *"Not realistic to use the crossing…you might need to run for the bus and need the bus driver to see you so they can wait, which if you were coming from the Zebra crossing they wouldn't see you."* (mobility impaired focus group participant)

  Participants suggested that crossings situated on the diagonal entry and exit of bypass lane would be preferable. However, when exiting the bus the crossing was conveniently located in front of the door, which encouraged use.

- **Detectability** – some participants commented that it was difficult to identify where the designated crossing point was situated. For example, the Ramp/No Zebra crossing design was described as having *"no features to inform you what to do"*. When it was easier to detect the crossing (e.g. when it was more visibly identifiable with Zebra markings, extended tactile paving and belisha beacons), some participants felt more inclined to use it (although note that statistically this was not supported).
- **Rate of cycle traffic** – several participants stated that they would be more likely to use the crossing if cycle traffic in the bypass lane was heavy, and less likely to use it if there were no cyclists approaching.
- **Time pressure** – several participants commented that if they were under time pressure (e.g. to catch a bus) then their crossing location would be determined by the shortest route and not the location of the designated crossing point.
- **Crossing capacity** – if the crossing point was in use by several other pedestrians, some participants would choose to avoid it. A few respondents stated that the designated crossing point was rather small and could be wider. In addition, it was feared that for guide dog users, locating the crossing point when on the island could be a complicated task:

  > *"In London there are lots of people about, I would say to* [guide dog] *find the kerb and she would direct me to the crossing, in that circumstance it is such a small island that could be quite confusing with a lot of people trying to go around the same area."* (blind/partially sighted participant)

- **Safety** – several participants reported that they felt safer using the designated crossing point than crossing elsewhere in the bypass.

1. The majority of participants (69%) used the designated crossing on most occasions, if not all the time. Frequency of use was not affected by the type of crossing.
2. There was no significant preference for any particular crossing design according to how busy it was.
3. Participants with hearing loss used the designated crossing less frequently, as did participants with mobility impairments.
4. In London, wheelchair users expected to make more use of the designated crossing then some other disability groups.
5. Participants' willingness to use a bus stop bypass facility as pedestrians was influenced by opinions regarding safety, the capacity of the island and the crossing, the layout, the visual features and the traffic conditions.

E.13 Right of way at the crossing point

Participants were asked who they felt had right of way: pedestrians, cyclists or neither. Their answers are summarised in Figure 21.

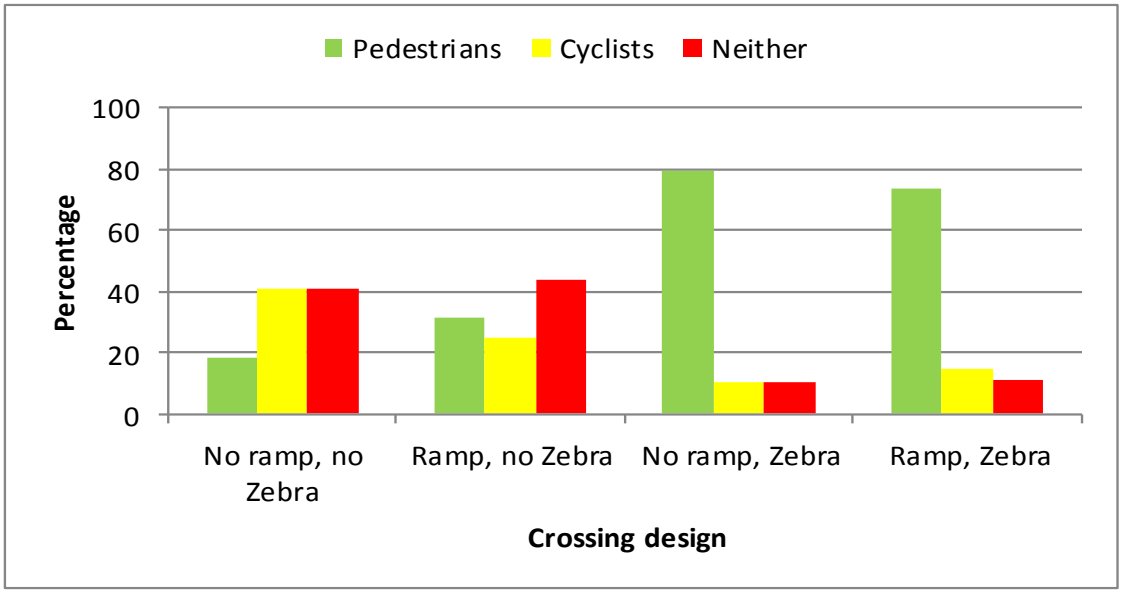

Figure 21: Perceptions of who had right of way at the crossing point

There was a significant relation between the type of crossing design and which road user group participants felt had right of way. It was found that the vast majority of participants using the No Ramp/Zebra and Ramp/Zebra designs recognised that pedestrians had right of way (79% and 74%, respectively). In contrast, participants

were divided on whom had right of way at the No Ramp/No Zebra crossing, with equal proportions stating that cyclists had right of way or that neither pedestrians nor cyclists had right of way (41% for both). However, their assessment of the Ramp/No Zebra crossing design was more divisive: more participants (44%) felt that neither group had right of way than did the proportion who felt that right of way sat with cyclists (25%) or pedestrians (31%).

At the No Zebra designs cyclists did have right of way; however, it appears that a Ramp/No Zebra crossing gave participants a stronger (false) impression that pedestrians had right of way than if the crossing had no ramp.

E.14 Perceptions of who should have right of way

Participants were asked who they felt should have right of way: pedestrians, cyclists or neither. Their answers are summarised in Figure 22.

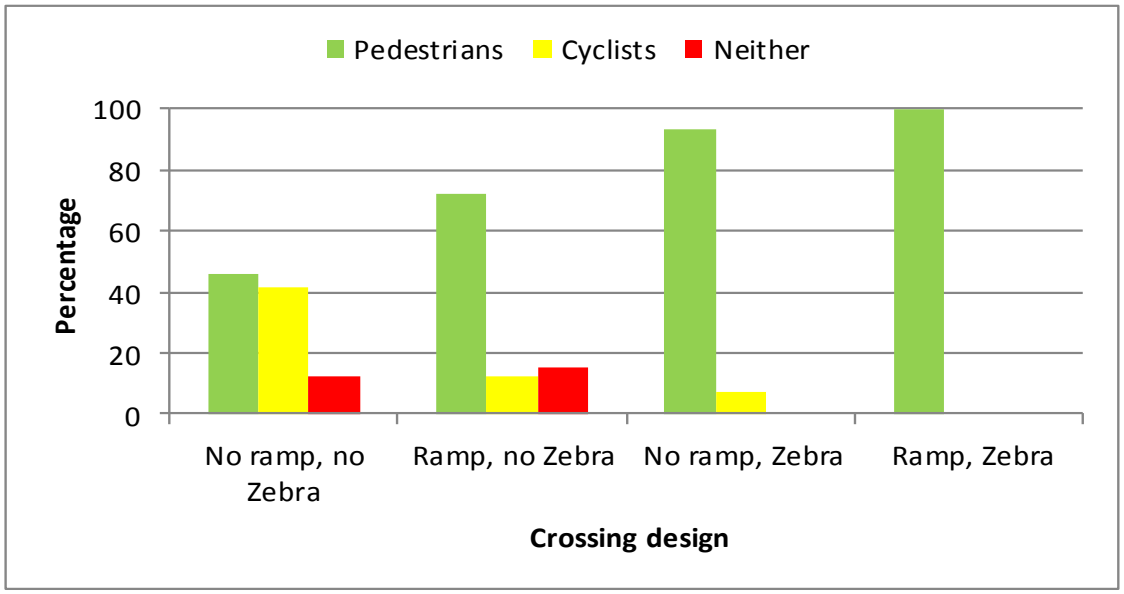

Figure 22: Perceptions of who *should* have right of way at the crossing point

It was evident that almost all participants felt that pedestrians should have right of way at Zebra crossings. At the No Ramp/No Zebra crossing, participants were almost equally divided as to whether right of way should fall to cyclists or pedestrians; however, at the Ramp/No Zebra crossing, almost three-quarters (72%) of participants felt that pedestrians should have right of way. This supports the interpretation that a Ramp/No Zebra crossing gives pedestrians a stronger impression that they have right of way, even though they do not. This was reinforced by comments on both types of crossing without a Zebra:

> *"Hated this layout, confusing and no markings to say who has priority."* (deaf/hard of hearing participant)
>
> *"…to put this* [no Zebra] *design into a real life setting it is completely unsafe, without a Zebra or pelican it would be a complete free for all, I would not chance it."* (wheelchair user participant)

"I didn't know who had priority, I sat there [at the crossing] *for ages because I didn't know and was too scared to go."* (wheelchair user participant)

"Priority should be pedestrians but felt like cyclists." (deaf/hard of hearing participant)

"Designated crossing could be confusing - not obvious who has priority, cyclists or pedestrians." (mobility impaired participant)

"Cyclists think they have priority and so do the pedestrians." (mobility impaired participant)

Participants were asked if pedestrians should give way to cyclists using the bypass (higher ratings show stronger levels of agreement). Their answers are summarised in Figure 23.

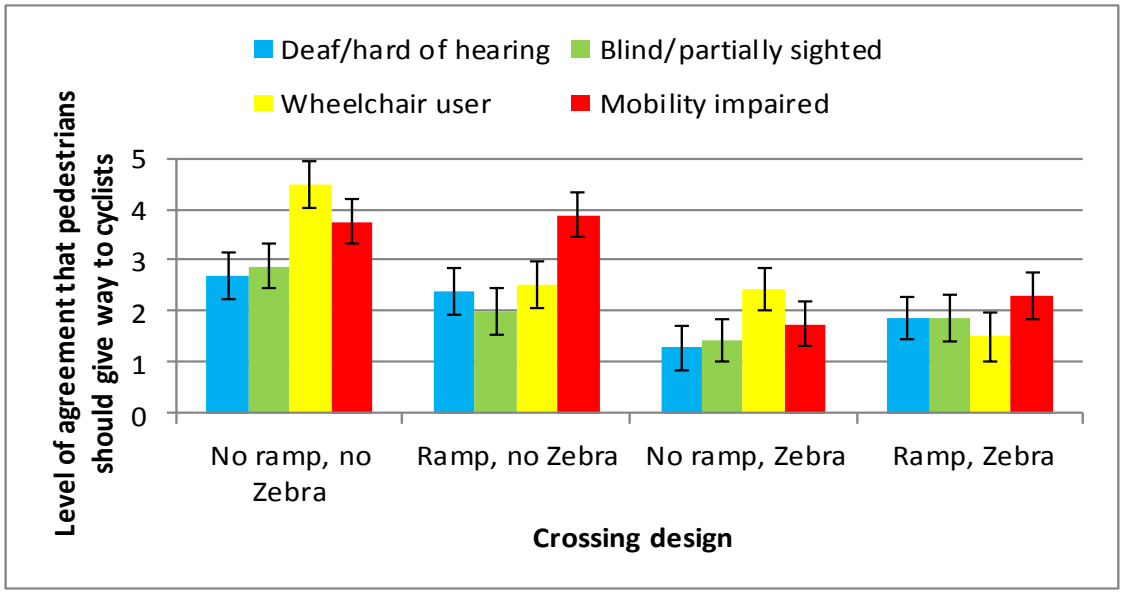

Figure 23: Agreement that pedestrians should give way at the crossing point

The effect of crossing design was significant. In general, participants at a No Ramp/No Zebra crossing had significantly higher levels of agreement that pedestrians should give way to cyclists than did participants at both types of Zebra crossing design. The effect of disability was also significant. In general, participants with mobility impairments had significantly higher levels of agreement that pedestrians should give way to cyclists than did participants with hearing or sight loss.

It was clear from the focus group discussions that a Zebra crossing was the preferred design to ensure there was clarity about right of way. However, it was felt that not all cyclists would be inclined to stop for pedestrians using the Zebra crossing point.

"Right of way depends on the compliance of cyclists." (wheelchair user participant)

Alternatively, there were fears that to avoid having to stop cyclists might simply avoid using the bypass, negating the primary purpose of the facility. This would create a situation that was described as *"the worst of both worlds, as some cyclists would end up using the facility and others not using it"*.

Blind and partially sighted participants were particularly critical of the crossing designs with no Zebra. During the focus group discussions they explained that, *"you can't say to a blind person to give way"*. It was generally acknowledged that cyclists did have right of way when there was a crossing with no Zebra (excepting the high levels of ambiguity for the Ramp/No Zebra crossing that, as discussed earlier, seemed to be attributed to the raised platform implying that pedestrians may have right of way even though there were no further markings or controls to support this). Nevertheless, such no Zebra designs were viewed as a substantial barrier to accessibility for people with sight loss who would want to use a bus stop island. It was felt that "No Zebra" designs did not fit with the seamless experience that is expected of accessible transport provisions in London.

Nevertheless, Zebra crossing points were not a universally agreed solution for blind and partially sighted pedestrians. With the bypass being used exclusively by cyclists, there were concerns that cyclists would not adhere to the rules of priority.

In addition, concerns about delay were associated with who has priority. No Zebra designs could mean that some pedestrians might miss a bus service while waiting to cross, leading to a substantial delay to their journey. A Zebra crossing might delay cyclists' journeys but focus group participants generally felt that this delay would be minimal and would at least ensure that all pedestrians had timely access to bus services using the bus stop island.

E.15 Understanding the features of the facility

Participants rated the visibility, pedestrian safety and appearance of the crossing point, with higher ratings indicating higher levels for each factor. Their answers are summarised in Figure 24.

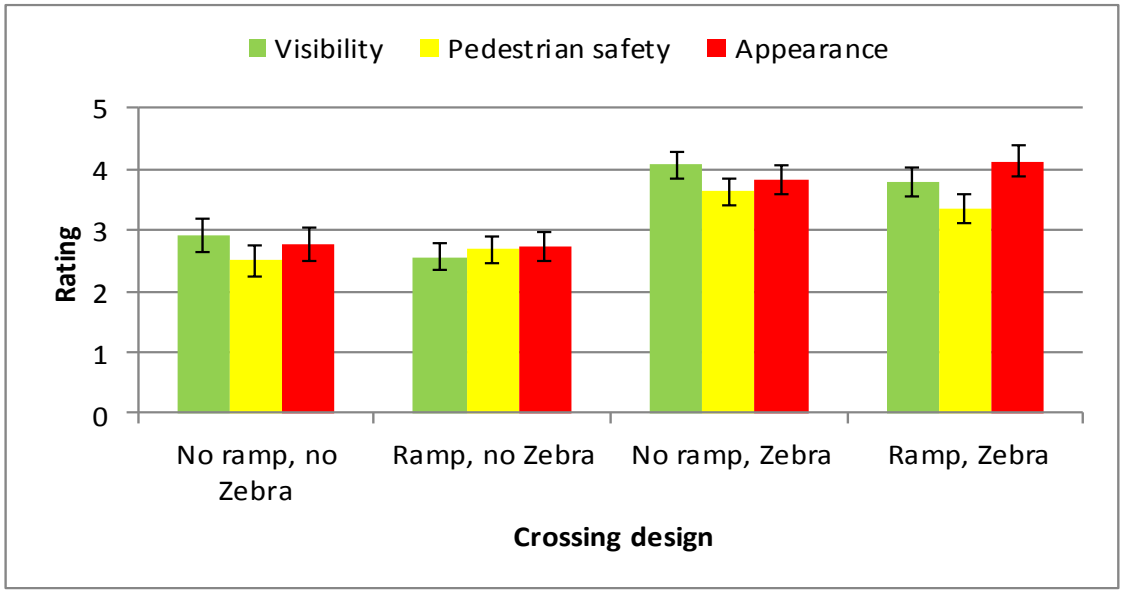

Figure 24: Ratings of crossing visibility, pedestrian safety and appearance

The effect of crossing design on visibility was significant In general, participants felt that the No Ramp/Zebra crossing was significantly more visible than both no Zebra designs. Also, the Ramp/Zebra crossing was significantly more visible than the Ramp/No Zebra design.

The effect of crossing design on pedestrian safety was significant. Participants felt the No Ramp/Zebra crossing was significantly better for pedestrian safety than both no Zebra designs.

Participants with mobility impairments felt that the No Ramp/No Zebra crossing design offered a safer pedestrian environment than did participants with sight loss. Also, wheelchair users felt that the No Ramp/Zebra crossing design offered a safer pedestrian environment than did participants with sight loss.

The effect of crossing design on appearance was significant. Participants felt that both Zebra crossing designs had a significantly better appearance than both no Zebra designs.

1. The majority of participants using the Zebra crossing designs recognised that pedestrians actually had right of way.
2. Participants were divided on who actually had priority at the no Zebra designs, especially when using the Ramp/No Zebra design.
3. At all crossing designs, participants felt that pedestrians *should* have right of way over cyclists, although strength of opinion was marginal at the No Ramp/No Zebra crossing.
4. The No Ramp/Zebra crossing was considered safer for pedestrians than both no Zebra designs.
5. Participants reported that the Zebra crossing designs were significantly more visible and had a significantly better appearance than the no Zebra designs.

E.16 Suggested improvements to the bus stop bypass facility

Participants were invited to suggest ways in which the bus stop bypass facility could be improved. The suggestions focused on the size of the bus stop island, the clarity of the design, the speed of cyclists along the bypass lane, the crossing point and the bus stop shelter. The recommended improvements are not only helpful for the further development of the facility, they also highlight aspects of the design that participants with disabilities found most challenging to use.

E.16.1 A wider bus stop island

The vast majority of participants wanted a wider bus stop island. Most had concerns that the island was not sufficiently large to accommodate the throughput of passengers and at the same time provide an accessible space. Participants noted that entering the island when it was congested would make it difficult to circulate freely around the island, especially if they had a disability that required them to only access the island using the

crossing point (e.g. wheelchair users) rather than elsewhere along the bypass lane where it may be possible to enter a less congested part of the island.

The area adjacent to the exit doors of the bus was highlighted as a potential 'pinch point':

> *"There could be a queue to get off the bus, and with people having to wait to cross the cycle path you might struggle to have space to get off the bus, especially people with buggies."* (mobility impaired participant)

Wheelchair users would also be waiting in this area to board and therefore obstructing the crossing and the exit point for other users.

The island width at the crossing point offered restricted manoeuvring space when the bus boarding ramp was deployed for wheelchair users. As well as offering limited space to turn, some manual wheelchair users had to use the extra space of the crossing point itself to build sufficient momentum to board the bus using the ramp.

> *"Island was too narrow to have a run up onto the ramp… needed the Zebra crossing for the run-up."* wheelchair user participant)

In addition, when exiting the bus using the ramp it was difficult for some wheelchair users to control their speed – the close proximity of the crossing provided little run-off before entering the bypass. A Zebra crossing at least meant cyclists were encouraged to stop if a wheelchair user was unable prevent themselves entering the crossing area when alighting from the bus.

Participants also noted limited space along the island for two or more wheelchair users to pass each other (e.g. at the bus stop flag, at the entrance to the bus shelter).

E.16.2Improving the visual appeal and clarity of the facility

A general criticism of all the crossing designs was that the facility lacked visual instruction. Different surface colours and signage were typical descriptions of suitable visual instructions. This criticism was more commonly directed at the two no Zebra designs, where it was perceived that the pedestrian footway and the cycle bypass lane did not have sufficient visual separation:

> *"Was difficult to see which path was which."* (deaf/hard of hearing participant)
>
> *"Visually its poor; cycle lane and pavement are black, especially bad at night time."* (deaf/hard of hearing participant)

One blind guide dog user was even guided along the bypass when trialling the facility with a No Ramp/No Zebra crossing because, *"…*[the] *dog didn't recognise it as a cycle lane, just the same as a pavement"*. Another participant with sight loss noted the difficulties that blind people experience when presented with an atypical infrastructure design:

> *"Blind people do not have a concept for the whole area so I was surprised by the cycle path."* (blind/partially sighted participant)

The two Zebra crossing designs received more favourable feedback, with the inclusion of the zig-zag white lines in the bypass lane before and after the Zebra crossing providing some of the visual separation that was claimed to be missing from the no Zebra designs:

> *"…understood the design, it was very clear."* (deaf/hard of hearing participant)
>
> *"Although I didn't use it every time, it made me more aware that there was a hazard there."* (deaf/hard of hearing participant)
>
> *"Everything is demarcated; all road users know where they are."* (wheelchair user participant)

Specifically, the inclusion of Zebra and zig-zag markings did highlight the hazard associated with the bypass lane. However, even the Zebra crossings were still considered to lack visual separation between the pedestrian and cycle flows:

> *"There was nothing to show why there was a crossing."* (deaf/hard of hearing participant)
>
> *"Because everything is the same colour, you may need differentiation in the surface for pedestrians and cyclists."* (deaf/hard of hearing participant)

In summary, the most common recommendation to improve the clarity of the facility was to highlight the cycle bypass by using a different surface colour (red, green or blue were the colours suggested), or to use cross-hatching or kerbside LED lighting along the entire length of the bypass lane. Although this was not a universally accepted solution (as one participant stated, *"A little bit of paint is not going to make it right."*), there was a clear theme in the feedback received to indicate that further information would be beneficial. The key suggestions to improve the clarity of the facility for users were to provide:

- Signage to inform pedestrians and cyclists of the layout (e.g. pictograms on cycle bypass lane).
- Audible and visual real-time bus information at the island to provide improved accessibility and to prevent pedestrian crowding around information points at the bus stop shelter.
- Audible/visual on-bus announcements to inform arriving passengers that they are stopping at a bus stop island.
- Audible/visual indicator of bus service for cyclists so they are aware of pedestrians using the crossing point (e.g. school flashing ambers).

- Improved contrast for the bus stop flag:

  "The bus stop flag should have the same high contrast as the belisha beacon posts." (blind/partially sighted participant)

- Lighting:

  "Will need lights for night time. Some deaf people have bad balance and night blindness." (deaf/hard of hearing participant)

- Additional tactile warning paving along the length of the bypass lane to notify blind pedestrians due to the angle of the kerbing and the way it cuts across the footway unexpectedly.
- Education/awareness campaigns to ensure wider knowledge of the bypass facility.

Not all participants were in favour of increasing signage and visual instruction at the facility. Several mobility impaired participants preferred the minimal design style:

> *"Getting rid of the signs made you have to think for yourself."* (mobility impaired participant)

There was also some support for the general change in visibility associated with the bus stop bypass facility:

> *"Opened the space up, sight lines were clearer than normal bus stops… knew where people were and what was going on."* (mobility impaired participant)

E.16.3 Changes to the cycle bypass lane

Changes to the cycle bypass lane tended to focus on ways in which cyclists could be slowed down:

> *"Need something to slow down cyclists as many cyclists go past. Need a warning making them aware of people crossing."* (deaf/hard of hearing participant)

The suggestions were to install:

- Speed humps along the length of the bypass to slow cyclists (a very common suggestion for the crossings with no ramp).
- A raised crossing design to slow cyclists (a common suggestion from those who experienced the No Ramp/Zebra crossing design).
- 'Slow' text on the bypass prior to the crossing point.
- Give way markings at the bypass entrance to encourage cyclists to give way to pedestrians anywhere along the bypass.

Finally, it was suggested to raise the entire bypass to make it level with the footway. It would be segregated by line markings only to provide a feeling of 'shared space' that would potentially slow cyclists whilst providing level access for pedestrians along the entire width of the bus stop island.

E.16.4 Changes to the crossing point

Ways in which participants would change the crossing point itself were to:

- Add a Zebra crossing to remove ambiguity (a very common suggestion from those who experienced either of the no Zebra designs).
- *"Move crossings away from centre so those getting off the bus are away from those getting on the bus."* (mobility impaired participant)

  Removing the single, central crossing and having one crossing at each end was reported to suit pedestrian desire lines and reduce potential crowding and conflicts at the exit doors of the bus.
- Install a signal controlled crossing point.
- Install 'look left' and 'look right' instructions on the footway because instinctively when exiting the bus there was a tendency for pedestrians to only look right (whereas cyclists approached from the left).
- Fence the island to enforce use of the crossing point – this was a point of disagreement among participants.

E.16.5 Changes to the bus stop shelter

Finally it was noted that the bus stop shelter would benefit from:

- Transparent sides to aid vision for cyclists and pedestrians at that end of the bypass lane.
- No open access at the rear to discourage crossing the bypass lane at that location.
- No bus information on the rear of shelter without sufficient space for pedestrians to stand on the island and read it without encroaching on the cycle bypass lane.

1. The bus stop bypass facility could be improved by:

a) Widening the island to increase capacity and pedestrian manoeuvring space.

b) Clarifying the visual design with colour contrasting surfaces, lighting, signage and pictograms.

c) Measures to reduce cyclist speeds.

d) Install crossing points along pedestrian desire lines.

e) Modify the bus stop shelter so it is transparent, accessible only from the front and displays information inside and not on the rear.

Appendix F - Capacity trial further details

F.1 Observations from trial

General observations of how the pedestrians and cyclists navigate the bus stop bypass and interacted were made by members of staff whilst conducting the trial. These are therefore subjective, but provide top level information on impressions.

F.1.1 Pedestrian behaviour

- All 97 pedestrians taking part could physically stand within the Bus Stop Island (BSI) central (rectangular) area. This was achieved with a low Level of Service that may not be acceptable for many pedestrians for any length of time, as the lowest level of service (Level F) can cause physical and psychological discomfort.
- Pedestrians waited on the footway when they judged the BSI was crowded: that is they judged the level of crowding on the Bus Stop Island as unacceptable.
- Some pedestrians stood on the cycle bypass lane, again indicating that the number of trial participants, as required, exceeded the capacity of the Bus Stop Island.
- When umbrellas were used the space required by such pedestrians on the Bus Stop Island slightly increased so probably reducing effective capacity. This small effect was not possible to isolate within the analysis.
- A few pedestrians crossed onto the island and then back onto the footway if the Bus Stop Island was crowded. That is, they had that the judged capacity had been reached.
- Many pedestrians crossed on their desire line i.e. the shortest point from start point to destination. This particularly held for those walking toward the cyclists travelling along the bypass cycle track.
- Pedestrians tended to be aware of the cyclists, and some waited to cross over the cycle track after a cyclist had passed. That is, they confirmed there was a suitable gap before crossing.

F.1.2 Cyclist behaviour

- Cyclists tended to cycle away closer to the footway when the Bus Stop Island was crowded.
- Cyclists tended to cycle in the middle of the bypass lane when pedestrians were situated close to both sides of the cycle bypass lane.
- Some cyclists used their bell or vocal warnings to warn pedestrians near or on the cycle track.

F.2 Capacity observations from trial

An example of the number of pedestrians using the bus stop island is illustrated in Figure 25

Figure 25 Bus Stop Island with 25, 50, 75 and 97 pedestrians

F.3 Immediate response of pedestrians during trial

A sample of pedestrians was asked to complete a short questionnaire after walking to the island. This enquired how they judged the extent of crowding on the Bus Stop Island, their safety, and how comfortable they were whist waiting.

The number of zones pedestrians traversed to reach their final zone is summarised in Figure 26 and Figure 27.

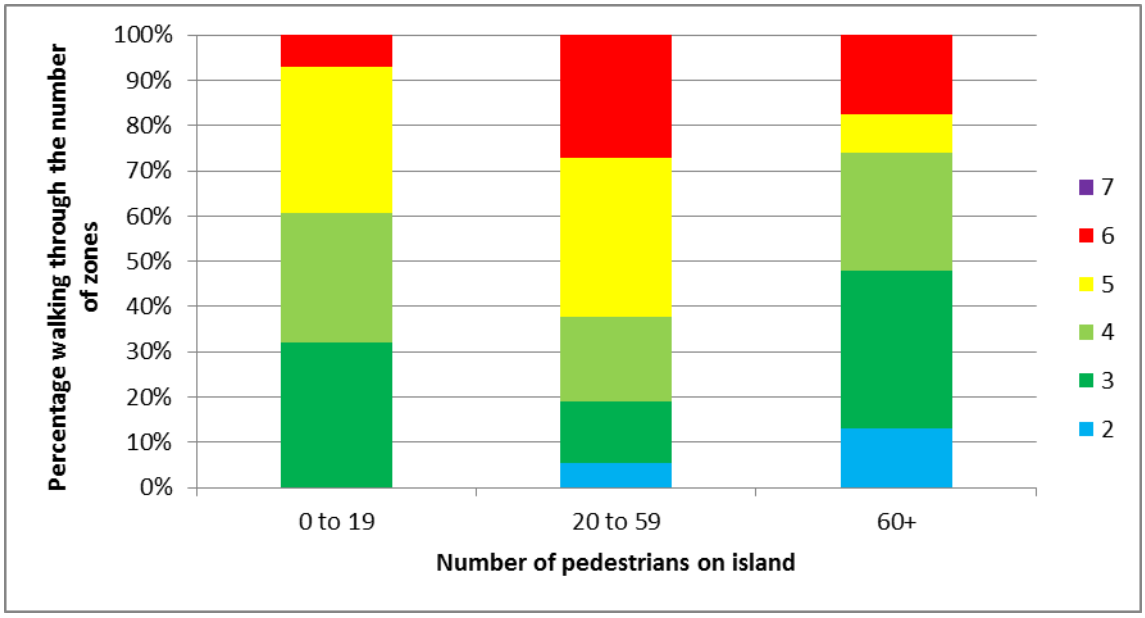

Figure 26: Zones traversed to reach waiting point: Start Point A

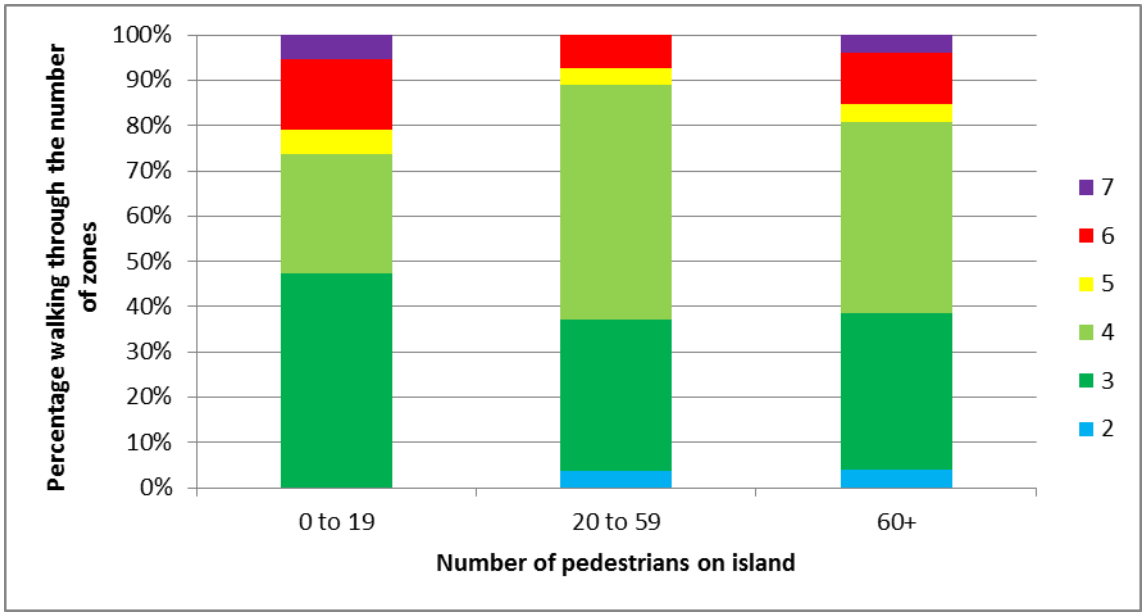

Figure 27: Zones traversed to reach waiting point: Start Point B

When there were few (less than 20) pedestrians on the Bus Stop Island, those starting from A or B generally could easily reach the end of the forming queue by travelled through only 3 or 4 zones to their destination. As the queue developed and then started to break down (between 20 and 59 pedestrians on the Bus Stop Island), those starting from B only walked through 3 or 4 zones to reach a place to stand, but those from A often (over 60%) had to walk further. With more pedestrians on the Bus Stop Island (60 or more), there was no formalised queue, so whilst those from B continued to walk to the closest zones, those from A stopped walking to find a queue and started to fill in spaces that were closest to their start point.

Pedestrians were also asked to rate the extent the Bus Stop Island was crowded, how safe they felt, and rate their comfort. Their answers are summarised in Figure 28 to Figure 30 respectively. It was found that although the percentage judging the Bus Stop Island as crowded slightly increased with the number of pedestrians standing on it, many (almost 60%) only considered movement to be at worst slightly restricted. This is probably a result of the pedestrians evenly spacing themselves, and not accepting high levels of crowding. The counter-intuitive small percentage increase in pedestrians considering the conditions were free flow when there were 80 or more pedestrians on the island may have been a result of them considering it easy to walk to an available space on the island. Also, this change was not statistically significant (at the 90% confidence level)

Similarly, there were no trends in their assessment of safety, or comfort, as the number of pedestrians on the Bus Stop Island increased. Overall, 20% of pedestrians stated they did not feel safe over all the conditions experienced, and 24% did not feel comfortable. The increase in the percentage feeling very safe under the most crowded conditions was statistically significant (at the 95% confidence level) and could be a result of feeling safety in numbers.

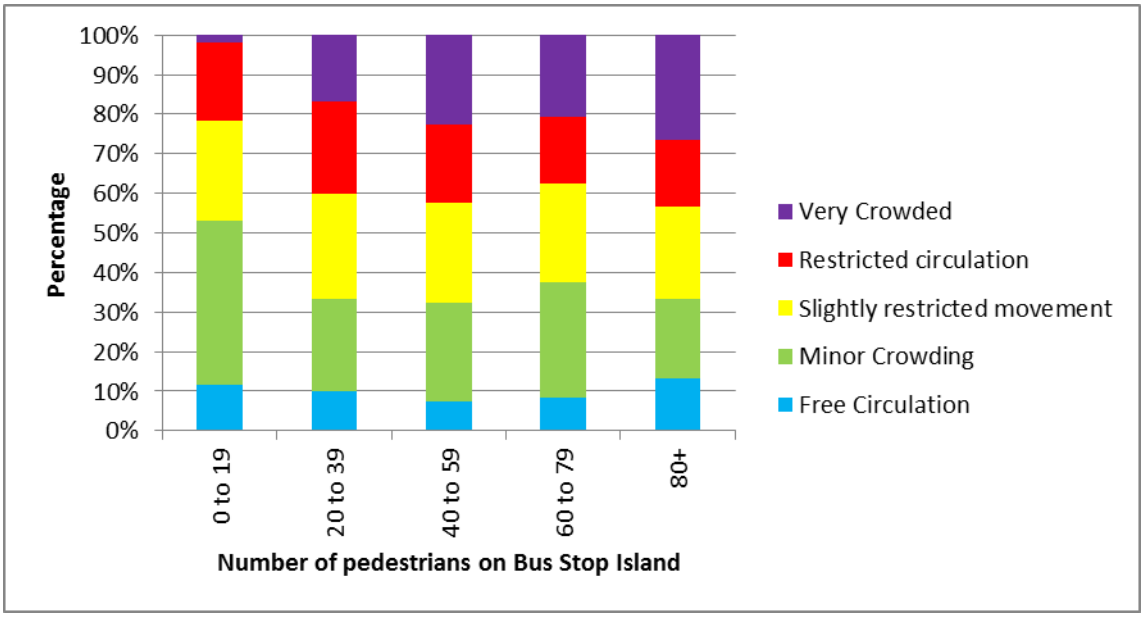

Figure 28: Pedestrian assessment of the extent island was crowded

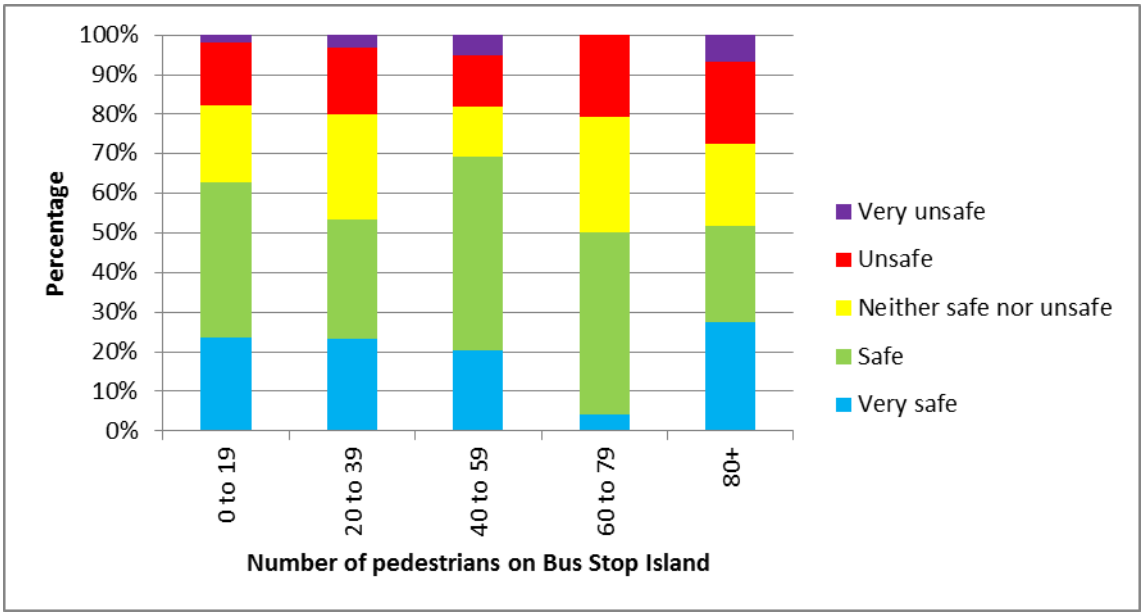

Figure 29: Pedestrian assessment of safety

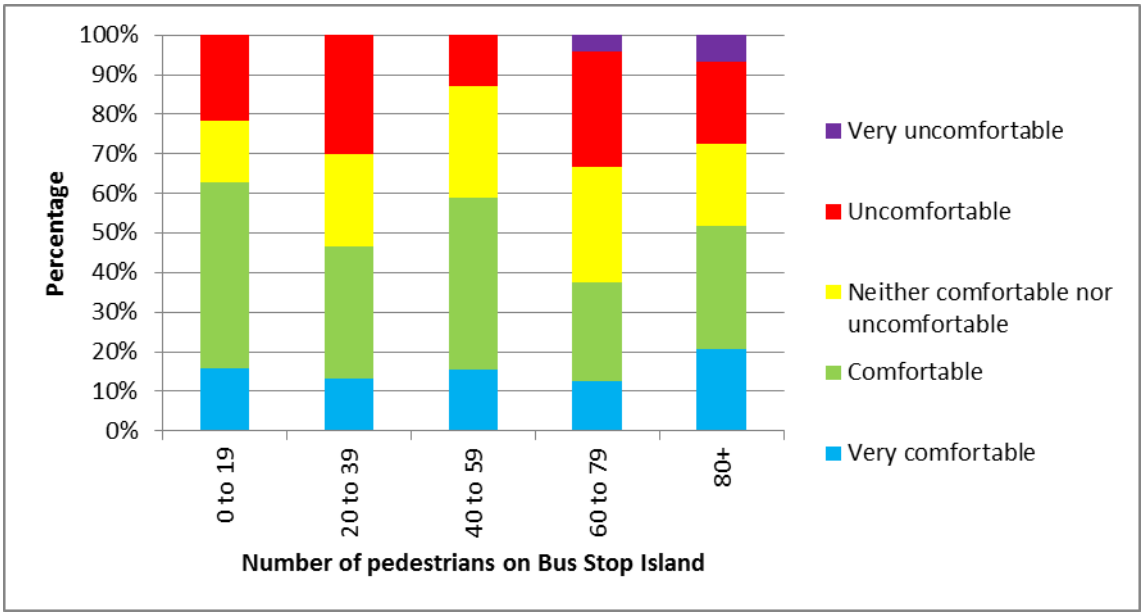

Figure 30: Pedestrian assessment of comfort

1. The distance walked (routes taken) varied according to the number of pedestrians on the bus stop island:
    a. Up to 20 pedestrians - walked 3 to 4 zones to reach end of queue
    b. Up to 59 pedestrians - walked 3 to 4 zones from B, but often further from A
    c. Above 60 pedestrians – walked different numbers of zones to fill in available spaces
2. Pedestrian estimates of crowding, safety and comfort did not vary greatly with numbers of pedestrians on the island. It is believed this was a result of the way that they stood on the island: expanding area used and only minimally increasing pedestrian densities in existing areas in use.

F.4 Pedestrian Questionnaire Analysis

A pedestrian questionnaire was completed by all participants at the end of the trial. The focus of this trial was island capacity, however, the opportunity was taken to collect initial feedback on the concept of a bus stop bypass.

F.4.1 Ease of using bus stop bypass

Participants were asked to rate how easy it was to cross to and from the bus stop, and also to identify the crossing point. Their answers are summarised in Figure 31.

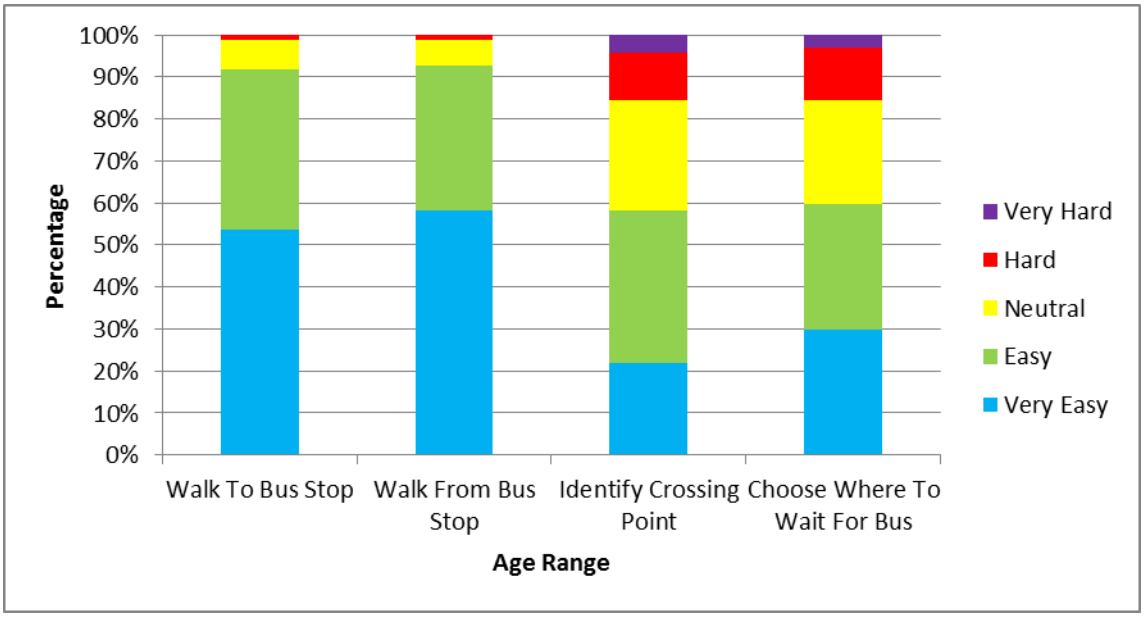

Figure 31: Ease of Seeing Crossing Point and Walking to and from the Bus Stop

Nearly all (99%) had no difficulty getting to and from the bus stop, with most (92%) finding it easy. This assessment was also apparent in their lack of comments made in the questionnaire (an open question on the subject). The only points raised were:

- 9 participants stated that you needed to watch for cyclists
- 6 participants stated the ease of crossing varied with the direction they approached the bus stop

However, they did find the crossing point harder to locate: 15% thought it was hard, and 58% considered it easy. They found similar levels of difficulty in choosing where to wait for the bus. Their most often expressed issues with respect to waiting for the bus are summarised in Figure 32.

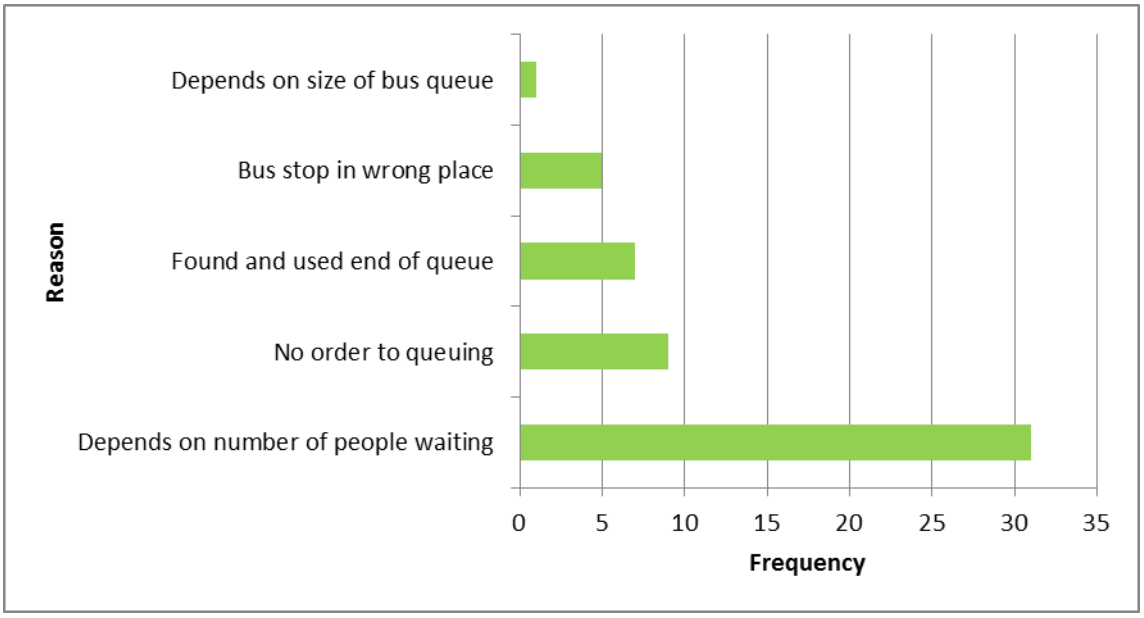

Figure 32: Summarised reasons for ease of waiting for the bus

The most expressed comment (32% of the participants) was that they chose where to stand based upon the number of people waiting at the bus stop, with only a few 7(%) stating they found and waited at the end of the queue. Slightly more (9%) were of the opinion that there was actually no orderly queuing.

1. Nearly all (99%) had no difficulty getting to and from the bus stop, with most (92%) finding it easy.
2. They found the pedestrian crossing point fairly hard to locate: only 58% found it easily.
3. They found choosing where to stand to be fairly hard and it was generally determined by the number of people already at the bus stop.

F.4.2 Safety of using bus stop bypass

Participants were asked to assess how safe they felt crossing to the bus stop island whilst queuing for a bus. Their answers are summarised in Figure 33 and their comments on crossing to the island have been summarised in Figure 34.

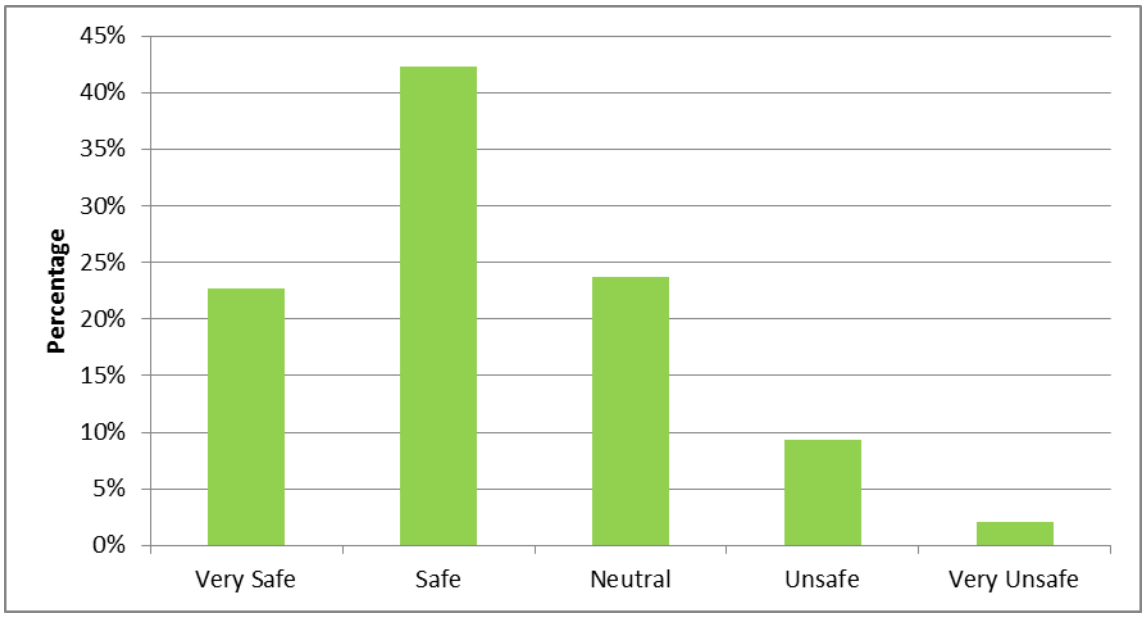

Figure 33: Assessed overall feeling of safety using the bus stop

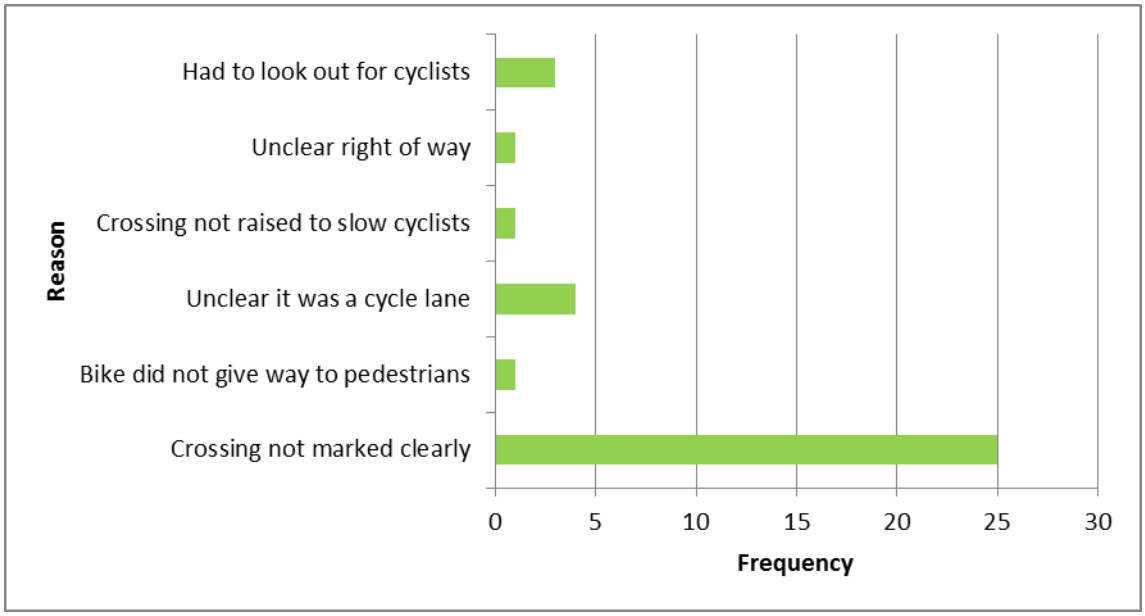

Figure 34: Summarised comments on safety

Most (65%) participants considered that the bus stop was safe and only 11% judged it as unsafe. The main comment made was that the designated pedestrian crossing was not sufficiently marked to make it obvious; 26% noted this in their feedback. Only 7% raised any concerns directly related to safety, and there were mainly associated with unclear cycle track markings and understanding right of ways. This feedback is both in agreement with the relatively low scoring on ease of locating the pedestrian crossing point and with most feeling safe when crossing the cycle track.

1. Most (65%) participants considered that it was safe to cross to the bus stop.
2. They did, however, want the pedestrian crossing point markings to be clearer.

F.4.3 Right of way at the crossing point

Participants were asked to state who they thought had right of way, and who should have right of way at the bus stop bypass. Their answers are summarised in Figure 35.

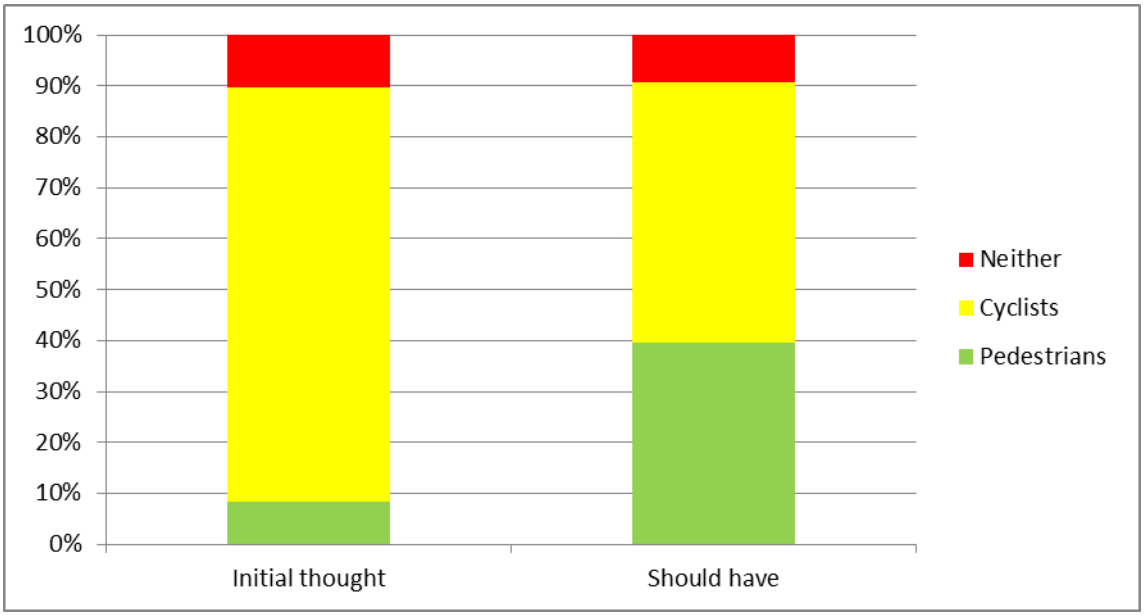

Figure 35: Right of way

Most (81%) of the participant pedestrians understood that the cyclists had right of way, however, a small number (8%) initially thought they had right of way, which corresponds to the small percentage (6%) who commented on the unclear marking of the cycle way and priorities in Section 3.6.2. Understandably a higher percentage (40%) thought that pedestrians should have priority.

1. Most (81%) participants understood that the cyclists had right of way, but 40% thought that pedestrians should have priority.

F.4.4 Interaction with cyclists

Participants were asked to assess how easy it was to see cyclists and correctly judge their distance and speed. Their answers are summarised in Figure 36 and their comments on crossing to the island have been summarised in Figure 37.

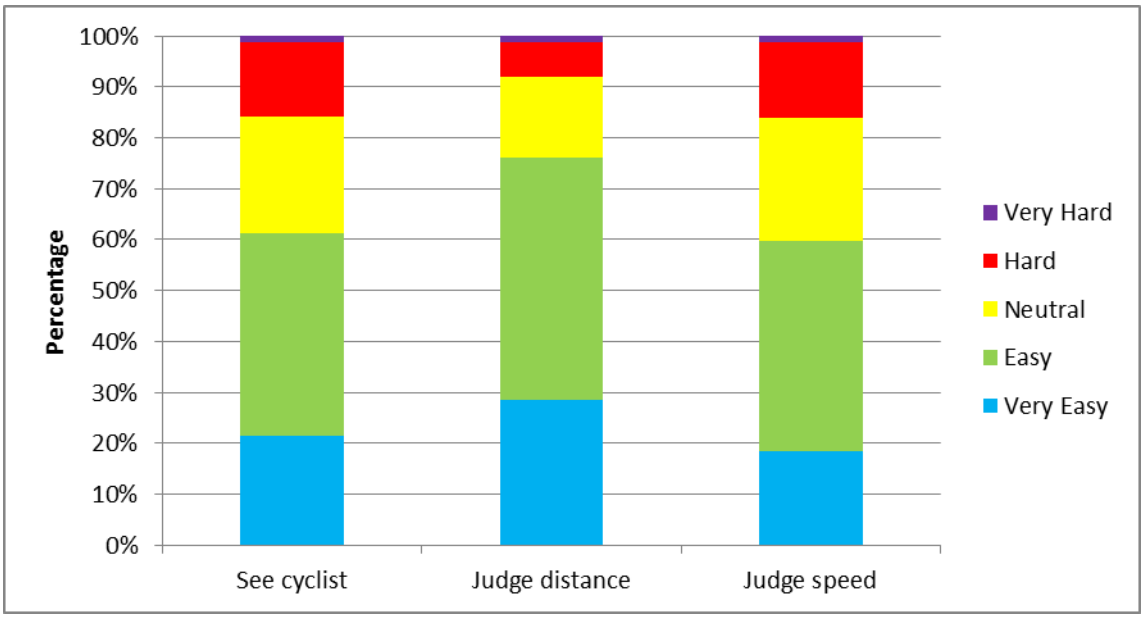

Figure 36: Assessed ease of interacting with cyclists

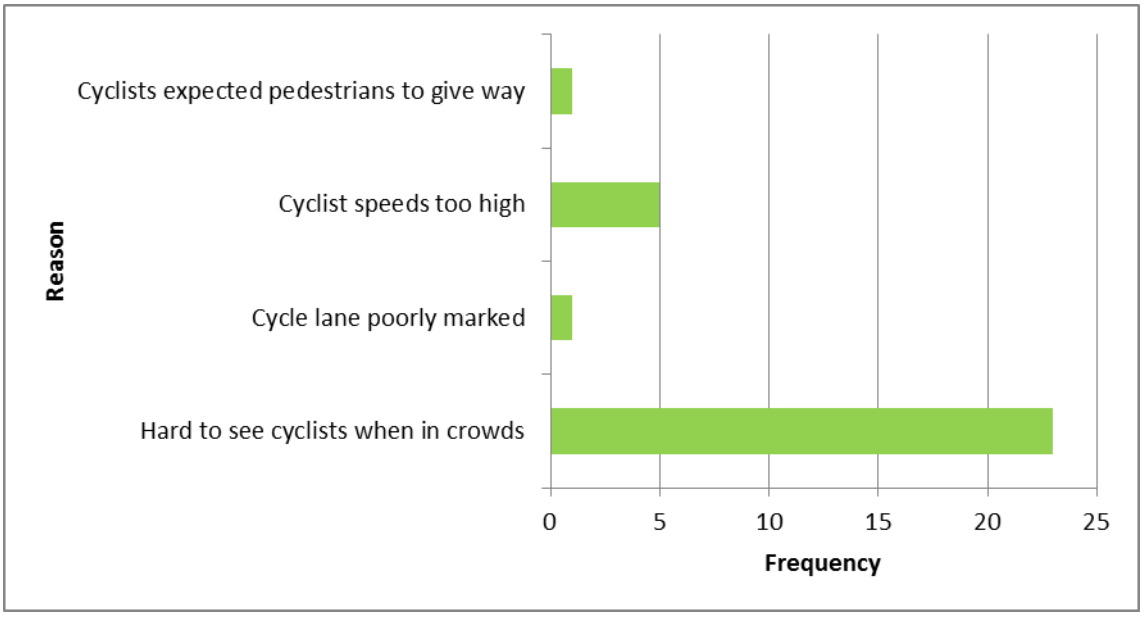

Figure 37: Summarised comments on interacting with cyclists

Only 8 to 16% of the participants considered any aspect of interacting with the cyclists was difficult. The main reason for any difficulties was generally attributed to not being able to see cyclists when in crowded conditions. However, it should be noted that the flow of cyclists was relatively low at approximately only three a minute.

Fewer than 16% of the participants considered interacting with the cyclists as difficult, and this was mainly a result of them being unable to see cyclists in crowded conditions

F.4.5 Using the provided pedestrian crossing

Participants were asked how often, in their recollection, had used the provided pedestrian crossing point. Their answers are summarised in Figure 38 and their comments on using the crossing have been summarised in Figure 39.

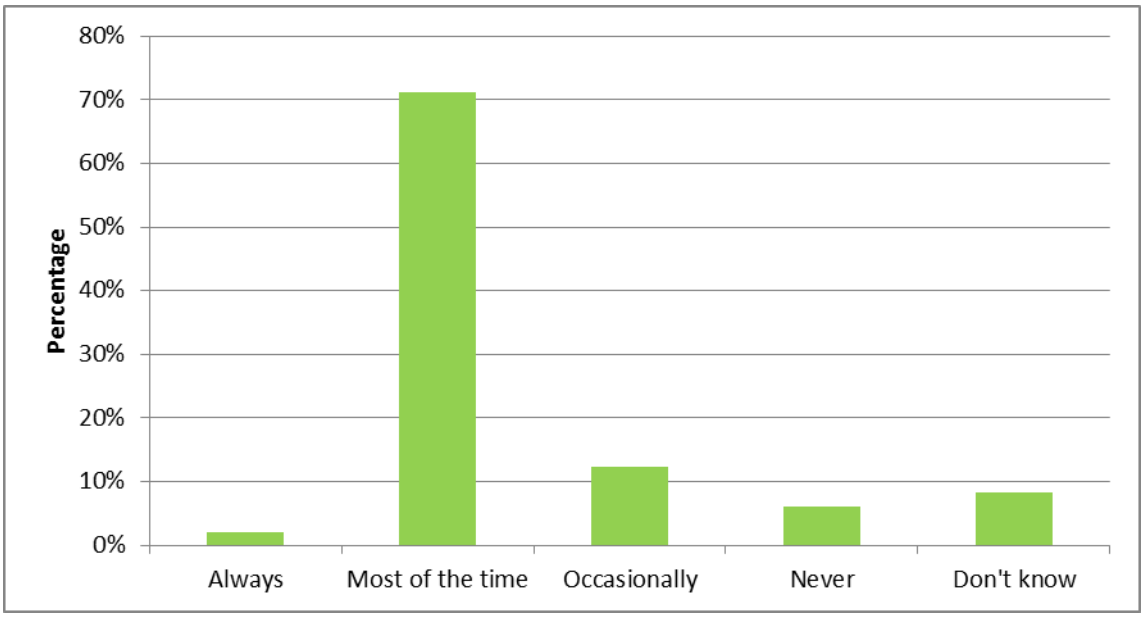

Figure 38: Frequency of using the provided pedestrian crossing point

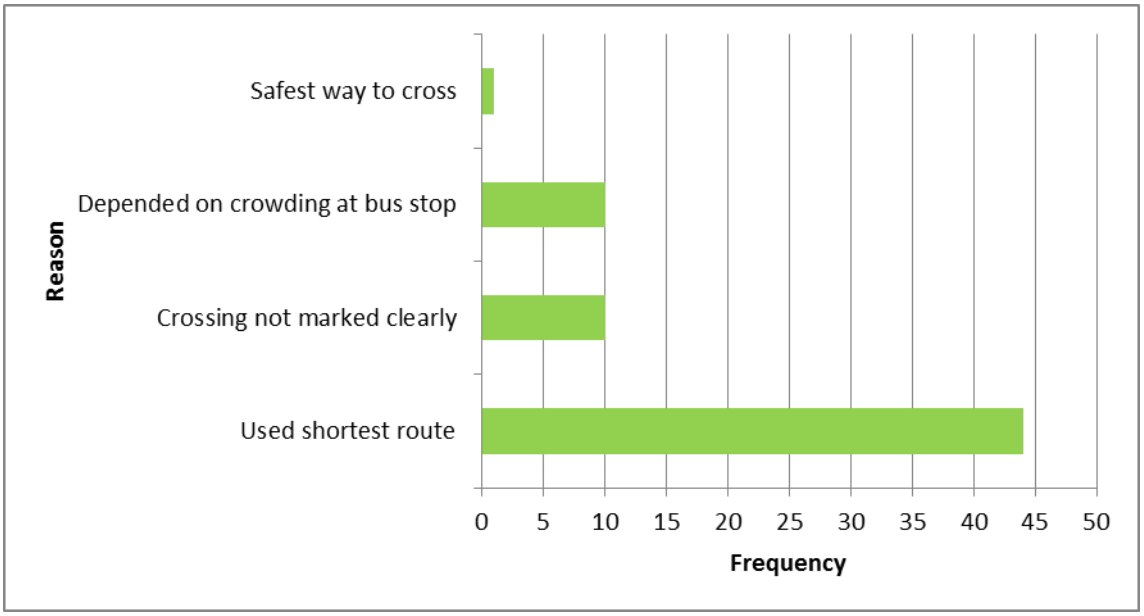

Figure 39: Summarised comments on using the pedestrian crossing point

Most of the participants (70%) stated they used the crossing most of the time, which includes all those who consider they had used it reasonably regularly. Overall, given that 45% stated that they tended to follow their desire line (the shortest route), it is probable that most pedestrians altered routing according to shortest route to an available space on the island and used the provided crossing point mainly when it was convenient to do so, rather than as a matter of course.

They were asked to rate the crossing point according to a set of five criteria, Figure 40, and state how often they thought they would use it in London under different flow conditions, Figure 41.

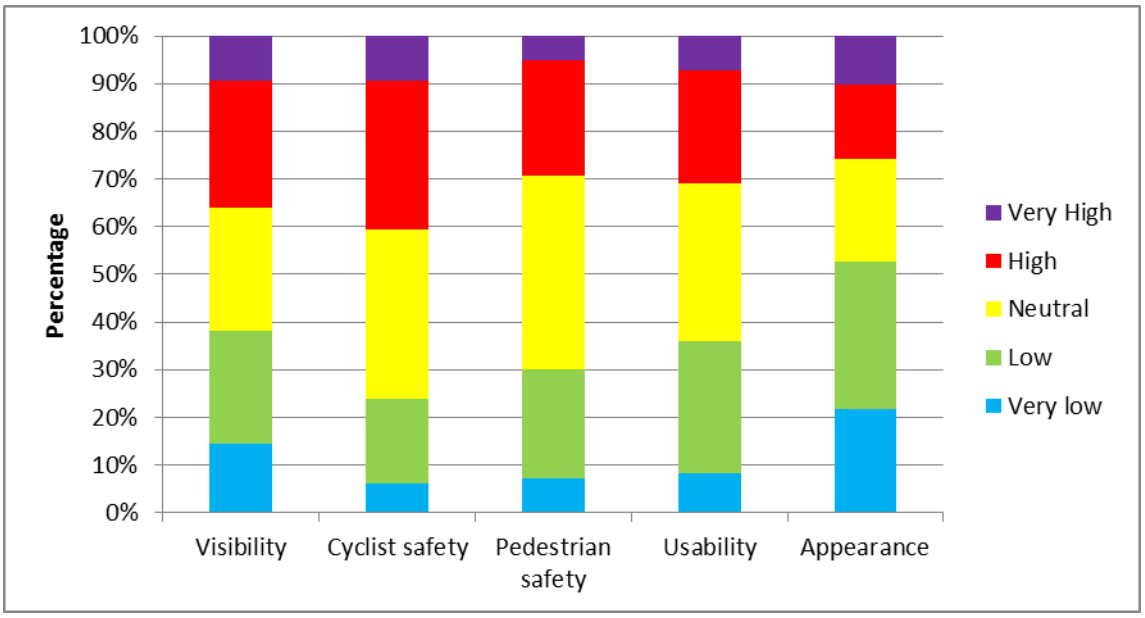

Figure 40: Rating of the pedestrian crossing point

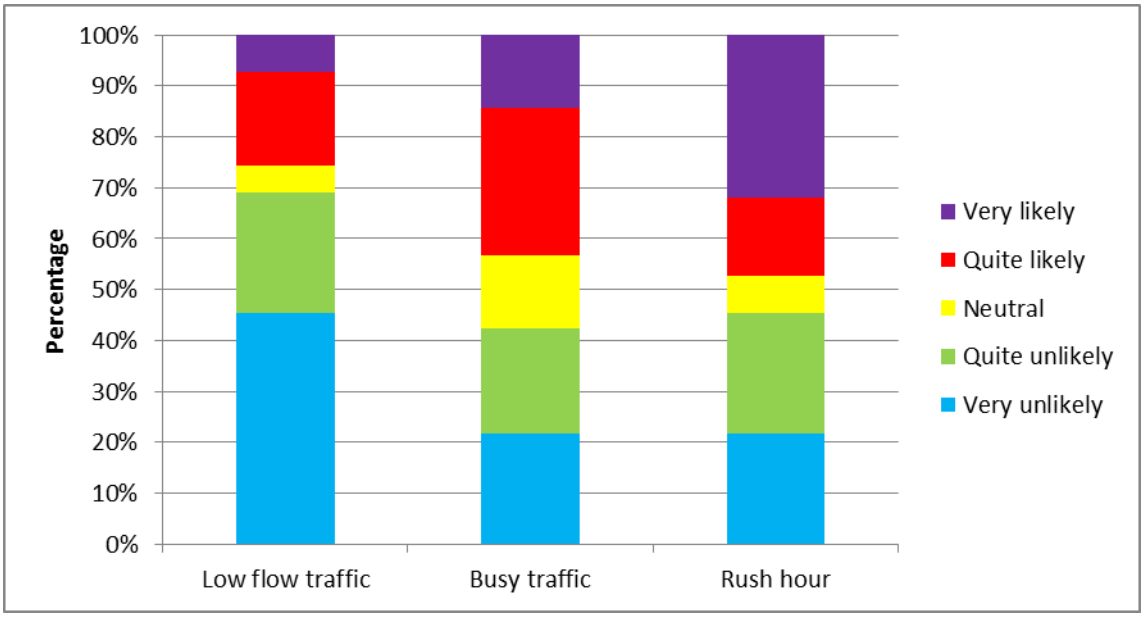

Figure 41: Would participant use the pedestrian crossing point in London?

The provided pedestrian crossing point did not provide any priority when crossing the cycle track, and was only evident from the dropped kerbs and grey tactile paving. It therefore did not rate highly on any scores, which were particularly low for visibility and appearance. As expected, higher percentages of the participants would expect to use the crossing point under higher flow conditions, but even at rush hour nearly half (47%) felt they would be unlikely to use it.

1. The implication was that most pedestrians altered routing according to the shortest route to an available space on the island and used the crossing when it was convenient.
2. The pedestrian crossing point did not rate highly on any scores, and the scores were particularly low for visibility and appearance.
3. Higher percentages of the participants would expect to use a crossing point in London as cycle flow increased, but nearly half (47%) felt they would be unlikely to use it under any conditions.

F.4.6 Other comments

Participants were asked to rate how strongly they agreed with five statements about the bus stop bypass, see Figure 42 and were given the opportunity to provide further comments about it. These have been classified and summarised in Figure 43.

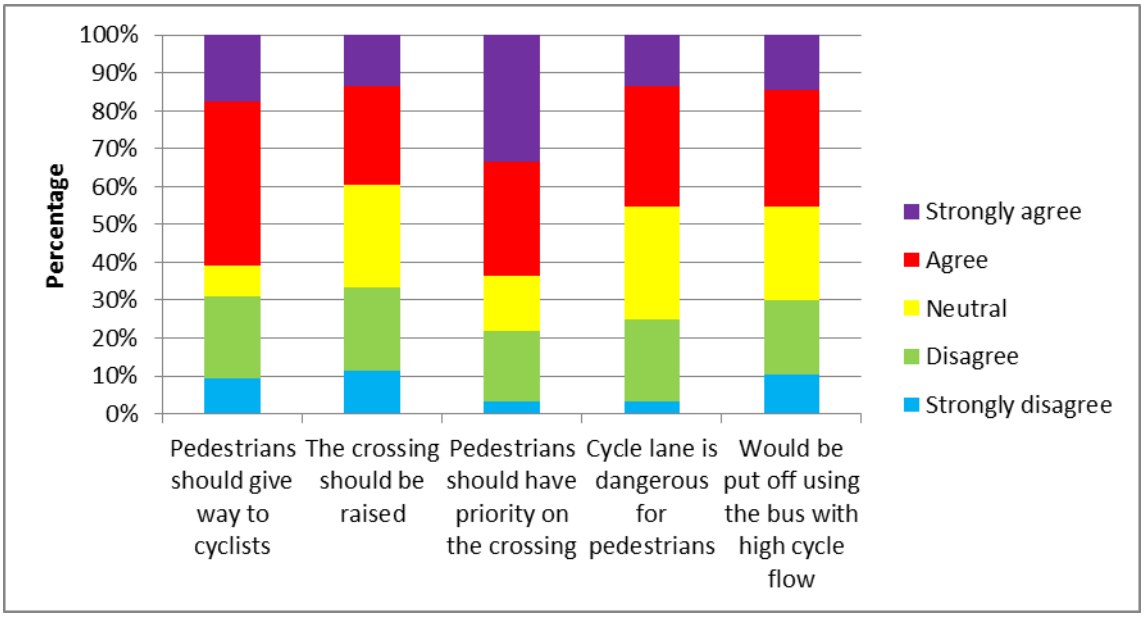

Figure 42: Agreement with statements

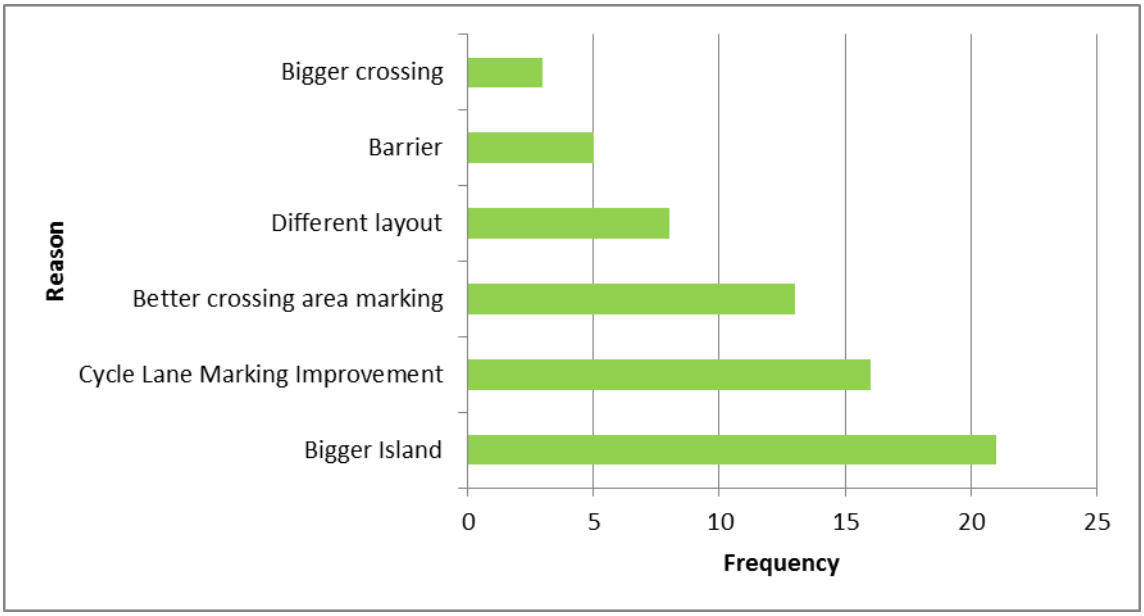

Figure 43: Other comments

The participants generally considered that the cyclists should have right of way, but that they should have right of way at the crossing point. Nearly half considered that the cycle track was dangerous and similar numbers thought they would be put off using the bus if there was a high cycle flow.

Other feedback from the participants tended to exemplify the comments made elsewhere in the questionnaire. Apart from the preference for a larger island, they generally wanted clearer markings as to space ownership and priority.

1. Participant pedestrians generally considered that the cyclists should have right of way, but that they should have right of way at the crossing point.
2. Although they generally felt safe, nearly half considered that the cycle track was dangerous and similar numbers thought they would be put off using the bus if there was a high cycle flow.
3. Pedestrians generally wanted clearer markings as to space ownership and priority.

F.4.7 Summary of pedestrian behaviour and opinions

1. Nearly all (99%) had no difficulty getting to and from the bus stop, with most (92%) finding it easy.

2. They found the pedestrian crossing point fairly hard to locate: only 58% found it easily. This was overall feedback with regard to the crossing, and only indicates their impression of the crossing. They may, in reality, not find this an issue with familiarity.

3. They found choosing where to stand to be fairly hard and it was generally determined by the number of people already at the bus stop.

4. Most (65%) participants considered it was safe to cross to the bus stop, i.e. that the interaction with the cyclists was safe. They did, however, want the pedestrian crossing point markings to be clearer.

5. Most (81%) participants understood that the cyclists had right of way, but 40% thought that pedestrians should have priority.

6. Less than 16% of the participants considered interacting with the cyclists as difficult, and this was mainly a result of them being unable to see cyclists in crowded conditions. However, it should be noted that the flow of cyclists was relatively low at approximately only three a minute.

7. Most participants tended to follow their desire line to an available space on the bus stop island and used the provided pedestrian crossing point regularly as, and when, it was convenient. Under London's rush hour conditions nearly half thought they would be unlikely to use the crossing point.

8. The pedestrian crossing point did not rate highly on any scores, and the scores were particularly low for visibility and appearance.

9. Participant pedestrians generally considered that the cyclists should have right of way, but that they should have right of way at the crossing point.

10. Although they generally felt safe, nearly half considered that the cycle track was dangerous and similar numbers thought they would be put off using the bus if there was a high cycle flow.

11. Pedestrians generally wanted clearer markings as to space ownership and priority.

F.5 Capacity formula worked example

Table 6 shows a worked example of how to determine the capacity of a Bus Stop Island given its area:

Table 6: Worked example of model for trial bus stop island

Zone	Area Size (m^2)	Max. pedestrian density	Capacity
1	10 x 2.45 x 0.5	2.4	5.1
2	4.3 x 2.45	1.0	10.5
3	6.8 x 2.45	0.6	27.8
4	7.1 x 2.45	0.6	29.0
5	10x 2.45 x 0.5	1.6	7.7
TOTAL CAPACITY			**80.1**