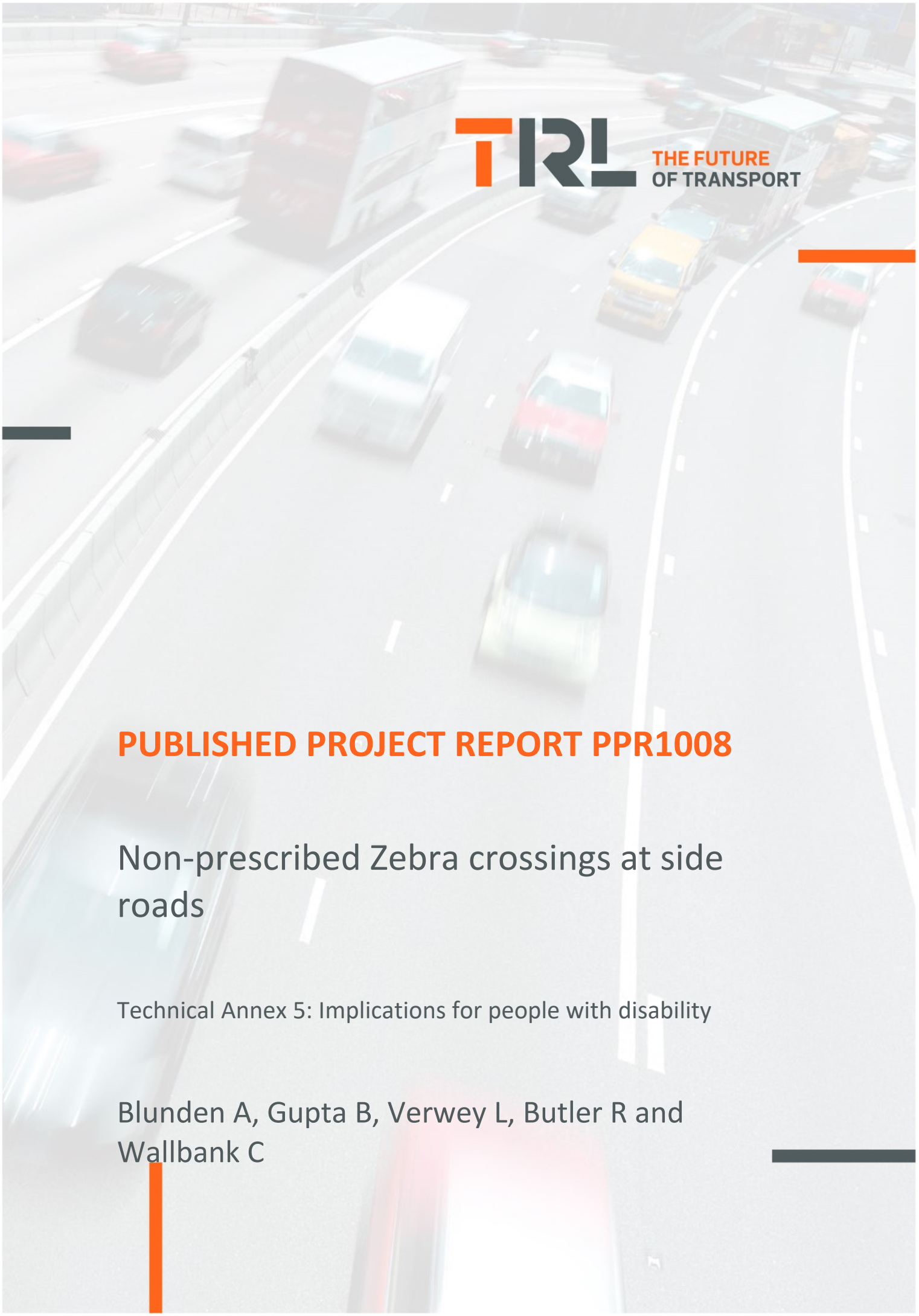

THE FUTURE OF TRANSPORT

PUBLISHED PROJECT REPORT PPR1008

Non-prescribed Zebra crossings at side roads

Technical Annex 5: Implications for people with disability

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Report details

Report prepared for:	Transport for Greater Manchester
Copyright:	© TRL Limited
Report date:	October 2021
Report status/version:	1.0

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Executive Summary

This document forms a Technical Annex to the report *Trials of non-prescribed Zebra crossings at side roads: Final Report*, which presents the findings of a programme of user research and trials into the proposed use of a non-prescribed form of zebra crossing at side-roads. This technical annex presents the findings from research with people with disabilities into their perceptions of the safety of the proposed crossing type and how it would affect them.

Methods

The purpose of this study was to investigate perceived safety and convenience of use of the non-prescribed zebra crossing design from the perspective of individuals with disabilities, in comparison with a side-road with no formal crossing provision. Five disabilities groups were identified:

1. Mobility impaired (including wheelchair users)
2. Deaf and hearing impaired
3. Blind and visually impaired
4. Learning disabilities and cognitive disorders
5. Mental health conditions

Table 1 shows a summary of the sample size for each of the five disability groups and method of collecting data. Respondents were asked to imagine they encountered a junction with the proposed crossing. They were asked about their likelihood of using, the ease of using, and perceived safety around the proposed crossing. They were also asked to comment on overall safety around the proposed crossing, and their likelihood of crossing the junction without a crossing.

Table 1: Summary of responses

Disability group	Type of respondents	Data collection method	No. of respondents
Mobility impaired (including wheelchair users)	Individuals with mobility impairment recruited from TRL's participant database	Online survey	24
Deaf and hearing impaired	Deaf individuals or individuals with hearing impairment recruited through groups on social media	Online survey	17
Blind and visually impaired	Blind individuals or individuals with visual impairment recruited through groups on social media	Telephone interview with 3D tactile model sent by post	4
Learning disabilities and cognitive disorder	Representatives of organisations representing people with learning disabilities	Online interview conducted on Microsoft Teams	4
Mental health conditions	Representatives of organisations representing people with mental health disabilities	Online interview conducted on Microsoft Teams	4

Participants in the blind and visually impaired group were sent 3D tactile models depicting the proposed crossing. These models were small enough to be held by hand and were used to facilitate the telephone interviews. For the groups with learning disabilities, cognitive disorders, and mental health conditions, who may not be able to give consent to participating in a study, we conducted online interviews representatives of organisations/groups who act on behalf of people with these conditions. For these groups therefore the responses provide an expert opinion of how the different users would respond to the proposed crossing, rather than reflecting personal experiences of the users.

Main findings

Most of the participants with a mobility impairment said that they would be likely to use a non-prescribed zebra crossing. Generally, participants responded positively about the effect of the proposed crossing. Nine out of 24 respondents said it was better than not having any crossing, or that the markings were a good reminder for drivers to slow down, or that a shorter walking distance would make their trip easier. Those who said they would be less likely to use the crossing or found it inconvenient expressed concerns about not being seen by drivers, specifically referring to the lack of traditional zebra crossing features which would indicate to drivers to look out for pedestrians. In addition, the position of the crossing close to the mouth of the road raised some concerns. Some participants felt that the vehicle would not have enough time to stop for a pedestrian. Participants' feelings of safety varied with the type and turning movement of the vehicle, being the lowest with large vehicles turning into the side road. The two most common suggestions from participants for improving the junction layout were adding warning signs or road markings and moving the crossing away from the junction.

Respondents from the hearing-impaired group were split when asked how likely they would be to use the crossing. Seven were ‘highly unlikely’ or ‘unlikely’ to use these crossings; whilst eight were ‘likely’ or ‘highly likely’. While there were participants who welcomed the position of the crossing as it made their journey easier, some of them expressed safety concerns and uncertainty about priority. Similar to the mobility impaired group, they felt that drivers may not be aware of the crossing and may not see the pedestrian or stop in time. This was the main safety concern among participants as they are unable to hear oncoming traffic from behind them. Participants’ feelings of safety were the lowest with large vehicles turning into the side road. Participants were concerned about not being seen by the driver of large vehicles as they have a higher seating position. The top three suggestions from participants were to move the crossing away from the junction, add warning signs for drivers, and to improve visibility of the crossing to drivers.

While three of the four participants who were Blind or visually impaired said they would be ‘very likely’ to use the crossing, there were concerns about its proximity to the main road. In particular, the perceived risk that pedestrians who were Blind or partially sighted could accidentally walk out into a lane on the main carriageway if they deviated from the crossing line. They highlighted the importance of installing tactile paving correctly to ensure that pedestrians were directed across the crossing point accurately and safely. Another factor that was raised was that the volume, speed and noise of traffic has a huge impact on the

ability of Blind people to detect when it is safe to cross. It is therefore essential that traffic speed, density, and noise at the junction should be considered when selecting appropriate sites. These factors impact whether a Blind or partially sighted pedestrian would use this crossing point or whether they would "*indent*" further into the side road before attempting to cross.

Health care professionals and carers were interviewed on behalf of people with learning disabilities, cognitive disorders, and mental health conditions. Most participants across the three groups felt that people with disabilities will tend to interact with the new crossing design as if it was a prescribed zebra crossing because it is recognisable, and the patterns are familiar. Further, that the simplicity of the design meant that most people will not be distracted or confused by having to complete additional tasks before crossing. Participants also welcomed having the crossing in the direction of the desired walk line. For people with cognitive disorders that have lost some visual processing capacity, the provision of a single-coloured path across the junction could support crossing behaviour.

Most participants reported that any changes have an impact on the ability of people with disabilities to navigate their environment. Information and communication were therefore raised as key components to the successful introduction of the new crossing design. The position of the crossing close to the mouth of the road also raised some safety concerns. These included that pedestrians will need to look behind them to check if a vehicle is about to turn into the sideroad and then be able to correctly interpret the behaviour of the vehicle as turning, instead of just looking left and right before using the pedestrian crossing. The visibility of the crossing for drivers and other road users were also a concern. Some of the suggestions participants made included moving the crossing away from the junction, slowing vehicles down on the main road or adding vehicle stopping restrictions across the junction. Several participants felt that it would be important to introduce the new designs only after the impact of other factors such as the traffic density and speed in the main road have been considered.

1 Introduction

1.1 This document

This document forms a Technical Annex to the report *Trials of non-prescribed Zebra crossings at side roads: Final Report*, which presents the findings of a programme of user research and trials into the proposed use of a non-prescribed form of zebra crossing at side-roads. Technical Annex 5 sets out the methodology and findings from research conducted to explore understanding the safety and convenience of the non-prescribed side road zebra crossing from the perspective of individuals with disabilities. The overall conclusions from the research programme are set out in the Final Report.

1.2 Background

The markings, equipment and signs used to denote a zebra crossing in the UK are prescribed in statutory government regulations. Key differences between a prescribed and non-prescribed zebra crossing are shown in Table 2. A prescribed zebra crossing is indicated by a series of alternate black and white stripes on the carriageway; a yellow globe is positioned at each end of the crossing (commonly referred to as a Belisha beacon); and the crossing area is marked with a line of studs; give ways lines and zigzag markings. The requirement for at least two zigzag markings means the minimum a zebra can be set-back from the mouth of a side road is about 5 meters.

Conversely, non-prescribed crossings exclude some or all the following: studs, zigzag markings and Belisha beacons. A simplification in the crossing could lower implementation and maintenance costs for TfGM and local authorities. In addition, removing the requirement for zigzag markings (and therefore the need for a 5-metre set-back) has the advantage of keeping pedestrians on their desired walking line, giving them a more direct route across the mouth of the junction.

Table 2: Key differences between a prescribed and a non-prescribed zebra crossing

Design feature	Prescribed zebra crossing	Non-prescribed zebra crossing
Crossing markings	Black and white stripes and give way markings	Black and white stripes
Peripheral markings	Line of studs Zigzag markings	May include zigzag markings on one or both sides of the crossing
Set-back distance from junction	The requirement for at least two zigzag markings creates a minimum set-back distance of around 5 meters	No minimum distance, could be flush with the end of the side road
Additional equipment	Yellow globe on a black and white striped pole (Belisha beacon)	

Both prescribed and non-prescribed crossings are intended to give pedestrians wishing to cross the side road priority over vehicles; this applies to vehicles on the side road approaching the junction, and to vehicles on the main road wishing to turn into the side road. Drivers (and to a lesser extent pedestrians) have a short time in which to determine

what to do when confronted with an unfamiliar road layout. They key to effective road markings is the ability to quickly and accurately convey the intended message to road users, so that both drivers and pedestrians can intuitively take appropriate action.

This study aimed to explore understanding of the meaning and purpose of the non-prescribed side road zebra crossing from the perspective of individuals with disabilities. The participants were asked questions about perceived safety, convenience of use, and areas for improvements on the non-prescribed zebra crossing design. This study, therefore, aimed to address the following research question:

> How do individuals with disabilities comprehend and anticipate behaving around non-prescribed side road zebra crossings?

TRL's original proposed methodology involved conducting focus group sessions with individuals with various disabilities. Participants would be shown videos, images or a tactile model followed by questions about their understanding, perceptions, and concerns. TfGM was to aid with the recruitment of these individuals. Originally, there were four disability groups identified, from each of which five participants would be invited:

- Blind and visually impaired
- Mobility impaired (including wheelchair users)
- Deaf or hearing impaired
- Learning disabilities and mental health

In March 2020, the spread of COVID-19 initiated social distancing policies, followed by a nationwide lockdown. For this reason, the study could not be carried out using the initial proposed method. Instead, TRL and TfGM agreed a revised approach, adapting the methodology to use online surveys and telephone/online interviews.

2 Study Design

2.1 Method

To ensure our research was conducted in a manner that observed safe social distancing measures and would not be interrupted by future lockdown protocols, the methodology was reconsidered and redesigned. Table 3 provides an overview of the new approach.

Table 3: Overview of the disability groups and methods of engagement

Disability group	Type of respondents	Recruitment	Method	No. of respondents	Incentive
Mobility impaired (including wheelchair users)	Individuals with mobility impairment	Relevant organisations Facebook groups TRL's participant database	Online survey	15-20	One prize draw winner for £100 Amazon voucher
Deaf and hearing impaired	Deaf individuals or individuals with hearing impairment	Facebook groups	Online survey	15-20	One prize draw winner for £100 Amazon voucher
Blind and visually impaired	Blind individuals or individuals with visual impairment	Facebook groups	Telephone interview with 3D tactile model sent by post	4	£30 Amazon voucher per individual
Learning disabilities and cognitive disorders	Representatives of organisations representing people with learning disabilities and cognitive disorders	Relevant organisations Snowballing method	Online interviews conducted on Microsoft Teams platform	4	£30 Amazon voucher per individual
Mental health conditions	Representatives of organisations representing people with mental health disabilities	Relevant organisations Snowballing method	Online interviews conducted on Microsoft Teams platform	4	£30 Amazon voucher per individual

2.1.1 Data collection

Online survey

An online survey was used to gain an understanding of public perceptions around safety and convenience when using the non-prescribed zebra crossing. The survey comprised a series of images detailed in Section 2.2, followed by a series of questions. The survey included a

mixture of multiple choices and open-ended questions (Appendix A and Appendix B). Participants were asked to select an option in multiple choice questions and then asked to explain their choice in an open-ended question.

Two separate online surveys were created for the following disability groups: mobility impaired and deaf or hearing impaired.

Online or telephone interviews

Online or telephone interviews were conducted with the remaining disability groups, Blind or visually impaired, learning disabilities and cognitive disorders, and mental health conditions.

Participants in the Blind or visually impaired group were provided a tactile model detailed in Section 2.2.2. This model was sent to them by post after confirming their interest in participating in the study. Interviews were conducted over a phone call and recorded with the consent of participants. The recordings were used to supplement notes made during the interview. A topic guide was used (shown in Appendix C).

Participants in the learning disabilities and cognitive disorders, and mental health condition groups were interviewed over Microsoft Teams and recorded with the consent of participants. The recordings were used to supplement notes made during the interview. During interviews, a topic guide was used and participants were shown PowerPoint slides to provide the visual context for questions (shown in Appendix D and Appendix E).

2.1.2 Recruitment

Several methods were used to recruit the relevant participants from each group.

Mobility impaired

We reached out to organisations and groups within Manchester to represent or provide support to individuals with disabilities. Additionally, we posted on relevant Facebook groups with the information about the study and the link to the online survey. Finally, the survey was sent to TRL's database of participants. TRL's participant database has approximately 1,200 members based in Berkshire, Hampshire and Surrey (in the UK).

Hearing impaired and Blind or visually impaired

We reached out to UK based Facebook groups catered to providing support to deaf and hard of hearing individuals, or Blind and visually impaired individuals. Deaf and hard of hearing groups were provided information about the study and a link to the online survey. Blind or visually impaired individuals were asked to express interest in the study by commenting on the Facebook post. They were then sent the information sheet providing details of the study.

Learning disabilities, cognitive disorders and mental health conditions

We reached out to organisations/groups who act as representatives for people with learning disabilities, cognitive disorders and mental health conditions. These categories encompass a

wide variety of disabilities. We took this approach because we felt that representatives would be able to give a broad overview of the issues faced within each of these categories. This also ensured that our participants were able to give informed consent to participate in the study, which may not have been possible if speaking directly to people with learning disabilities / cognitive disorders / mental health conditions. Our aim was to recruit some participants from Manchester. In total eight representatives were recruited, four representatives for people with learning difficulties and cognitive disorders, and four for people with mental health conditions. To help ensure that the project had enough participants, potential participants were also identified through LinkedIn and then contacted.

2.1.3 Data analysis

Online survey

The survey was made up of quantitative, fixed choice, questions as well as qualitative, open questions. This mixed methods study allows rich data to be captured and analysed in an effective manner with quantitative data analysis providing measurable and comparable results and qualitative data providing context and deeper understanding of participants responses.

The quantitative element of the survey data was analysed and tabulated/graphed for each question. Demographics of each sample are also presented. Due to the small sample size for this analysis, it is not be possible to examine differences between groups of participants (e.g. by age, gender, or region).

Online and telephone interviews

Notes were taken during the interviews in addition to using the audio recordings. Relevant concepts or ideas were identified in the notes and incorporated in the results. Since the number of participants were relatively small, all relevant information was included.

2.2 Stimuli

2.2.1 Virtual simulated environment

Sub tasks 1, 2, 4, and 5 utilised still images developed using a virtual simulated environment[1] showing the non-prescribed zebra crossing to participants before asking them questions. The images were from the pedestrian's perspective at a junction (shown in the Appendices). A total of six different images, varying in the following ways, were used:

1. **Point of view**: from left to right, or right to left
2. **Vehicle movement**: into the side road from the left, into the side road from the right or out of the side road.

[1] The virtual simulated environment was created by Agility3.

The combination of these two variables across six stimuli is shown in Table 4.

Table 4: Conditions and variables for the images

Condition no.	Point of view	Vehicle movement
1	Left to right	Out of side road
2	Left to right	Into side road (left)
3	Left to right	Into side road (right)
4	Right to left	Out of side road
5	Right to left	Into side road (left)
6	Right to left	Into side road (right)

Point of view

The point of view was from the perspectives of a pedestrian crossing at the junction. The pedestrians were either standing at the right or left side of the side road waiting to cross to the left or right respectively.

For sub tasks 1 and 2, participants were shown all six images in the same order presented in Table 4. The images were shown to help them understand the various possible scenarios at that crossing.

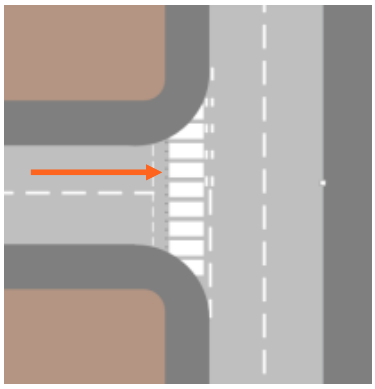
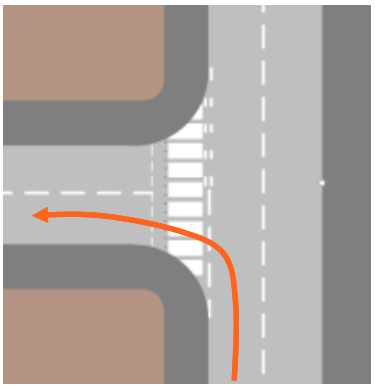
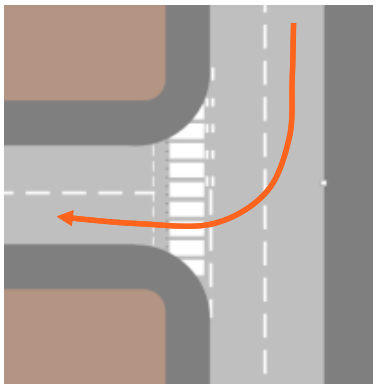
For sub tasks 4 and 5, participants were shown seven images with one image being repeated. These were presented to explain the differences between the prescribed and non-prescribed crossings and to provide a variety of contexts for follow-up questions. Two topic guides were developed and followed. One for participants representing people with learning disabilities and cognitive disorders (Appendix D) and one for those participants representing people with mental health condition (Appendix E) .

Vehicle movement

There are three vehicle movements (see Table 5).

For the '1. Out of side road' movement, the car is in front of the crossing, along the side road. For, the other two '2. Into side road (left)' and ‘3. Into side road (right)’ movements, the car appears to be turning into the side road from the main road.

Table 5: Description of the three different vehicle movements

1. Out of side road	2. Into side road (left)	3. Into side road (right)
		
The car approaches the junction from the side road and stops before the crossing.	The car begins to make a left-hand turn from the main road into the side road.	The car begins to make a right-hand turn from the main road into the side road.

2.2.2 Tactile model

As it was not possible to share the 'pedestrian's eye view' images with participants with visual impairment, 3D tactile models were used to support the interviews and provide detailed understanding of the proposed road layout. Figure 1 shows the tactile model which includes give way lines, black and white crossing markings across the road, as well as blister paving on either side of the crossing point. These models were designed and provided by Brian Deegan from TfGM.

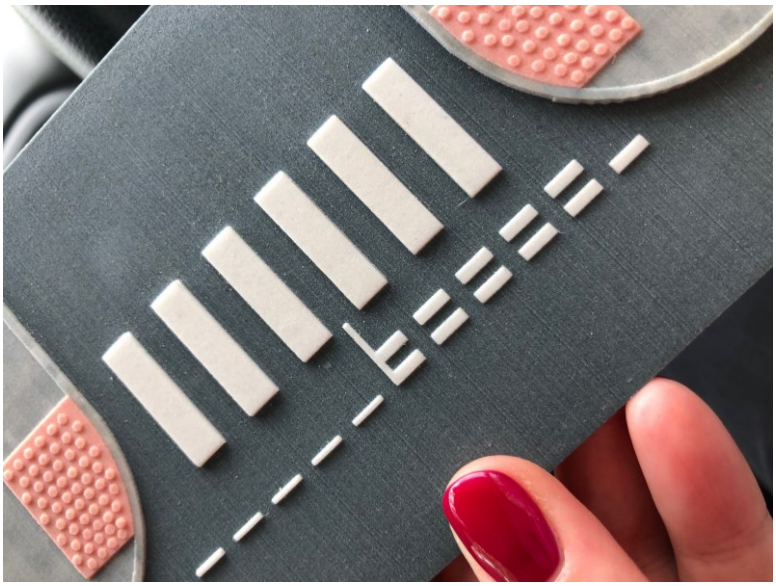


Figure 1: 3D Tactile model (showing scale of model)

3 Results

3.1 Mobility impaired group

Participants

Thirty-nine people completed this survey. Of these, 13 were removed because they reported no mobility impairments, and two were moved to the deaf or hearing impaired group (see Section 3.2) because they reported no mobility impairments only hearing impairments. Responses from the remaining 24 respondents were analysed and reported.

Participants with mobility impairments reported impairments included a leg amputation, arthritis, hip issues and mobility impairment requiring full-time wheelchair use. Eight people reported using sticks or crutches to get around, four used a wheelchair and a further three reported using a powered wheelchair.

Table 6 shows the demographics of respondents. The majority were female but there was a good spread across age groups.

Table 6: Demographics of the deaf or hearing-impaired group

	Gender			
Age group	**Female**	**Male**	**Other (non-binary or gender fluid)**	**Total**
18-24 years	0	0	1	**0**
25-34 years	0	0	0	**1**
35-44 years	2		1	**2**
45-54 years	3	2	0	**6**
55-64 years	3	2	0	**5**
65-74 years	3	3	0	**6**
75+ years	2	2	0	**4**
Total	**13**	**9**	**2**	**24**

Figure 2 shows the distribution of respondents by region. Almost half of the respondents (11) were from the South East, reflecting the location of volunteers in TRL's participant database.

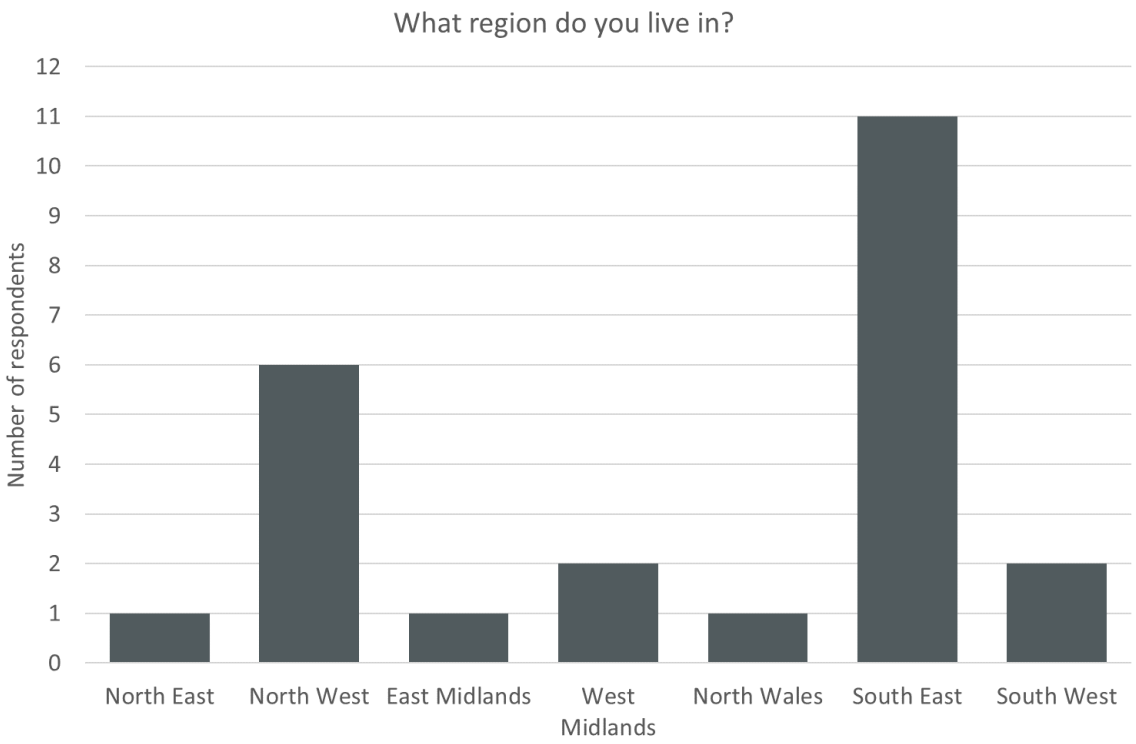


Figure 2: Number of respondents by region

Perception of proposed crossing

Respondents were asked “Imagine these proposed crossings were introduced at junctions in your area. How likely are you to use these crossings?” Figure 3 shows the responses were more positive than negative: 15 were ‘likely’ or ‘highly likely’ to use these crossings; whilst four were ‘highly unlikely’ or ‘unlikely’. Five were ‘not sure’.

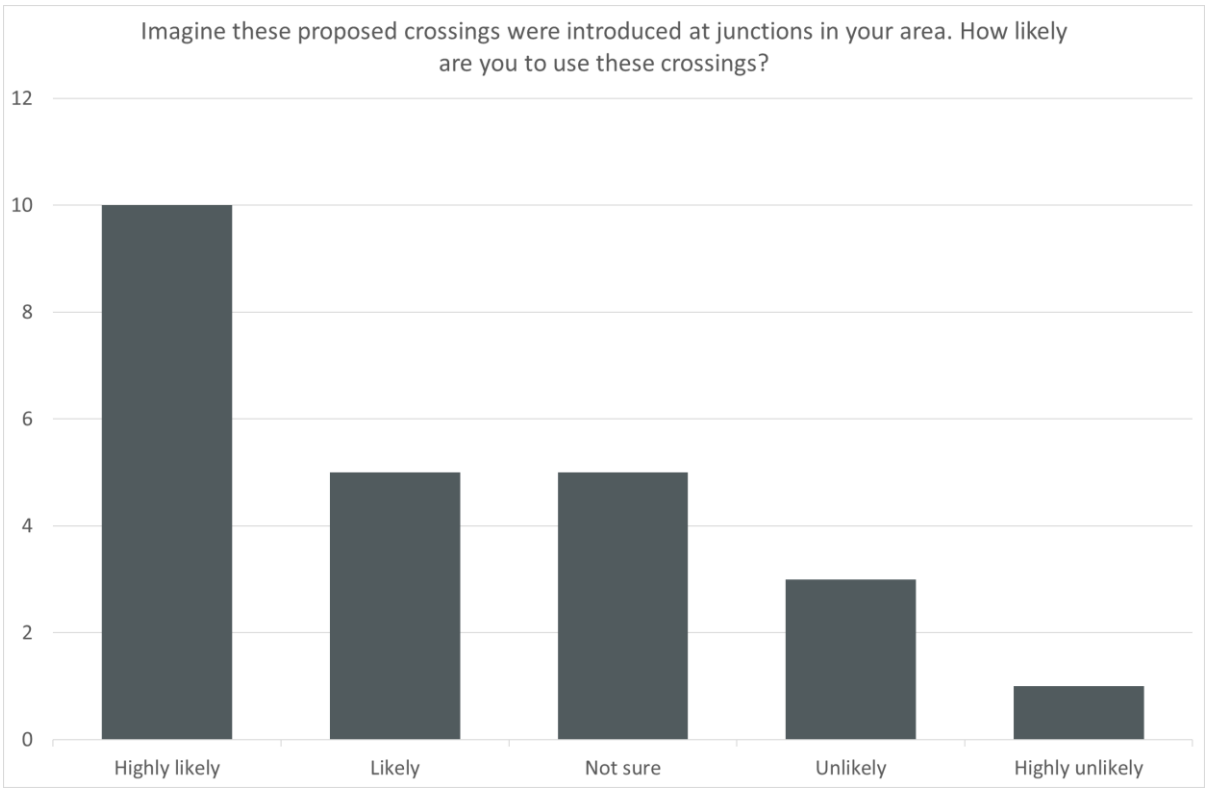


Figure 3: Number of responses by likelihood they would use these crossings

Participants were asked to comment on their reasons for the choices they made. 40% (6 out of 15) of those who selected 'highly likely' or 'likely' reported that the crossing was in line with their path, and hence made it easier to walk. Five of them said it was "*safer*" or "*better*" than having no crossing at all. Table 7 shows a categorisation of the various reasons provided by respondents. Other responses included "*would wait for traffic to pass to cross*", "*needs some of form of warning to those turning in*", "*many people cross at the junction anyway*", and that it was "*easy to recognise*".

Table 7: Reasons for likelihood of using the crossing

Responses	Highly unlikely	Unlikely	Not sure	Likely	Highly likely	Total
In line with their path	-	-	-	1	5	**6**
Better/safer than no crossing	-	-	-	1	4	**5**
Don't think driver would notice/ understand the markings or stop	-	1	4	-	-	**5**
Depends on many other factors (car speed, traffic volume)	-	-	3	1	-	**4**
Could cause obstruction to traffic	-	2	1	-	-	**3**

Others[2]	1	-	1	1	1	**4**

Participants were also asked to "Imagine these proposed crossings were introduced at junctions in your area. How convenient or inconvenient would you find the position of these crossings?" Figure 4 shows that over half of the participants (15 out of 24) found the crossing position 'convenient' or 'very convenient'; six reported it was 'very inconvenient' or 'inconvenient' and three were 'not sure'.

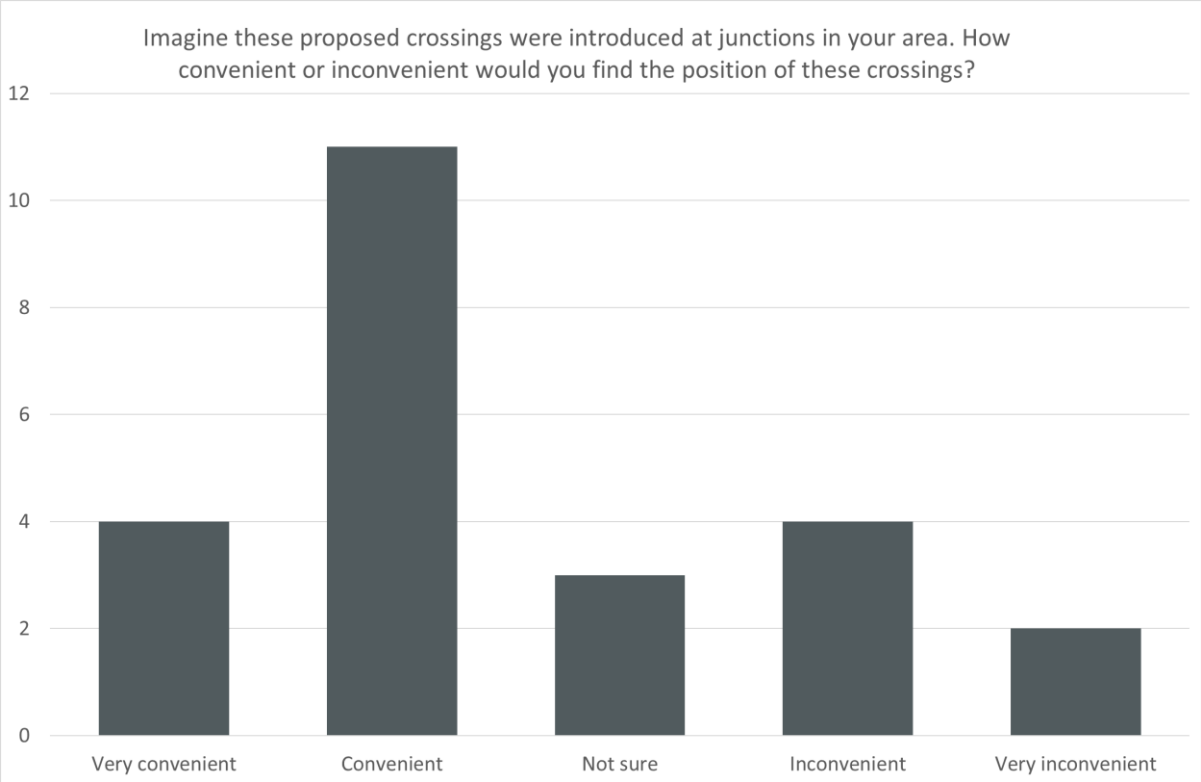


Figure 4: Number of responses by convenience of crossing position

Participants were asked to comment on their reasons for the choices they made. Almost half (7 out of 15) of those who selected 'very convenient' or 'convenient' said the crossing was in line with their path. Another four said they thought it 'convenient' because it reduced their walking distance; they attributed less walking to less physical pain. Table 8 shows a categorisation of various reasons provided by respondents. Other responses included: uncertainty about whether a driver approaching could see the markings and possible confusion about priority at junction. Some also said the markings could potentially slow traffic compared to an unmarked junction.

[2] Throughout the report we collapse answers with very few responses into an 'other' category, where appropriate.

Table 8: Reasons for convenience of crossing position

Responses	Very inconvenient	Inconvenient	Not sure	Convenient	Very convenient	Total
In line with their path	1	-	-	5	2	**8**
Shorter walking distance - less painful	-	-	-	4	-	**4**
More visibility needed	-	1	1	1	-	**3**
Could be further away from junction	-	2	1	-	-	**3**
Others	2	1	1	4	1	**9**

Perceived safety

Participants were also asked "how safe or unsafe do you think you would feel using this crossing in the real-world?" under various situations with approaching vehicles (cyclists, cars and large vehicles) either where the vehicle was approaching from the side road (option 1 in Table 4), or into the side road (options 2 or 3 in Table 4). Figure 5 shows the responses.

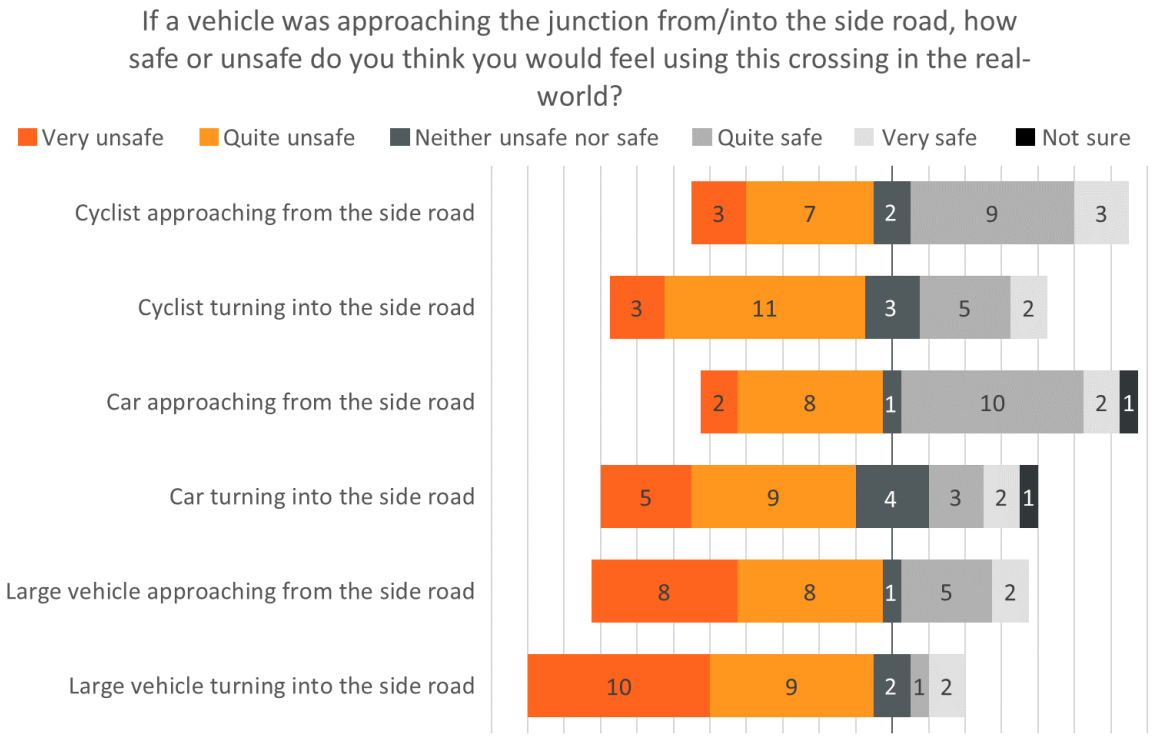


Figure 5: Number of responses by feelings of safety when different vehicle types are approaching the crossing

For cyclists and cars approaching from the side road, results were mixed; half of respondents (12) reported feeling 'quite safe' or 'very safe' whilst just under half (10) reported feeling 'very unsafe' or 'quite unsafe'.

Participants were asked to provide a reason for the choices they made (See Table 9 and Table 10). Majority of those chose ‘very unsafe’ or ‘quite unsafe’ for cyclists reported that “*cyclists never/don’t stop for road signs or crossings*”, or that they did not trust cyclists to stop. Other reasons for choosing ‘very unsafe’ or ‘quite unsafe’ was that there were multiple directions to check before crossing, or they felt drivers have too many things to pay attention to which can lead them to miss pedestrians during high traffic.

The majority (9 out of 12) of those chose ‘very safe’ or ‘quite safe’ for both cyclists and cars said cyclists and car drivers should be able to see the markings clearly. Some also added that cyclists should be able to stop easily or that they trusted drivers to adhere to road markings.

Table 9:Response to cyclist approaching the side road

Response	Very unsafe		Quite unsafe		Neither safe nor unsafe		Quite safe		Very unsafe		Not sure	
	From side road	Into side road	From side road	Into side road	From side road	Into side road	From side road	Into side road	From side road	Into side road	From side road	Into side road
Cyclists never stop for road signs or crossings	3	2	4	3	1	-	-	-	-	-	-	-
Cyclist likely to notice the crossing	-	-	-	-	-	-	6	3	1	1	-	-
Cyclist may not notice the crossing	-	-	-	5	-	1	-	-	-	-	-	-
Others	-	1	3	5	-	2	3	2	2	1	-	-

Table 10:Response to car approaching the side road

Responses	Very unsafe		Quite unsafe		Neither safe nor unsafe		Quite safe		Very unsafe		Not sure	
	From side road	Into side road	From side road	Into side road	From side road	Into side road	From side road	Into side road	From side road	Into side road	From side road	Into side road
Driver may not see the marking	1	3	5	6	-	2	-	-	-	-	-	-
Driver should be able to see the markings clearly	-	-	-	-	-	-	7	2	-	-	-	-
Too many things for driver to pay attention to	-	-	1	4	-	1	1	-	-	-	1	1
Others	3	2	3	3	1	2	3	1	2	2	-	-

Table 11:Response to large vehicle approaching the side road

Responses	Very unsafe		Quite unsafe		Neither safe nor unsafe		Quite safe		Very unsafe		Not sure	
	From side road	Into side road	From side road	Into side road	From side road	Into side road	From side road	Into side road	From side road	Into side road	From side road	Into side road
Don’t think driver would notice the crossing or can see me	6	8	4	3	1	1	-	1	-	1	-	-
Depends on many other factors (car speed, traffic volume, driver attention on junction)	1	1	3	2	-	1	-	-	-	-	-	-
Others	4	3	2	5	-	-	4	2	-	1	-	-

Compared with the situation when vehicles were approaching from the side road, more respondents reported feeling unsafe when the cyclist or car was turning into the side road from the main road (14 reported feeling 'very unsafe' or 'quite unsafe' when vehicle is turning into the side road compared with 10 when the vehicle was approaching from the side road). Table 9 and Table 10 shows a categorisation of the various reasons provided by respondents.

When asked about their response to large vehicles approaching the crossing point, the majority of respondents reported feeling 'very unsafe' or 'quite unsafe', with large vehicles driving into the side road (19 out of 24), rather than those coming from the side road (16 out of 24), making more participants feel unsafe (see Figure 5). Seven out of 24 participants reported feeling 'very safe' or 'quite safe' with a large vehicle turning from the side road, while only three reported the same with large vehicles turning into the side road. Table 11 above shows the top two responses from majority of the participants. Other responses included "*the markings help with my anxiety*", "*the markings can be seen clearly*", "*trust large vehicles drivers to be more aware of pedestrians/road markings*", and " *afraid I won't be fast enough on the road*".

Comments on safety and convenience

Participants were then asked if they had any comments on how the proposed crossing may affect their safety. Four participants suggested that there is a need for a formal campaign to create more awareness about the proposed design. They were concerned about road users being unfamiliar with these markings or that it causes confusion about priority. Three participants said there were too many directions to look at before crossing and two of them added that they would not feel safe using this crossing. Other responses are listed in Table 12.

Table 12: Comments on how the proposed crossing may affect perceived safety

Responses	Count
Need for a formal campaign / create awareness	4
Too many directions to look at before crossing	3
Safer/better than no crossing	3
Would feel unsafe using this crossing	2
Add more indication or warning signs to drivers	2
No "obvious impact"	2
Good idea/ could potentially enhance safety	2

Participants were asked if they had any comments on how the proposed crossing may affect how easily they could cross the road. Nine out of 24 participants responded positively about the effect of the proposed crossing. Four participants referred to safety being an issue – that they would feel unsafe using this crossing. Three of the respondents thought it was better than not having any crossing. Four of them did not have any comments. Other responses are listed in Table 13.

Table 13: Comments on how the proposed crossing may affect ease of crossing the road

Responses	Counts
Would feel unsafe using this crossing	4
No difference	4
Shorter walking distance would mean less physical pain for them	3
Good reminder for cars to slow down at junction	3
Safer/better than no crossing	3

Proposed recommendations

Seventeen of the 24 respondents reported they would make changes to the design of the crossing. The two most common responses for improving the junction layout were adding warning signs or road markings and moving the crossing away from the junction. Other suggestions included adding Belisha beacons, adding more lights for better visibility in the dark, ensure the kerbs are dropped for wheelchair users, and making the pavement textured (see Table 14).

Table 14: Recommendations

Suggestions	Count
More signage/warning to drivers	6
Should be slightly away from junction	6
Add Belisha beacons	5
Add lights for visibility in dark	4
Ensure kerbs are dropped	1
Make the pavements textured	1

Finally, respondents were asked “How likely are you to cross at the junction if there is no crossing installed?” Figure 6 shows that 13 respondents reported being ‘likely’ or ‘highly likely’ to cross and seven were ‘highly unlikely’ or ‘unlikely’. Four were ‘not sure’.

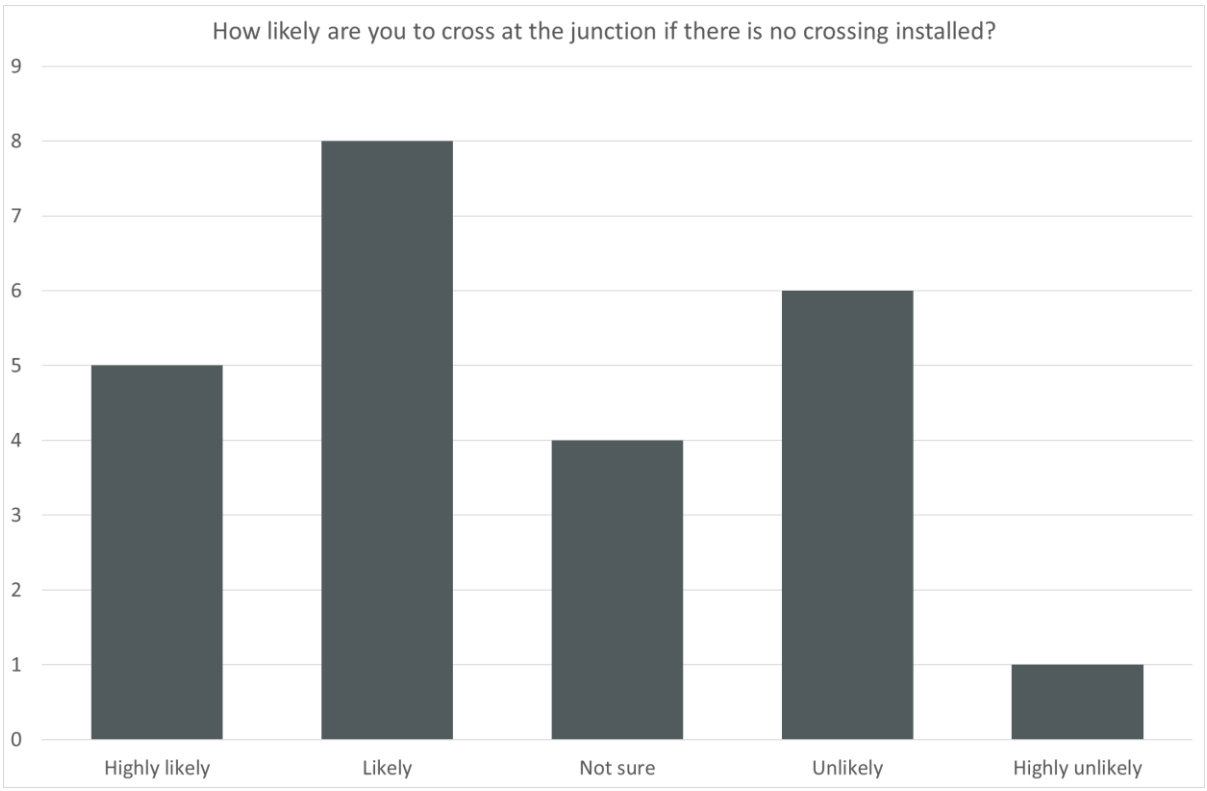


Figure 6: Number of respondents by reported likelihood that they would cross at the junction with no crossing installed

No crossing

The majority responded that if they needed to go that direction, they would cross the road without a crossing (see Table 15). Other responses included a wheelchair user saying they would cross without a crossing if there was a dropped kerb and noted that usually there is not one. Another person said they were unsure if the driver would see or understand the markings which makes them less confident of the proposed design.

Table 15: Reasons for likelihood of crossing at a junction without a crossing installed

Responses	Highly unlikely	Unlikely	Not sure	Likely	Highly likely	Total
I would if needed to go that way	1	-	1	3	2	**7**
Depends of level of traffic	3	-	-	1	-	**4**
I would cross at a point away from junction	-	-	2	1	-	**3**
Hurts to walk, would likely cross here	-	-	-	1	2	**3**
I usually cross at a crossing point		1	1	-	-	**2**
Markings help to relieve some anxiety compared to no crossing	1	-	1	-	-	**2**
Others	-	1	1	-	-	**2**

3.2 Deaf or hearing-impaired group

Participants

Seventeen people completed this survey. Two were removed because they reported no hearing impairments. The remaining 15 respondents all reported hearing impairments and six also reported physical mobility issues or issues with anxiety that effect their mobility.

Two people with hearing impairments completed the mobility impaired survey and their responses have been moved to this survey for analysis, meaning the results for 17 respondents in total are reported below.

Table 16 shows the demographics of respondents. The majority were female but there was a good spread across age groups.

Table 16: Demographics of the deaf or hearing-impaired group

	Gender			
Age group	**Female**	**Male**	**Prefer not to say**	**Total**
18-24 years	2	0	0	**2**
25-34 years	3	0	0	**3**
35-44 years	3	0	0	**3**
45-54 years	0	0	1	**1**
55-64 years	2	2	0	**4**
65-74 years	2	1	0	**3**
75+ years	0	1	0	**1**
Total	**12**	**4**	**1**	**17**

Figure 7 shows the distribution of respondents by region. There was a fairly even spread across the country.

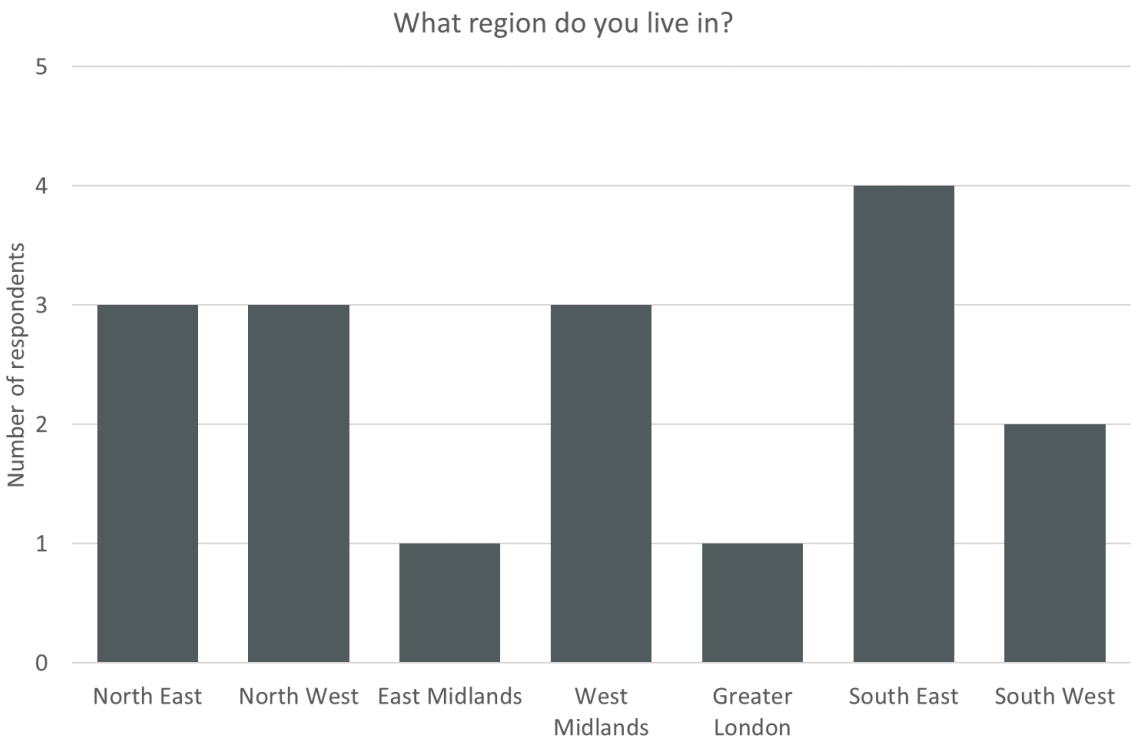


Figure 7: Number of respondents by region

Perception of proposed crossing

Respondents were asked “Imagine these proposed crossings were introduced at junctions in your area. How likely are you to use these crossings?” Figure 8 shows the responses were mixed. Seven were ‘highly unlikely’ or ‘unlikely’ to use these crossings; whilst eight were ‘likely’ or ‘highly likely’. Two were ‘not sure’.

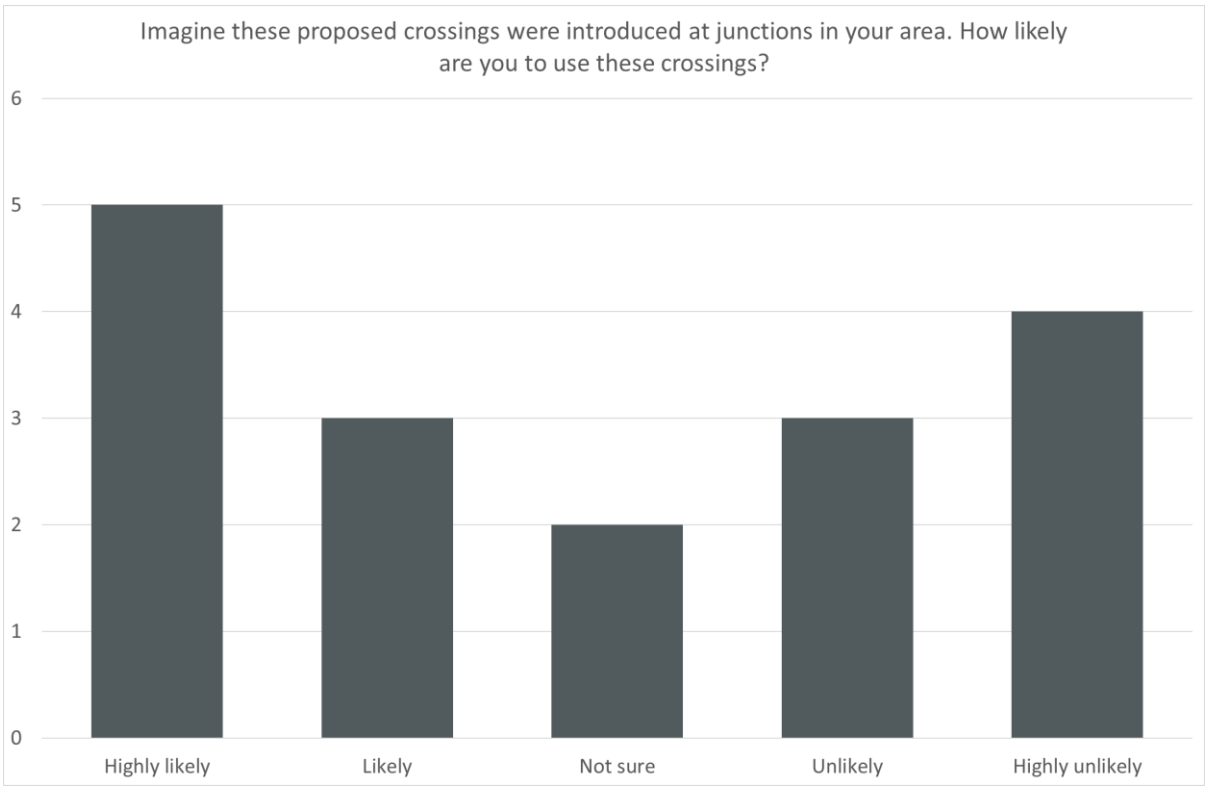


Figure 8: Number of responses by likelihood they would use these crossings

Participants were asked to comment on the reasons for the choices they made (see Table 17). Of those who chose that they were 'highly unlikely' or 'unlikely' to use these crossings, five of them responded that not being able to hear makes it harder for them to detect oncoming traffic. Six of them said that they felt that due to the lack of Belisha beacons or distance between the junction and the crossing, the drivers may not see the crossing in time to stop.

Of those who chose that they were 'highly likely' or 'likely' to use these crossings, two of them said they would wait to use it if they needed to cross the road at that point. Other reasons mentioned were: crossing being in the "*direct route*", or that respondent "*always looks for a crossing*", "*feel more safe using it than if it wasn't there*", or had a "*good view of the roads around*" them. Some did not provide any reason.

Table 17: Reasons for likelihood of using the crossing

Values	Highly unlikely	Unlikely	Not sure	Likely	Highly likely	Total
Cannot hear oncoming vehicle/traffic	2	3	-	-	-	5
Driver may not see me (missing globes)	-	1	2	-	-	3
Driver may not see me (too close to junction)	2	1	-	-	-	3
Will wait to use	-	-	-	2	-	2
Others	-	-	-	1	4	5

Participants were also asked to "Imagine these proposed crossings were introduced at junctions in your area. How convenient or inconvenient would you find the position of these crossings?" Figure 9 shows that 41% (7 out of 17) respondents were 'not sure'. Of the others, responses were mixed: four found the position 'very inconvenient' and six found them 'convenient' or 'very convenient'.

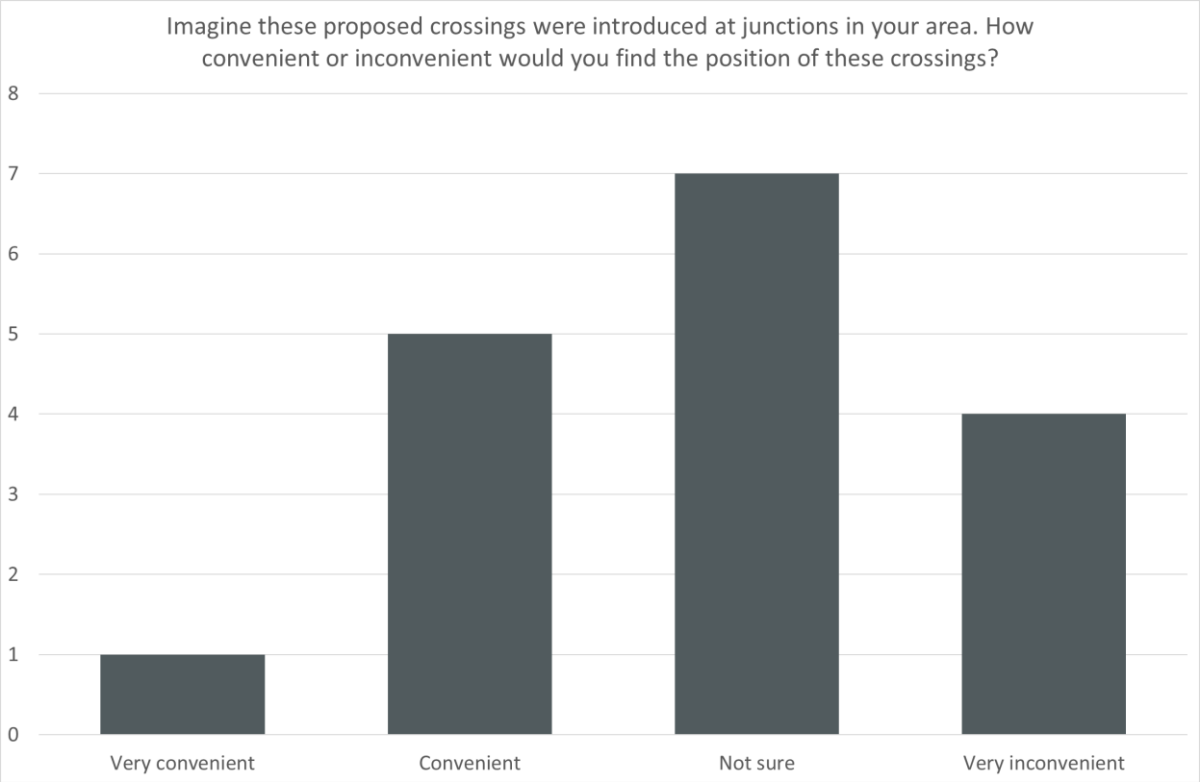


Figure 9: Number of responses by convenience of crossing position

Participants were asked to comment on the reasons for the choices they made (see Table 18). Five respondents said the crossing is in line with their path. Three participants stated that although it may be convenient, it is still dangerous. Two of them elaborated that the lack of indication about the crossing point to the driver makes it dangerous. One of them added that a raised table would clarify who has priority. Other reasons mentioned for concerns were inability to hear oncoming traffic, lack of priority on the crossing point, and that some roads are too small. On the other hand, one person mentioned the possibility that the crossing could slow down traffic at the junction which would help with safe crossing. One respondent raised a question about how this would be indicated by tactile paving.

Table 18: Reasons for convenience of using the crossing

Values	Very inconvenient	Not sure	Convenient	Very convenient	Total
In line of path	-	2	2	1	5
Convenient but dangerous	-	2	1	-	3
Depends how busy the road is	1	1	-	-	2
Too many directions to check	2	-	-	-	2

Others	1	2	2	-	5

Perceived safety

Participants were also asked "how safe or unsafe do you think you would feel using this crossing in the real-world?" under various situations with approaching vehicles (cyclists, cars and large vehicles) either where the vehicle was approaching from the side road (option 1 in Table 4), or turning into the side road (options 2 or 3 in Table 5). Figure 10 shows the responses.

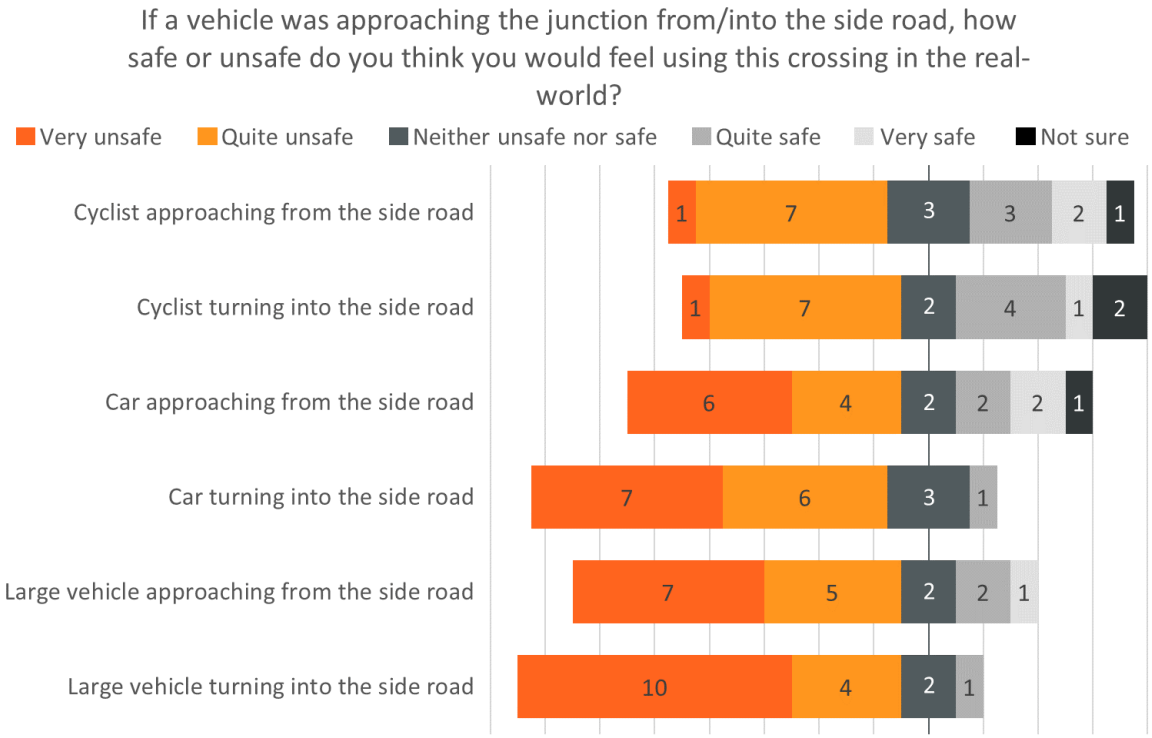


Figure 10: Number of responses by feelings of safety when different vehicle types are approaching the crossing

For all three vehicle types, the majority of respondents reported feeling 'very unsafe' or 'quite unsafe', with these figures being largest for the large vehicle conditions. In general, vehicles driving into the side road, rather than those coming from the side road, were considered to make participants feel more unsafe.

Participants were asked to comment on their reasons for the choices they made (see Table 19). The most common reason provided for selecting feeling 'very unsafe' or 'unsafe' when encountering a cyclist was that "*cyclists rarely give way*", or that they won't be able to hear the cyclist approaching. Of those who selected 'quite safe' or 'very safe', the most common reason was that they could see the cyclist or that cyclists can easily slow down. Other reasons mentioned were "*depends on cyclist's speed*", "*cyclists are harder to see*", "*cyclist may not see me*", and "*not enough room for bike to stop*".

Table 19:Response to cyclist approaching the side road

Response	Very unsafe		Quite unsafe		Neither safe nor unsafe		Quite safe		Very unsafe		Not sure	
	From side road	Into side road	From side road	Into side road	From side road	Into side road	From side road	Into side road	From side road	Into side road	From side road	Into side road
Cyclists rarely give way	1	-	2	2	-	-	1	-	-	-	-	-
Cyclists can easily slow down	-	-	1	-	-	1	2	1	1	-	-	-
Cyclist can easily be seen	-	-	1	-	-	-	2	-	1	1	-	1
Unable to hear it approaching	1	1	1	2	-	1	-	-	-	-	-	-
Others	-	-	3	6	2	2	-	3	-	-	1	2

Table 20:Response to car approaching the side road

Response	Very unsafe		Quite unsafe		Neither safe nor unsafe		Quite safe		Very unsafe		Not sure	
	From side road	Into side road	From side road	Into side road	From side road	Into side road	From side road	Into side road	From side road	Into side road	From side road	Into side road
Poor visibility of marking	3	4	-	1	-	2	1	-	-	-	-	-
Depends on car's speed	2	2	1	2	1	-	-	-	1	-	1	-
Driver likely to focus on main road/traffic and not see me	1	2	2	2	-	1	-	-	-	-	-	-
Too close to junction	1	1	2	2	-	-	-	-	-	-	-	-
Unable to hear it approaching	1	4	-	-	-	-	-	-	-	-	-	-
Others	3	7	-	2	-	-	1	1	-	-	-	-

Table 21: Response to large vehicle approaching the side road

Response	Very unsafe		Quite unsafe		Neither safe nor unsafe		Quite safe		Very unsafe		Not sure	
	From side road	Into side road	From side road	Into side road	From side road	Into side road	From side road	Into side road	From side road	Into side road	From side road	Into side road
Driver because higher driver seat	2	2	3	3	-	-	-	-	-	-	-	-
Driver likely to focus on main road/traffic and not see me	3	3	2	2	-	-	-	-	-	-	-	-
Too close to junction	2	2	1	1	-	-	-	-	-	-	-	-
No warning to drivers	2	2	1	1	-	-	-	-	-	-	-	-
Others	2	2	3	3	1	1	2	1	2	2	-	-

The most common reasons provided for selecting feeling 'very unsafe' or 'unsafe' when encountering a car was concern about visibility of the proposed crossing (see Table 20). Some added that they were worried that drivers may not notice the pedestrian crossing due to the lack of traditional signs like zig-zag lines or Belisha beacons. Four of them expressed concern about not being able to hear oncoming vehicle, especially when it is behind them.

Other reasons provided for reporting feeling safe or unsafe were not being quick enough to cross the length of the road, lack of warning signs to the drivers, or that drivers would ignore the road markings. One person mentioned that they expected the car to slow down at the junction which meant they could safely cross or see the car on the road if it was not safe to cross.

When asked about encountering a large vehicle, the responses were similar to when encountered by a car turning in/out of the side road (see Table 21). One additional reason stated by most respondents who selected feeling 'very unsafe' or 'unsafe' was that participants felt the driver's seat in large vehicles tend to be higher. This is another reason why they felt drivers can easily miss pedestrians. Other reasons provided were concern about not being able to hear oncoming vehicle, especially when it is behind them and not being quick enough to cross the length of the road. On the other hand, two mentioned that they expected the vehicles to slow down at the junction which meant they could safely cross or see the vehicle on the road if it was not safe to cross.

Comments on safety and convenience

Participants were then asked if they had any comments on how the proposed crossing may affect their safety (see Table 22). Six participants commented that they were concerned for their safety as they cannot hear oncoming traffic and may miss a car approaching. They did not refer to the proposed crossing in their response. Five participants said they did not think the proposed crossing would be effective in stopping cars. Two of them added that this was because they felt that drivers may not notice the markings on the road. Three participants expressed confusion about priority and worried this will out their safety at risk. Other comments included reasons that make them feel the proposed crossing is unsafe: lack of advance warning to drivers, drivers already have a lot to process at junctions, and no obvious impact.

Table 22: Comments on how the proposed crossing may affect perceived safety

Response	Count
I cannot hear oncoming vehicles so easy for me to miss it	6
Don't think it is effective in stopping cars	5
Confusion around priority	3
Poor visibility of crossing to drivers	3
Count of depends on cars coming	2
Others	3

Participants were asked if they had any comments on how the proposed crossing may affect how easily they could cross the road (see Table 23) . Four participants said that they would not use that crossing as the markings make it unsafe. Three participants said they do not see any benefit of having the crossing as they will still wait to cross. Two participants felt that it would make it easier for them to cross. Some suggested that better lighting could improve the crossing visibility or that warning signs should be added for drivers. Other comments included suggestions to install cameras to ensure liability in case of an accident and using brighter coloured surface rather than the proposed crossing.

Table 23: Comments on how the proposed crossing may affect ease of crossing the road

Response Table	Counts
Makes it unsafe; would not use this crossing	4
No benefit; slows me down as I would end up needing to wait till it was safe to cross	3
Needs to be well lit to have better visibility	2
Add advance warning for drivers	2
Would make it easier for walking	2
Others	3

Proposed recommendations

Fifteen of the 17 respondents reported they would make changes to the design of the crossing. The top 3 suggestions were to move away the crossing from the junction, add warning signs for drivers, and to improve visibility of the proposed crossing to drivers (see Table 24). Two participants suggested bringing back the beacons to increase visibility and another two said this design should not be used at all. Other suggestions included adding cameras to the junction, using brighter colours on the markings, using a raised table, and ensuring the junction did not have curved kerbs.

Table 24: Recommendations

Responses	Counts
Move it away from junction	4
Add warnings signs for drivers	3
Improve visibility	3
Should not be used	2
Add globes/ beacons	2
Others	4

No crossing

Finally, respondents were asked “How likely are you to cross at the junction if there is no crossing installed?” Figure 11 shows that fewer than half (7 out of 17) were ‘not sure’, whilst eight reported being ‘likely’ or ‘highly likely’ to cross. Two were ‘unlikely’ to cross with no crossing.

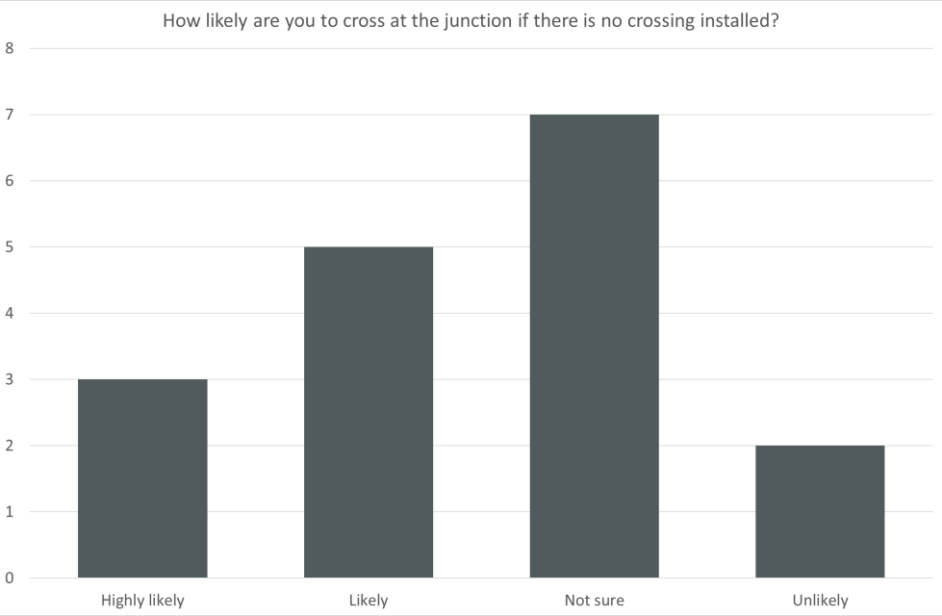


Figure 11: Number of respondents by reported likelihood that they would cross at the junction with no crossing installed

Participants were asked to comment on the reasons for the choices they made. Of those who chose 'not sure' in the above question, three of them did not provide any reason, another three said it depended on how busy the road was. One person thought it would be safer without a crossing for some people as it would make them more vigilant and stated that those with reduced mobility may find it to be more dangerous. Table 25 shows a breakdown of the different responses.

Table 25: Reasons for likelihood of crossing at a junction without a crossing installed

Response	Unlikely	Likely	Highly likely	Not sure	Total
No reason provided	-	1	1	3	5
Depends on how busy the road is	1	1	-	3	4
Need to get to the other side	-	2	2	-	4
Have a good view of the road	-	2	-	-	2
Never cross alone due to poor hearing	1	-	-	-	1
Safer without crossing	-	-	-	1	1

3.3 Blind or visually impaired group

Participants

The interviewees for this research task comprised two males and two females, with ages ranging from 24 years old to 47 years old.

Three participants were registered Blind and one was severely sight impaired. Three participants had been Blind or sight impaired since birth and one participant had gradually

lost their sight. Before this participant lost their sight, they had been able to drive a car and were therefore familiar with road markings. The other participants were not familiar with road markings. One participant also had hearing impairment and used a hearing aid. One participant had a guide dog and all participants used an assistance cane to assist their mobility.

Environment

Street furniture

To reduce the chance of a Blind or partially sighted person colliding with obstacles on the pavement, participants asked that street furniture be kept to a minimum. Participants described "*body slamming*" into street furniture that they didn't know was present. Minimal street furniture would also increase the visibility of pedestrians at the crossing point.

Visibility of pedestrians

Participants highlighted the importance of pedestrians at this crossing being as visible as possible to drivers. They suggested removing overhanging branches or unnecessary street furniture to improve sight lines. Similarly, concerns were raised about drivers not seeing pedestrian at the crossing, and the potential safety implications, especially to pedestrians who are Blind or partially sighted.

Help from others

One participant explained how crossing points in general provide a "*point of clarity*" where other (sighted) pedestrians are more likely to help a Blind or partially sighted person cross the road. If there is no crossing point, other pedestrians might not recognise that a person who is Blind or partially sighted intends to cross the road and may need assistance.

Familiarity

Familiarity with the route and the crossing point were highlighted by participants as a factor that would affect whether they used the crossing point or not. Participants tended to be more comfortable crossing roads that they were familiar with.

Traffic

Traffic noise

Throughout the interviews noise was mentioned frequently. Participants explained that they relied on their hearing when navigating.

Participants explained that locating the proposed crossing at the mouth of a junction could make it harder for Blind or partially sighted pedestrians to know when it is safe to cross. The proximity to the main road could mean that pedestrians could find it difficult to distinguish between traffic noise on the side road and traffic noise on the main road. One participant described this as a "*sound bleed*". When trying to cross near a busy main road, participants described how they would walk further up a side road to reduce the traffic noise from the main road. One participant described this method as an "*indent*". Another participant recalled some "*near misses*" that they believed were caused by traffic noise from a main

road affecting them hearing traffic approaching from the side road. This participant said that they have had a collision with their cane being struck by a car, which was "*scary*".

Participants discussed the noise associated with a variety of vehicle types and highlighted specific issues that they experience with bicycles and electric / hybrid cars. They explained that they struggled to identify the presence of these vehicles as they were either silent or very quiet. Participants went on to say how large vehicles, or temporally stationary vehicles, can block out other sounds. Participants said that they tended to wait for vehicles that blocked sound to move away, to help them hear if the whole road was clear to cross.

One participant also raised their concerns about the increased prevalence of eScooters on both roads and pavements. Like bikes and electric cars, eScooters are extremely quiet, making it very difficult for Blind or partially sighted people to detect their presence.

Volume and speed of traffic

Participants explained that their perception of safety at the crossing, and their decision to use the crossing point, would be greatly affected by the amount of traffic at the junction and the speed at which traffic was travelling. A participant commented about the importance of safety "*My life is more precious than time, so if it takes 20 minutes to cross a road then it takes 20 minutes*", "*so long as you cross it safely and you get to the other side safely*".

Design of crossing

Tactile paving

Participants described a reliance on tactile paving when crossing the road. When they identify the presence of tactile paving, they interpret that to mean that there is both a safe entry and exit from the road. It gives them reassurance that there will not be a parked car on the other side of the road preventing them from safely reaching the pavement on the other side. For this proposed crossing however, the presence of the tactile paving does not preclude the possibility of a vehicle being positioned over the crossing point as it makes its manoeuvre. This goes against the expectations of participants who were interviewed for this research.

Participants also highlighted some safety critical issues relating to the correct installation of tactile paving. The participants who were interviewed for this research explained that the tactile paving enables a pedestrian to identify a suitable place to cross the road, and the angle that the paving slopes towards the road provides the direction in which the pedestrian should walk. Unfortunately, when tactile paving is fitted to a junction incorrectly (e.g. at an incorrect angle), it can lead to safety issues for people who are Blind or partially sighted. Participants described how the angle at which the tactile paving was fitted to this proposed crossing would be critical. Due to the proximity to the main road, participants were worried that if the tactile paving was installed incorrectly it could direct Blind or partially sighted pedestrians diagonally towards the main road, leading to serious safety concerns.

Central island

Participant opinions, regarding the presence of a central reservation / island, were varied. One participant explained that an island was another obstacle that they could potentially

bump into if they weren't walking straight. However, another participant described the benefits of having a central reservation. They explained that if an island was present then it allowed them to turn their head and focus their hearing specifically in one direction before crossing to the central point. Once they had crossed halfway to the island, they then turned the focus of their hearing in the other direction.

Locating the crossing point

Participants explained that locating a crossing point was often challenging, especially if the pedestrian was not familiar with the route. One pedestrian suggested that tactility be added to the edge of the pavement, 2 meters either side of the entrance to the crossing point to aid Blind or partially sighted people in locating the crossing point. The participant described their vision being similar to a "*pie crust*" edge with slight tactile indentations that help guide a person with an assistance cane to the entrance of the crossing point.

Crossing in a straight line

Concerns about crossing the road in a straight line were raised numerous times, with participants saying it was challenging to remain on a straight trajectory. "*I have a tendency to not walk straight*" one participant explained. Participants described the importance of aligning themselves before beginning to cross. Participants believed that the consequences to not remaining on a straight path when crossing the road could lead to a pedestrian walking into a lane of traffic on the main road. "*I'm terrified of walking into a live lane of traffic*" one participant explained, "*it's frightening*".

When talking about previous experiences, one participant explained that on a road that they regularly cross, they are helped to maintain a straight trajectory by running their assistance cane along a tactile gully. This gully had not been intentionally positioned at the crossing point, yet it gave the participant a guide to help them remain in a straight line. Building on this, the participant suggested including a groove, gully or tactile surface that runs directly from one side of the road to the other. The intension being that an assistance cane user could maintain a straight line when crossing the road, which is of particular importance when a crossing point is located at the mouth of a junction.

Rating scales

Using a 5-point Likert scale, participants were asked to rate their likelihood of use, perception of safety, and perception of convenience.

Likelihood of use

When asked how likely they would be to use the proposed crossing, three of the participants said they would be very likely to use the crossing and one participant said they would be very unlikely to use the crossing point (shown in Figure 12). The participant who said 'very unlikely' clarified this by saying they would be very unlikely to use the crossing if they were unfamiliar with the crossing point. Another participant, who said they would be very likely to use the crossing, also went on to say "*If I need to use the crossing, then I will use the crossing. If there is another option I might consider another option*".

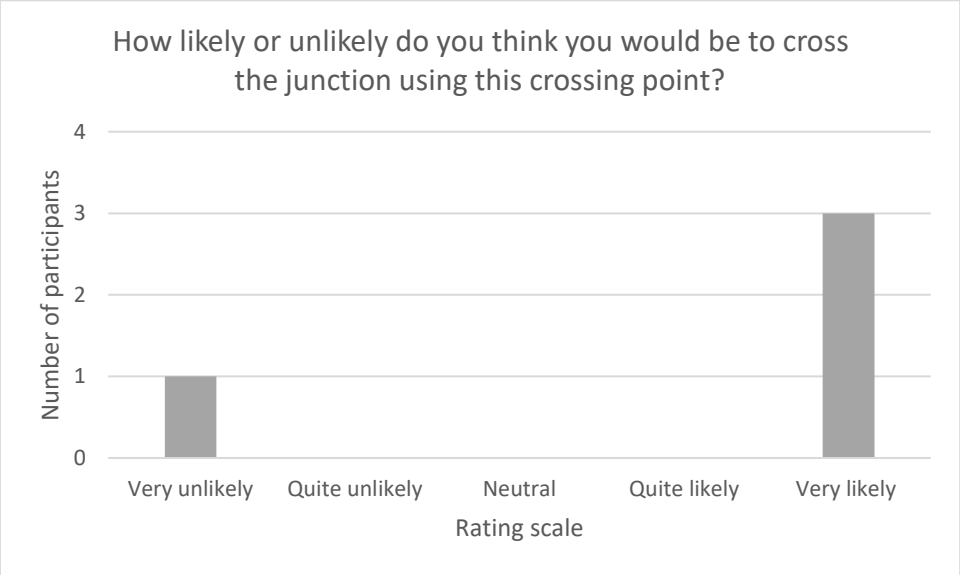


Figure 12 Likelihood of crossing the junction using the proposed crossing point

When asked how likely it would be for other Blind or partially sighted pedestrians to use the proposed crossing, one participants said they thought others would be very likely to use the crossing, two participants were neutral in their response, and one participant did not answer (shown in Figure 13). A participant felt that it would depend on the individuals' level of mobility, training and confidence.

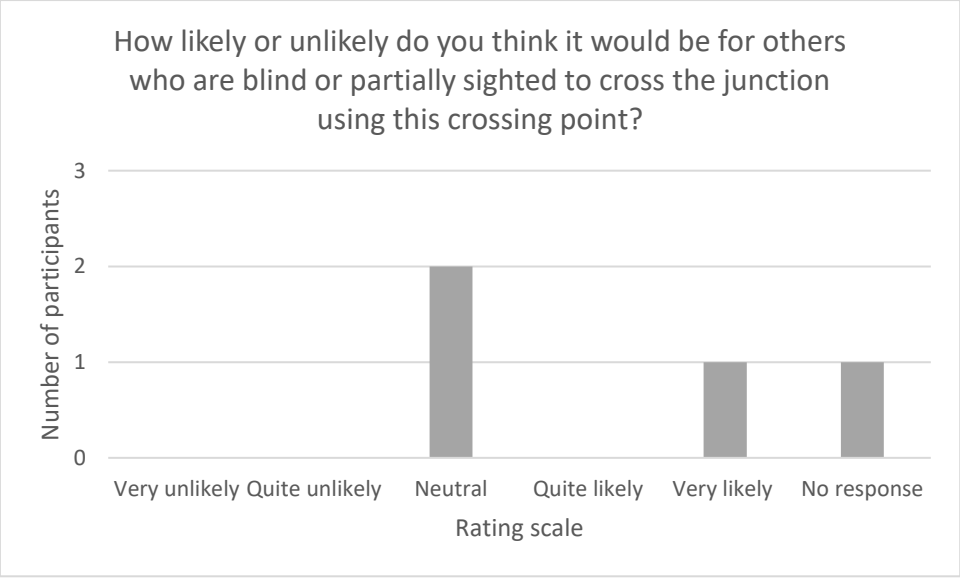


Figure 13 Likelihood of other Blind or partially sighted people using the crossing point

When asked whether they would cross the junction if there was no crossing point, one participant said they would be quite likely to cross, one participant said they were neutral about whether they would cross, and one participant said they would be very unlikely to

cross, saying that they would 'indent' instead. One participant did not comment (shown in Figure 14).

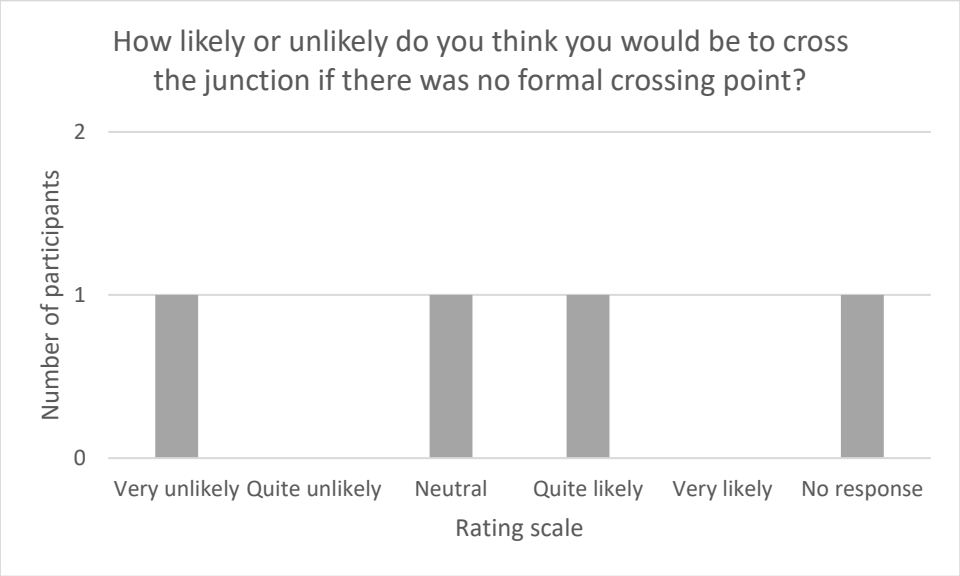


Figure 14 Likelihood of crossing the junction with no formal crossing point

Perceived safety

When asked whether they would feel safe using the proposed crossing point, one participant said that they thought it felt quite safe, one participant thought it was neither safe nor unsafe, one participant rated it 3.5 (between quite safe and neither safe nor unsafe), and one participant rated it 1.5 (between very unsafe and quite unsafe) (shown in Figure 15). A participant said that someone with less road confidence may find this crossing "*daunting*". Despite these relatively low scores, one participant said "*being at a designated crossing point does give me an extra level of feeling protected*".

Figure 15 Perception of safety

Convenience

When asked whether they felt the crossing was convenient, two participants said that it was very convenient, one participant said that it was quite convenient, and one participant said that it was quite inconvenient (shown in Figure 16). One participant stated that they did not think it was much more inconvenient to walk 5 meters down a side road to cross at a traditional zebra crossing, and another believed that a crossing like this would be very convenient for a sighted pedestrian.

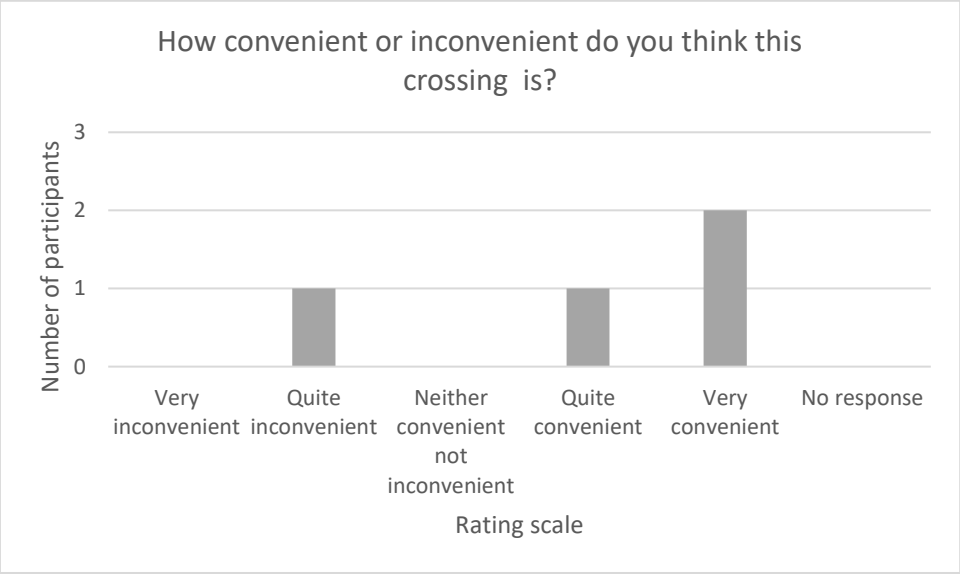


Figure 16 Perception of convenience

Proposed recommendations

When asked whether they had any recommendations for improving the proposed crossing, participants discussed several factors, including:

- Minimising street furniture
- Ensuring clear visibility of pedestrians at the crossing point
- Installing tactile paving correctly, focussing on angle and direction of tactile paving incline
- Considering volume, speed and noise of traffic flow when selecting suitable junctions where this proposed crossing point
- Avoiding installing crossings to junctions in areas where there is a high prevalence of electric / hybrid vehicles
- Avoiding installing crossings to junctions in areas where there is a high prevalence of cyclists
- Considering the addition of tactile edging 2 meters either side of the start of the crossing point to help identify Blind or partially sighted pedestrians locate the crossing point
- Considering the inclusion of a gully / groove / tactile surface running in straight line across the road to aid an assistance cane use.

Other comments of interest

Size of tactile model

One participant explained that working with a small-scale model such as the 3D model in this research task, was easier than working with a large one, as had been originally planned for the focus groups. The participant said that working with smaller models meant they could interact with the entire model at once, rather than a large-scale model. The participant felt that this helped them visualise the crossing in their mind more easily.

Zychem

One participant recommended using a technique called Zychem. Zychem is a technique where a design can be drawn onto paper before a heat lamp is applied. The result is a raised tactile outline of the design. The participant believed that this might be an effective way of posting out tactile models to Blind and visually impaired participants.

3.4 Learning disability and cognitive disorders

3.4.1 Participants

Four representatives for people with learning disabilities and cognitive disorders were interviewed. Two of the participants were healthcare professionals and were able to provide insights into a range of learning disabilities and cognitive disorders, including autism, down syndrome, and Alzheimer's/dementia. Two participants had lived-in experience of caring for someone with a cognitive disorder. One of the carers was also a subject expert in the design of environments that could help in the care of people with Alzheimer's. Table 26 provides an overview of the participants, their knowledge area and if they were based in Manchester.

Table 26: Participants representing people with learning disabilities and cognitive disorders

Experience of participant	Knowledge area	Manchester location
Healthcare professional	Learning disabilities and cognitive impairments including autism and Down syndrome	No
Healthcare professional	Range of cognitive disorders	Yes
Carer	Alzheimer's/ dementia	No
Carer/design subject expert	Alzheimer's/dementia	Yes

3.4.2 The impact of learning disabilities and cognitive disorders on people's experience of their environment

How do people with these learning disabilities and cognitive disorders experience the environment differently?

The experiences of people with cognitive disorders and learning disabilities vary across individuals. For instance, for those with cognitive disorders, the impact of their impairment

depends on the level of brain damage that has occurred and the location of the damage. All the participants stated that it was therefore difficult make generalisations. However, some tendencies could be identified, as summarised below.

Navigation skills and familiarity

Participants reported that people with cognitive disorders tend to develop a diminished ability to navigate their environments and people with learning disabilities tend to need to learn, with the help of a supporter, how to navigate within a specific environment. Therefore, for both groups familiarity with their environment is very important and any changes could lead to feelings of uncertainty in how to act, anxiety or confusion.

Visual impairments and cognition

The issue of limited visual processing for both people with cognitive disorders and learning disabilities were raised several times. People with cognitive disorders tend to only process what is in front and to the sides of them, while looking backwards could lead to dizziness and confusion.

Participants reported that depending on where the brain damage occurred, people with cognitive disorders may not be able to see contrast clearly and find it difficult to process depth, colours and textures. Patterns could therefore cause confusion. The combination of an impairment in the ability to see contrast, cognition and depth perception could lead to the misinterpret of patterns or changes in colours. For instance, a dark shape could be interpreted as a hole, and elicit a fear response.

Two participants also reported that there could be a decreased ability to recognize objects and follow instructions. For instance, the push button operation of traffic lights and what this means for road crossing, could become confusing.

Decreased ability to interpret social interactions

One participant reported that people with learning disabilities tend to find it difficult to interpret social interactions. Therefore, they may not be able to correctly predict if a vehicle is slowing down and if it is therefore safe to step onto the crossing. A further consequence of this is that it is more likely that they would have been involved in incidents and have less confidence to use a pedestrian crossing.

Impact of sensations

One participant mentioned that for people with dementia, haptic sensations could be difficult to process. For instance, textured tiles leading up to a crossing could be experienced as shifting ground. People with learning disabilities may also have problems with visual and auditory overload.

Loss of reading skills

People with cognitive disorders may also lose their reading skills and therefore the use of pictures to convey messages are more useful.

What are the implications of this for the new proposed crossing design?

It was felt that the new pedestrian crossing design has implications for both pedestrians, drivers and other road users, and that it would therefore be important to look at the crossing from a wider contextual perspective.

Pedestrians

All the participants stated that overall having a crossing is better compared to not having a crossing. Participants also felt that the new design could make it easier for people with learning disabilities and cognitive disorders to recognise the design as a crossing and use it. A number of design features were mentioned to support this:

- All the participants mentioned that the position of the crossing on the desired walk line makes it more visible and the use of black and white stripes, that are familiar, memorable and recognisable, would support the recognition and use of the crossing.

  "I think in many people they'd still link the notion, 'I've seen zebra crossings before, this is what this looks like, it's at a point where I would logically cross the road', but it depends on age and stage and whether the individual has got support."

  "And people are used to know what to do at a zebra crossing, and that will make it logical, 'Well I'm going to cross here', rather than popping down the road. So, if anything, I think it feeds into the knowledge that people already have."

- Two participants mentioned that the position of the crossing near the mouth of the road could assist pedestrians to see vehicles moving in front of them on the main road, and on the side-road.

- Several participants felt that taking out distractions from the crossing may support crossing behaviour since lights and other road furniture may cause confusion or sensory overloading.

- The use of the simple black and white stipe design, rather than multicoloured or patterned, was generally considered positive. More patterned designs or the use of multiple colours would make the environment harder to process and therefore more confusing and challenging to interact with.

- Several participants also reported that the simplicity of the design reduced distractions and sensory overload for those with learning disabilities and cognitive disorders.

However, several concerns were raised by participants:

- That the ease of use could also be a potential hazard, was raised as a possible concern.

  "The easier it is for people with cognitive disorders to recognize the crossing and cross it, the more likely they are to cross without necessarily taking a moment to become aware of possible road users that may not stop."

  It was felt that it was therefore important to build into the design a sense of caution so that it could warn unaccompanied pedestrians of the crossing as a potential hazard. One suggestion was that signage could be used, however that it needs to be simplistic and easily understood, using pictures rather than words.

- That the black gaps between the stripes could be interpreted as soil or holes by someone with dementia. The suggestion was made that it may help if there was a white or black 'passageway' across the design where there were no contrasting colours.
- One participant suggested that it would be important to maintain the paint on the white stripes so that they do not develop patches, where the paint wears off, that may be interpreted as holes by people with cognitive disorders.
- Having a shallow step down to the road was felt to potentially reduce the likelihood of trips and falls for people with depth perception impairments.
- Any changes in the familiar environment could lead to confusions and uncertainty in what to do and how to interact with the crossing. It would therefore be important to involve the support networks around people with a diagnosis to ensure that they receive the necessary training or support to cope with any new changes.

Other road users

One participant felt that the positioning of the crossing at the mouth of the sideroad made the pedestrian crossing more visible to drivers. However, the way that other road users interact with the crossing was felt to be an integral part to the safety of pedestrians by all of the participants. All the participants felt that the design must encourage drivers, cyclists and other road users to stop and that they will need to be educated to ensure that they do this.

> *"Someone with a cognitive disorder may just think that, 'This is here, and I can cross'. It needs to encourage all road users to stop."*

3.4.3 The impact of the design on how safe someone with a learning disability or cognitive disorder would feel using the crossing

Compared with having no crossing, how safe would someone feel crossing the road? Would they prefer crossing the road somewhere else?

Responses to the questions around perceptions of safety varied and included:

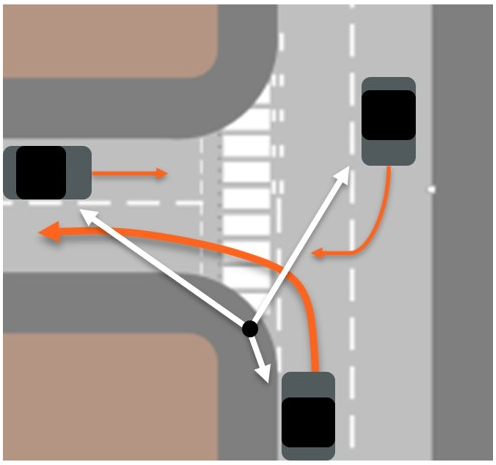


Figure 17: Directions that a pedestrian must look to observe vehicles approaching the crossing

- Having a crossing on a junction, means that the pedestrian has to look in three different directions: ahead, behind and to the side (Figure 17). This requires the recognition and integration of three sets of information and could disorientate the brain and lead to dizziness in people with cognitive disorders.
- Several participants felt that how safe a crossing would feel would depend on

where it is located within wider traffic considerations. For instance, if it is located in a very busy area, with fast moving and high-density traffic, people with learning disabilities and cognitive disorders may prefer to avoid it.

- Having a defined path continuing on from the sidewalk and in the direction of travel means that the pedestrians would tend to stay on the route, rather than walk around it or find a different route.
- One of the participants also thought that having the crossing located at the mouth of the road meant that it is also more visible to drivers.

"What is quite valuable is from the driver's perspective as well is that they have that visual cue, that they have to stop at the road and it is not just relying on them seeing a pedestrian, they'll be having that cue of having seen a zebra crossing and thinking, 'oh I need to check if someone is on there', rather than just having a plain road."

3.4.4 The factors that could impact how convenient the crossing would be for someone with a learning disability or cognitive disorder

Would they prefer crossing somewhere else? Would they use the walk line?

Overall, participants felt that the crossing would be seen as convenient and all the participants thought that someone with a cognitive disorder or learning disability would tend to use it because it follows their desired walk line and is therefore clearly visible to the pedestrian. If the crossing is set back from the mouth of the road, it may not be seen by the pedestrian. Pedestrians may also not realise that they need to look for a crossing further down the road and attempt to cross the road following their desired walk line.

Some participants raised concerns around convenience if:

- There were vehicles parked or stationary on the crossing and pedestrian have to walk around the vehicles. However, several participants felt that this may not be unique to the new crossing design.
- Someone is aware that they have an impairment or are aware that they are a bit confused, they might be more likely to wait until the road is clear before crossing.
- Pedestrians have to look behind them to check if vehicles are about to turn into the side-road it could lead to dizziness and confusion for those with cognitive disorders.

3.4.5 Understanding the impact of vehicle position and size on how people with learning disabilities and cognitive disorders may interact with the new crossing design

When asked how people with cognitive disorders and learning disabilities may react to the pedestrian crossing in the presence of a vehicle turning into the road, most participants found it difficult to respond. They felt that reactions could vary and will depend on the disability or condition of the individual.

However, most felt that the pedestrian would either wait for the vehicle to cross before proceeding or cross in a straight line.

> *"There might be individuals who will find the crossing confusing and will try and find another place to cross. There might be people who will just blindly walk out no matter what was on the road and there will be others who will just use it as a regular zebra crossing, maybe noting it is in a funny place. I would like to think that a lot of individuals will have that support if they need it so that they won't be on their own dealing with it."*

To get an understanding of the impact of vehicle size and positioning on how people with learning disabilities and cognitive disorders would interact with the design, participants were presented with three different scenarios. For each scenario participants were asked how pedestrians may act if differently sized vehicles (cycle, car or large vehicle) were positioned at different points in the road.

Scenario 1

The vehicle is approaching the crossing from driving in the far side lane of the sideroad towards the main road (Figure 18).

Figure 18: Vehicle approaching the crossing in the sideroad

It was reported that movement and changes in texture are visually processed by the brain and if the brain cannot process it or cannot process it fast enough, it induces fear, confusion and panic. Most participants felt that the larger the vehicle and the more movement there is, the more confused and agitated the pedestrian will become and the less they likely they will be to cross. Once traffic has stopped there should not be a problem for most pedestrians to cross the road at the crossing. What may be problematic is that some pedestrians may not think that they need to stop for, for instance a cyclist and that this could lead to an incident.

Scenario 2

The vehicle is positioned turning right into the side-road from the near side lane of the main road (Figure 19).

Figure 19: Vehicle turning left into the sideroad from the near side lane in the main road

A concern that was raised several times was that, since the vehicle is coming from behind the pedestrian, they may not be aware of it. People with learning disabilities would have learned to look left and right, before crossing a road, as a short and memorable stepwise action. Some people may not be able to remember to look behind them as well. People with cognitive disabilities, tend to become dizzy or confused when look behind them and may also not remember to do it.

A cyclist in dark clothing against a dark vehicle may not be seen. Several participants were concerned that cyclists may not pay attention to road signs or signals, and therefore not consider that the pedestrian may not see them approaching from behind.

Scenario 3

The vehicle is positioned to turn into the sideroad from the far side lane of the main road (Figure 20).

Figure 20: Vehicle turning into the sideroad from the far side land in the main road

Most of the participants felt that because the vehicle is in front of the pedestrian, they would be able to see it. However, the concern was raised a number of times that some pedestrians may not be able to identify that the vehicle is about to turn into the side-road. A further concern that was raised was that the driver may not be paying attention to the crossing and that it may be hidden behind approaching vehicles as they attempt to turn into the side-road. Since there is no-where for the driver to stop before the crossing, it was felt that this could lead to an incident with a pedestrian on the crossing.

How the crossing design could be changed to improve safety

The following suggestions were made when participants were asked how they felt the crossing design could be improved:

- The introduction of a yellow hatched area across the junction to ensure that drivers only enter it when it is clear. The aim was to provide drivers with a visual warning to pay attention and to ensure that the pedestrian crossing was not hidden behind approaching vehicles.
- Maintaining the paint on the white stripes to reduce the occurrence of black patches that could be misinterpreted as holes. However, it was felt that this is no different from regular zebra crossings.
- Three participants felt that the positioning of the crossing could be moved slightly back to allow for a vehicle to fit in-between the crossing and mouth of the road so that they do not straddle the crossing when turning out of the side-road or into the side-road. However, one participant felt that the position of the crossing at the mouth of the road made it more visible to drivers.
- The addition of easily understandable signs that warn pedestrians that a crossing is coming up and that they need to be aware of it as a potential hazard.
- One participant felt that traffic lights would be useful since it clarifies when a pedestrian can cross and when a driver or other road user has to stop their vehicle.
- The provision of a safe place or central island for the pedestrian to stop in the middle of the crossing.

3.4.6 Recommendations

Based on the findings the following recommendations are made:

- Provide a single coloured path across the crossing, this could be positioned either on the side of, or within the crossing markings.
- Ensure that it is clear to both pedestrians and other road users, how they should interact with the road crossing. Ensure that people with disabilities are introduced to the new design so that their supporters can help them to interact with it. Link in with existing support networks to ensure that people with a diagnosis are trained to know how interact with a new crossing design. Drivers and other road users must also be educated on how to interact with the crossing.

- Provide clear pictorial signs to warn pedestrians of upcoming crossings and that it could be potentially dangerous.
- Provide a safe refuge or central island in the middle of the crossing or use a tight turning radius at the junction. This reduces the amount of directions the pedestrian needs to look when crossing.
- Develop a set of measures to guide the location of crossings within the wider urban context, including traffic type, volume, frequency of turning into the side-road, and speed on the main road.
- Introduce measures to slow vehicles down on the main road.
- Ensure that the crossing is not obscured by oncoming vehicles for drivers turning into the side-road from the main far-side lane. One suggestion that was made was to make use of a yellow hatched area to ensure that the crossing remains visible to drivers.

3.4.7 Other comments of interest

One participant raised the issue that it is important to be aware that people with a cognitive disorder may still be driving. Most people that get a diagnosis continue driving for a while and have regular assessments to make sure that they are still confident and competent, and maybe something like this can be added. A change in the road, something that is unusual or out of their typical remit, could be confusing. The participant suggested that it may be useful to link in with the network of support around clinical dementia diagnoses to see how best to introduce information about changes in their environment.

3.5 Mental health conditions

3.5.1 Participants

Four healthcare professionals were interviewed as representatives of people with mental health conditions. The interviews covered a range of conditions including panic attacks, phobias, anxiety, attention-deficit/hyperactivity disorder (ADHD) and depression. Two of the participants were local to the Manchester area.

3.5.2 The impact of learning disabilities and cognitive disorders on people's experience of their environment

Mental health conditions cover a wide range of people with different disorders including PTSD, anxiety, ADHD, depression and phobias (including social and agoraphobias). Participants felt that it would be difficult to generalise across conditions.

> *"… since one person could have a phobia of traffic, while someone else with a mental health condition may be fine."*

However, participants were able to provide a combination of insights into specific and more general trends that will be discussed in this section and appreciated the opportunity to contribute to this study.

> *"I think it is a fantastic thing that you are doing. It is so good that people are actually considering people with mental health issues for this kind of thing, because it is not well known."*

How do people with mental health conditions experience the environment differently?

When asked how someone with a mental health condition experience their environment differently, there was a range of responses with some of these specific to the condition while others showed tendencies between conditions. Responses included:

A binary perspective

People with ADHD tend to experience and respond to their environment in very specific ways dependent on their interpretation of the context.

> "*With crossings they may think, "That is my crossing, I can cross". They can experience a basic thought such as who has priority at a crossing as something concrete."*

While another person may be over cautious when using a crossing. There is therefore a decreased ability to adapt their behaviour to take into account variations in the context.

Easily distracted

People with mental health conditions, such as anxiety, depression or ADHD, can become very absorbed by their own thoughts or very focussed on something in their environment. This could result in a lack of attention and being unaware of potential hazards in their environment. For instance, they may not be aware of having to look behind them to see if vehicles are approaching or to notice that the indicator of a vehicle is on.

Change causes anxiety

Three participants mentioned that people with mental health conditions tend not to like change. People prefer a routine and consistency within their environment; and would tend to plan out a route that they feel safe to use. If something unexpected happens this tends to cause them anxiety and could cause confusion. This could deter them form, for instance, continuing a journey. This could lead to reactions and "*road rage*" from other road users which exacerbates feeling of *"… you are being useless, or not understanding, or not paying attention"*.

What are the implications of this for the new proposed crossing design?

Warn people that a change is coming

Because people with mental health conditions prefer a routine and find change challenging, anything that changes in their environment could be confusing, overwhelming, and stressful. The introduction of a new crossing or crossing design could therefore cause them concern and they may try to avoid using it. It would be important to warn people that a new crossing design is being planned, where it will be placed and clarity on how they should interact with

the crossing. Participants suggested putting up signs where a crossing is going to be developed and using local support networks, established relationships with healthcare providers and organisations, and GP surgeries to pre-warn people with mental health conditions that changes will be happening and to provide them with information about upcoming changes int heir environment.

> *"Warning in advance would really, really help, so that is isn't that just one day they go to do their normal walk and all of a sudden they are thrown into complete disarray because something has changed. So, warning would be one of the best things you could do to help people."*

Posting something through their door was felt as not being as useful since they may not take notice of it.

Draw attention to the crossing

Since people with mental health conditions can become easily distracted and may not be aware of their environment, one participant felt that it would be useful to offset the crossing from the main line of travel to draw the attention of people with ADHD to it and warn them of an impending hazard.

> *"The concern with the new crossing is that they may see the crossing as a right of way and use it without considering the traffic. They may also not be aware of the traffic coming up behind them to turn into the junction or see that a vehicle has an indicator on."*

The other participants felt that it made sense to continue in a straight line across the road rather than to have to weave between people and walk around a corner. However, that not being aware of vehicles coming up from behind to turn into the crossing remained a concern.

Clarify expectations

Three participants raised concerns around clarity of expected behaviour for both vehicles and pedestrians. For instance, one of the participants felt that a distinguishing feature of a crossing is Belisha beacons and that it provides a clear cue to both pedestrians and drivers of how they should interact with it. Another participant felt that traffic lights was an important feature since it stops traffic and clearly indicates when people can safely cross a crossing. It therefore removes uncertainty for both the driver and the pedestrian and decreases the amount of information that needs to be processed at any one time.

> *"If you don't have the traffic light system, and on top of that don't have the pole, I just think that would increase accidents and would (they) know what their role is in terms of stopping at that place? So, they might think it is not important to stop. So, you might think that it is not important to stop, that it is a dumb down version, a less important version of the pedestrian crossing."*

However, two participants felt that since the basic design, using black and white stripes, remained the same, the removal of other features, like the Belisha beacons, would not have an impact on road crossing behaviour.

Three participants felt that having information in a suitable format, such as videos, could help to clarify to all road users how the new crossing design should be used. One participant also suggested using social media channels to promote the information.

In comparison with having no crossing

Three participants felt that having a crossing is better than not having a crossing. Only one participant felt that having no crossing would be better. This was based on the concern that the ease of use could cause some people with ADHD not to recognise the crossing as a hazard and take action to cross safely; not having a crossing will more likely make them stop and think about their action to cross.

3.5.3 The impact of the design on how safe someone with a learning disability or cognitive disorder would feel using the crossing

Compared to having no crossing, how safe would someone feel crossing the road? Would they prefer crossing the road somewhere else?

The following responses were given by participants:

- Two participants felt that people with a mental health condition will still take ownership of their own safe crossing behaviour and do a personal risk assessment before they cross the road and felt that the crossing provided added safety to the pedestrian since vehicles have to give way to pedestrians.
- For people who suffer from anxiety, three participants felt that having a crossing will provide the pedestrian with some reassurance to cross as compared to having no crossing.

  "If we are comparing the two, one without and one with, then obviously it is going to be a lot more reassuring to have the one with since it is a slight reassurance that this is the part of the road where they should be able to cross without too much anxiety."

Participants raised the following concerns:

- One participant felt that people with ADHD will be able to identify the new design as a crossing. Since the crossing is in their direct line of travel, they may proceed onto it without thinking about the traffic. The crossing may therefore give them a false sense of safety to proceed across.
- The proximity to the mouth of the road caused some concerns for all the participants. They felt that drivers may be distracted if they are turning into the crossing or the visibility of the crossing may be obscured by other drivers and they may not be aware that there is a crossing. They felt that drivers will need to be made aware that there is a crossing.

  "So it will be a multifaceted pronged approach: you have your communication with your health teams, you have your communication with your local authority, changes are coming and these are here, safe ways to cross, information for drivers, information for pedestrians, and then there are actually the people who do the job."

3.5.4 The factors that could impact how convenient the crossing would be for someone with a mental health condition

All the participants felt that the crossing would be very convenient to use and that it is "*a natural place to cross anyway*" and "*if you move it back into the road, people may not cross it there*".

Would they prefer crossing somewhere else? Would they use the walk line?

However, pedestrians may prefer to cross further down the road if they are concerned about the corner of the pavement or want to move away from a busy main road.

Most people with mental health conditions would prefer to have a crossing than not to have one.

"*And in a way it gives them a positive reinforcement message that: 'You pedestrians are important, and we realise and acknowledge that. And therefore, we're adding these so drivers are mindful that they don't own the road, even though they pay the road tax. you guys can cross the road and this is your safe place to cross it'*."

3.5.5 Understanding the impact of vehicle position and size on how people with learning disabilities and cognitive disorders may interact with the new crossing design

All of the participants felt that people with mental health conditions would use these crossings sensibly, in line with their use of a prescribed crossing. That pedestrians would cross being mindful of their own safety and would tend to stop and wait for a vehicle before proceeding on their way. However, participants also raised a few concerns:

- The crossing may convey to people with that it is safe to cross without them adequately considering potential hazards.
- People with dyspraxia and dyscalculia may not be able to estimate speed and change in speed in vehicles.
- Most people are used to checking left and right and then cross this adds another direction to check.
- "*Whose right of way is it?*" One participant felt that both drivers and pedestrians need to be clear on their rights and responsibilities when interacting with the crossing and that drivers will need to be educated to ensure the safety of pedestrians using the crossing.

To get an understanding of the impact of vehicle size and positioning on how people with mental health conditions would interact with the design, participants were presented with three different scenarios. For each scenario participants were asked how pedestrians may act if differently sized vehicles (cycle, car or large vehicle) were positioned at different points in the road.

Scenario 1

The vehicle is approaching the crossing, driving in the far side lane of the sideroad (Figure 21).

Figure 21: Vehicle approaching the crossing in the sideroad

There were a variety of different responses to Scenario1. Two participants felt that the size of the vehicle would not have an impact on how someone with a mental health condition would interact with the crossing but that the amount of traffic would be greater consideration. Someone with a mental health condition "*would probably tend to avoid busy roads if they had anxiety issues with traffic*" and move to cross somewhere else.

Vehicles would be considered a risk to personal safety and felt that pedestrians would tend to:

- Give way to cyclists.
- Adjust their own crossing behaviour dependent on an assessment of the speed of the vehicle, whether it is a car or a large vehicle. They would only cross if the vehicle had slowed down significantly.

However, people with ADHD may respond differently. The participant felt that pedestrians may:

- Either stop or step out in front of a vehicle dependent on the individual's personal behaviour patterns and belief systems.
- Feel overwhelmed by the noise and the size of a large vehicle and therefore stop on the sidewalk and not being able to move until the vehicle has gone.

Scenario 2

The vehicle is positioned turning left into the sideroad from the near side lane of the main road (Figure 22).

Figure 22: Vehicle turning left into the sideroad from the near side lane of the main road

Responses were similar to that of Scenario 1. Participants felt that people with anxiety disorders the main concern would be the amount of traffic rather than the size of vehicles and that they would tend to move away from a busy road. However, there were differences between the responses in Scenario 1 and this scenario, and these tended to be due to the position of the vehicle coming from behind the pedestrian before turning into the sideroad. The following points were raised:

- A cyclist could be going along the main road before turning into the sideroad, since they could be relatively quiet the pedestrian may not be aware of them before stepping onto the crossing.
- If the vehicle is a car, it may not be clear if they are slowing down to turn into the junction or for the crossing. Participants felt that if the pedestrian sees the vehicle they would tend to stop on the sidewalk and wait for the car to pass or stop before crossing.
- Large vehicles would be noisy and therefore more likely to draw the attention of the pedestrian and their responses would be the same as that for a car.
- A very interesting point that one participant raised was that because drivers are located on the right-hand side of heavy goods vehicles, they may not be able to see if there is a pedestrian approaching the crossing on the sidewalk. Especially if the crossing is located close to the mouth of the junction.

Scenario 3

The vehicle is positioned to turn into the sideroad from the far side lane of the main road across traffic (Figure 23).

Figure 23: Vehicle turning into the side-road from the far side land in the main road

All the participants felt that the position of the vehicle in the far side lane of the main road had an impact on the safety of people with mental health conditions using the crossing. Participants pointed out that pedestrians:

- May not be clear if the vehicle would be continuing in the main road or turning into the sideroad.
- The risks for other vehicles were also highlighted as illustrated in Figure 24:

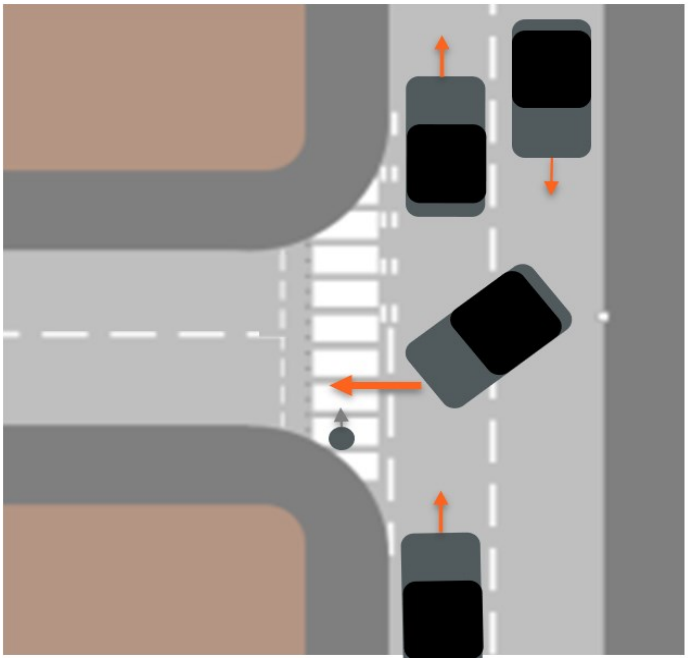


Figure 24: Vehicle turning into the sideroad from the main road

  - If there is a lot of traffic, the pedestrian crossing may be obscured from the driver's view by oncoming vehicles in the other lane. They may therefore not be aware that there is a crossing.
  - The driver may take a gap in the traffic and then be left stranded in the middle of the road if they have to stop for a pedestrian on the crossing.

- Three participants felt that before these crossings are put into place there needs to be an assessment of the roads and amount of traffic to ensure that the roads are not too busy.

  "You have to be mindful, the type of road you're putting this on. Because if you are putting this on a busy road, potentially you are going to put pedestrians and drivers at risk because there could be clashes."

How the crossing design could be changed to improve safety

Participants suggested a variety of ways in which the crossing could be changed to improve its safety for people with mental health conditions:

- Move the crossing a few metres or car's length into the sideroad, but not too far so that people do not use the crossing:
  - It will force pedestrians to consider the task of crossing by drawing their attention to a change in the environment.
  - The extra space between the mouth of the road and the crossing will enable vehicles to stop before the crossing when turning into the sideroad and to stop before the mouth of the road to turn out.
  - Pedestrians will only have to look left and right rather than behind them as well. This will reduce the amount of information that they have to process.
- Ensure that other road users (cars, bikes, etc) can always see the crossing and pedestrians approaching the crossing. For instance, by keeping the middle of the road clear to ensure visibility.
- Provide signage to ensure that people do not park over the crossing, such as using double yellow lines extended across the crossing.
- Keep both drivers and pedestrians informed of any changes and how they should interact with the new crossing design.
- Keep the speed of drivers in the main road down so that they have time to check if someone is on the crossing by, for instance, putting in speed restrictions or traffic calming measures.

3.5.6 Recommendations

The following recommendations are made based on the information provided in the interviews:

- Provide people with mental health conditions information about impending changes to their environment using existing networks of communication, such as general practitioners' surgeries, healthcare providers, social media and/or organisations.
- Develop suitable ways in which information could be delivered, such as the use of videos to illustrate how pedestrians and other road users should interact with the crossing.

- Consider how to draw the attention of someone with mental health condition to the fact that they are about to cross a road.
- Consider how the crossing design could be altered to prevent the pedestrian having to look behind them to see if a vehicle is about to turn into the sideroad- junctions with a tight turning radius will be helpful in this respect.
- Clarify how the crossing works for pedestrians and other road users (including cyclists):
    - Who has priority and when?
    - What could pedestrians expect drivers to do when interacting with the crossing?
- Ensure that the crossing, and pedestrians approaching it on the sidewalk, are visible to drivers turning into the sideroad.
- Ensure that drivers understand how to interact with the new crossing design.
- Consider how to assess the suitability of potential sideroads where the crossing design could be implemented. These may include considerations around the type of traffic, amount of traffic, the built environment and vehicle speeds.
- Consider slowing traffic down on the main road to reduce the likelihood of severe interactions with pedestrians and to provide drivers with more time to take visually scan their environment for hazards.

4 Limitations

When looking at the results of this study it is also important to understand any possible limitations and their potential impact on the outcome of the report.

The sample size for the research tasks involving Blind and partially sighted participants, learning disabilities, cognitive disorders and mental health conditions was limited, with four participants being interviewed for each. It is also important to note that the participants interviewed for groups with learning disabilities, cognitive disorders and mental health conditions were representatives of organisations that act on behalf of users with those conditions. They therefore represent expert opinions on those user groups and their needs, rather than reflecting the personal experiences of individual users. The small sample size means that this research provides an insight into the challenges that people with disabilities could face when interacting with the crossing point. However, it does not provide the breadth of results that could be achieved by a larger study with a greater sample size.

The project took a mixed methods approach, combining online surveys with interviews. The result highlighted some rich data and insightful findings. However, participant responses to how they would interact with the crossing were speculative. It would have been beneficial to conduct observational studies and further interviews, with people who are disabled, at a mock-up of the proposed crossing point. This would have allowed participants to interact with the crossing point and answer research questions based on their experiences.

Despite participants responding very positively to the use of 3D tactile models, there were some issues with sending them in the post. The fragility of the models meant that they broke easily or became chipped. Participants also queried some of the features of the model that differed slightly from the design of the proposed crossing (e.g. the tactile kerb being dropped and there being a tactile side around the edge of the pavement). Despite identifying this as a limitation, it also raised some useful discussions with participants about the benefits of small tactile models that can be held in the hands.

Participants were presented with image of scenarios that had minimal traffic in full day light conditions. Participants were only required to attend to one vehicle in the environment. In a real-life scenario, it is likely that there may be more traffic during certain times of the day. Poor weather conditions could also impact people's perception of safety when using the crossing point. In the images presented the field of view was limited. Although the scene presented to participants gave them an understanding of the environments and road layout, it did not allow them to adjust their field of view. In the real road environment pedestrians would be able to adjust their head and body position to gain a far greater field of view.

In summary, constraints imposed by this study include:

- Sample size – the samples sizes for groups 3, 4 and 5 were four participants each. The amount of information and variety of disorders that could be covered were therefore limited.
- Limitations using representatives – the use of representatives for tasks 4 and 5 provided expert insights into the conditions and the possible implications of these in terms of interactions with the crossing design. It also provided a broader overview of specific disability groups, compared to interviewing four individuals with specific disabilities. However, comments on how people may interact with the design are therefore inferred and may not necessarily be a true reflection of how people who have a disability would respond.
- Fragility of tactile models – the 3D tactile models used in the interviews with Blind or partially sighted people were extremely brittle. We encountered issues posting the models to participants and found that they broke easily, despite being packaged securely. In order to prevent further breakages, one tactile model was glued to a small wooden backboard before being posted to the last participant.
- Accuracy of tactile models – the 3D tactile models provided a good overview of the proposed crossing and were well received by participants. However, during the interviews it became apparent that there were some minor differences with the tactile model and the proposed crossing point which the interviewer had to explain to the participants. The blister paving on the model was not angled at an incline as it would be at the crossing point, there was a slightly raised edge around the pavement which has not been discussed in relation to the crossing, dashed lines in the middle of the road showing lane markings were not present and only one lane of the main road was present. It would have been beneficial to have the full road depicted on the main road when describing the scenario to participants who were Blind or partially sighted. It was also necessary to clarify that the give way markings and the black and white crossing markings would not be raised on the actual crossing point, as they

were on the model. The accuracy of the tactile models was of particular importance as 3 of the 4 participants were classified as Blind.

- Traffic – an increase in traffic levels in these scenarios could affect visibility of both pedestrians and drivers. Some respondents said their feelings of safety would depend on road traffic. In the survey no scenarios were shown when there was following traffic.
- Weather conditions – the images represent a junction in day light conditions with good visibility. In adverse weather conditions or low lighting levels/night-time, the visibility at the junction would be greatly impacted.
- Field of view – the images shown in the survey have a limited field of view. Pedestrians would be able to gain a greater field of view by moving their head, body, and eyes. A greater field of view would provide the pedestrian with a greater understanding of the environment around them, giving them more situational awareness. Some participants with a hearing impairment expressed concerns about not being able to hear vehicles approaching from behind them.
- Visibility – when developing the images for the survey, infrastructure was kept to a minimum to ensure maximum visibility of the junction. A real on-road scenario may have obscuration caused by road infrastructure / planting / buildings / parked vehicles etc.

5 Summary

The purpose of this study was to explore public understanding of the meaning and purpose of non-prescribed side road zebra crossing, in comparison with a side road with no formal crossing provision, from the perspective of individuals with disabilities. This was done with the aim of understanding perceived safety, convenience of use, and areas for improvements on the non-prescribed zebra crossing design. Five disabilities groups were identified:

1. Mobility impaired (including wheelchair users)
2. Deaf and hearing impaired
3. Blind and visually impaired
4. Learning disabilities and cognitive disorders
5. Mental health conditions

Table 27 shows a summary of the sample size for each of the five disability groups and method of collecting data. Respondents were asked to imagine they encountered a junction with the proposed crossing. They were asked about their likelihood of using, the ease of using, and perceived safety around the proposed crossing. They were also asked to comment on overall safety around the proposed crossing, and their likelihood of crossing the junction without a crossing.

Table 27:Summary of responses

Disability group	Type of respondents	Data collection method	No. of respondents

Mobility impaired (including wheelchair users)	Individuals with mobility impairment	Online survey	24
Deaf and hearing impaired	Deaf individuals or individuals with hearing impairment	Online survey	17
Blind and visually impaired	Blind individuals or individuals with visual impairment	Telephone interview with 3D tactile model sent by post	4
Learning disabilities and cognitive disorders	Representatives of organisations representing people with learning disabilities	Online interviews conducted on Microsoft Teams	4
Mental health conditions	Representatives of organisations representing people with mental health disabilities	Online interviews conducted on Microsoft Teams	4

The mobility impaired and hearing-impaired groups completed an online survey. While the questions presented on the survey was similar, they were distributed using two separate forms for the respective group. This was done to simplify the dissemination and analysis process. Majority of the respondents from the mobility impaired group received the survey link via an email to TRL's participant database. Majority of the respondents from the hearing-impaired group received the survey link via Facebook posts made by a team member in appropriate Facebook groups.

The remaining three groups conducted online or telephone interviews. Participants of the Blind group were recruited from appropriate Facebook groups. We reached out to organisations/groups who act as representatives for people with learning difficulties, cognitive disorders and mental health conditions.

5.1 Summary of responses from mobility impaired group

The mobility impairments reported included a leg amputation, arthritis, hip issues and mobility impairment requiring full-time wheelchair use. Eight people reported using sticks or crutches to get around, four used a wheelchair and a further three reported using a powered wheelchair.

When asked to imagine if the proposed crossings were introduced in junctions in their area and how likely they were to use these crossings; respondents were more positive than negative. 15 were 'likely' or 'highly likely' to use these crossings; whilst four were 'highly unlikely' or 'unlikely'.

Respondents were asked to comment on their reasons for their responses.

Those who selected 'highly likely' or 'likely' said that the crossing was in line with their path, and hence made it easier to walk, or that it was "*safer*" or "*better*" than having no crossing at all. Those who selected 'not sure' said they didn't think the driver could see the markings or that it depended on the traffic conditions.

When asked to imagine if the proposed crossings were introduced in junctions in their area and the convenience of using the crossing at that position, over half of the participants (15

out of 24) found the crossing position ‘convenient’ or ‘very convenient’; six reported it was ‘very inconvenient’ or ‘inconvenient’ and three were ‘not sure’.

Respondents were asked to comment on their reasons for their responses.

Those who selected ‘very convenient’ or ‘convenient’ said the crossing was in line with their path, or that it reduced their walking distance; they attributed less walking to less physical pain. For those who selected ‘very inconvenient’, ‘inconvenient’, or ‘not sure’, responses referred to the design on the proposed crossing and made recommendations for changes like adding more warning signs for drivers or adding lights for better visibility. This shows that the proposed crossing design makes it convenient for some of those with mobility impairment. Concerns around inconvenience suggest that having some additional features would reassure participants that the driver is aware of the crossing.

Participants were asked about how different vehicles approaching the junction from different directions affected their feelings of safety. In general, more participants reported feeling ‘very unsafe’ or ‘quite unsafe’ when the vehicle was turning into the side road compared to when vehicles were turning out of the side road. Their reasons suggest their feelings of safety was influenced by the type of road user rather than the proposed crossing design.

When shown scenarios in which cyclists and cars approach from the side road, results were mixed; half of respondents (12) reported feeling ‘quite safe’ or ‘very safe’ whilst just under half (10) reported feeling ‘very unsafe’ or ‘quite unsafe’. Similarly, their reasons related to how much they trusted or distrusted cyclists in general. Those who selected ‘very safe’ or ‘quite safe’ said that cyclists should be able to stop or normally give way to them. While the opposite comments were made from those who selected ‘very unsafe’ or ‘quite unsafe’: "*cyclists never follow road signs*" or "*cyclists never stop*".

Compared with scenarios where vehicles approach from the side road, more respondents reported feeling unsafe when the cyclist or car was turning into side road from the main carriageway (14 reported feeling ‘very unsafe’ or ‘quite unsafe’ when vehicle is turning into the side road compared with 10 when the vehicle is approaching from the side road). For the large vehicles, most respondents reported feeling ‘very unsafe’ or ‘quite unsafe’, with large vehicles turning into the side road, rather than those coming from the side road, making more participants feel unsafe.

With scenarios involving cars and large vehicles, participants were concerned about the driver not noticing the marking because of poor visibility or having too many things to focus on at a junction. With large vehicles, some participants noted that they felt drivers were less likely to notice them due to the height of the driver's seat.

Participants were then asked if they had any comments on how the proposed crossing may affect their safety. Some participants were concerned about road users being unfamiliar with the proposed markings which could causes confusion about priority among road users. They felt that a formal campaign would be needed to educate people about the changes. Other responses mentioned were having too many directions to look at before crossing and that it was better than having no formal crossing as it would allow for traffic to slow down which would increase the chances of a car giving way and the pedestrian not having to wait.

Participants were asked if they had any comments on how the proposed crossing may affect how easily they could cross the road. Nine out of 24 participants responded positively about the effect of the proposed crossing. They said it was better than not having any crossing, or that the markings were a good reminder for drivers to slow down, or that a shorter walking distance would make their trip easier. Four participants said that they would feel unsafe using this crossing and another four said it made no difference.

Seventeen of the 24 respondents reported they would make changes to the design of the crossing. The two most common responses for improving the junction layout were adding warning signs or road markings and moving the crossing away from the junction. Other suggestions included adding Belisha beacons, adding more lights for better visibility in the dark, ensure the kerbs are dropped for wheelchair users, and making the pavement textured.

5.2 Summary of responses from hearing impaired group

All 17 respondents reported hearing impairments and six also reported physical mobility issues or issues with anxiety that effect their mobility.

When asked to imagine if the proposed crossings were introduced in junctions in their area and how likely they were to use these crossings; there was an almost equal spread among the responses. Eight were 'likely' or 'highly likely' while seven were 'highly unlikely' or 'unlikely' to use these crossings. Two were 'not sure'.

Respondents were asked to comment on their reasons for their responses.

Of those who responded that they were 'highly unlikely' or 'unlikely' to use these crossings, reasons provided included: not being able to hear oncoming traffic, and uncertainty that the driver would have noticed the markings to stop in time. Various reasons were provided by those who responded that they were 'highly likely' or 'likely' to use these crossings. Some participants said they would wait to use it if they needed to cross the road at that point. Other reasons mentioned were crossing being in the "*direct route*", or that respondent "*always looks for a crossing*", "*feel more safe using it than if it wasn't there*", or had a "*good view of the roads around*" them. Some did not provide any reason.

When asked to imagine if the proposed crossings were introduced in junctions in their area and the convenience of using the crossing at that position responses were mixed: 7 out of 17 respondents were 'not sure', six found them 'convenient' or 'very convenient' and four found the position 'very inconvenient'.

Respondents were asked to comment on their reasons for their responses.

Reasons provided by the participants were varied: respondents said the crossing is in line with their path and some noted although it may be convenient, it is still dangerous due to the lack of warning signs to the driver. A potential benefit mentioned was the possibility that the crossing would slow down traffic at the junction, which will help with crossing. Concerns mentioned were inability to hear oncoming traffic and lack of priority on the crossing point.

Participants were asked about how different types of vehicle approaching the junction from different directions affected their feelings of safety. In general, vehicles turning into the side

road from the main carriageway, rather than those coming from the side road, were considered to make participants feel more unsafe. For all three vehicle types (cars, bicycles and large vehicles) , the majority of respondents reported feeling 'very unsafe' or 'quite unsafe', with these figures being largest for the large vehicle conditions and smallest for cyclist condition. Their reasons suggest their feelings of safety was influenced by the type of road user rather than the proposed crossing design.

The most common reason provided for feeling 'very unsafe' or 'unsafe' when encountering a cyclist was that "*cyclists rarely give way*", or that they won't be able to hear the cyclist approaching. Of those who selected 'quite safe' or 'very safe', the most common reason was that they could see the cyclist or that cyclists can easily slow down.

The top few reasons provided for feeling 'very unsafe' or 'unsafe' when encountering a car was concern about visibility of the proposed crossing. Some added that they were worried that drivers may not notice the pedestrian crossing due to the lack of traditional features like zig-zag lines or Belisha beacons. Other concerns were not being able to hear approaching vehicles, especially from behind, and not being quick enough to cross the width of the road. One potential benefit mentioned was that they expected the car to slow down at the junction which meant they could safely cross or see the car on the road if it was not safe to cross. This was mentioned as a reason for feeling 'quite safe' or 'very safe'.

When asked about encountering a large vehicle, the responses were similar to when encountered by a car turning in/out of the side road. Most respondents who selected feeling 'very unsafe' or 'unsafe' noted that the driver's seat in large vehicles tend to be higher. This is another reason why they felt drivers can easily miss pedestrians on the road.

Participants were then asked if they had any comments on how the proposed crossing might affect their safety. Six participants commented that they were concerned for their safety as they cannot hear oncoming traffic and may miss a car approaching. Five participants said they did not think the proposed crossing would be effective in stopping cars; two of them added that this was because they felt that drivers may not notice the markings on the road. Three participants expressed confusion about priority and worried this will put their safety at risk.

Participants were asked if they had any comments on how the proposed crossing might affect how easily they could cross the road. Generally, participants responded with suggestions to improve the design, or reasons for feeling unsafe using the proposed crossing. Some participants said that they would not use that crossing as the markings make it unsafe or that they do not see any benefit of having the crossing as they will still wait to cross. Two participants felt that it would make it easier for them to cross. Some suggested that better lighting could improve the crossing visibility or that warning signs should be added for drivers.

Fifteen of the 17 respondents reported they would make changes to the design of the crossing. The top 3 suggestions were to move away the crossing from the junction, add warning signs for drivers, and to improve visibility of the proposed crossing to drivers. Two participants suggested bringing back the beacons to increase visibility and another two said this design should not be used at all. Other suggestions included adding cameras to the

junction, using brighter colours on the markings, using a raised table, and ensuring the junction did not have curved kerbs.

5.3 Summary of responses from Blind or visually impaired group

The interviews provided an insight into the challenges that pedestrians, who are Blind or partially sighted, face when crossing roads. The results of the interviews helped to identify specific issues relating to the proposed crossing, as well as exploring possible improvements to the design.

Three of the four participants who were Blind or visually impaired said they would be very likely to use the crossing. Participants described how factors in their environment, such as the presence of street furniture, can affect how they use a crossing point. They requested that street furniture be kept to a minimum to reduce the likelihood of a colliding with it, when navigating the crossing. In addition, in order to improve safety, they requested that drivers' visibility of a pedestrian is maximised by keeping sight lines around the crossing point clear. This would include removing overhanging branches or other objects that obscure visibility of pedestrians. One potential benefit of the crossing mentioned was that having a defined crossing point would make drivers more aware of the need to look out for crossing pedestrians, and could also make it more likely that other pedestrians would notice and potentially assist visually impaired people who are trying to cross.

On concern raised was that visually impaired users might drift off the line of the crossing and end up walking in the adjacent main carriageway. Participants highlighted the importance of installing tactile paving correctly to ensure that pedestrians who are Blind or partially sighted are directed towards the other side of the side road accurately. Participants also suggested adding additional tactility to the crossing point. This included adding a tactile gully or groove running in a straight line across the road to help assistance cane uses cross the road in a straight line. This was seen to be of particular importance with the crossing point located close to the mouth of the junction. Another suggestion included helping pedestrians to locate the start of the crossing with the addition of tactile edging to the pavement 2 meters either side of the start of the crossing point.

Bicycles, and electric / hybrid vehicles are difficult to hear when at a crossing point. Participants struggle to identify their presence and as a result it would be useful to consider the prevalence of these types of vehicles in an area when selecting suitable locations to install the proposed crossing points. In addition, the volume, speed and noise of traffic should be considered when selecting suitable junctions for this proposed crossing point. These factors impact whether a Blind or partially sighted pedestrian would use this crossing point or whether they would "*indent*" further into the side road before attempting to cross.

Respondents were very positive about the use of the small tactile model for consultation, commenting that being hand-held made it easier to interpret than a larger model.

5.4 Summary of responses from representatives of the learning disabilities and cognitive disorder groups

The interviews reported that a decrease in the ability to process visual information made it difficult for people with learning disabilities and cognitive disorders to interpret and interact

with their environment. For people with cognitive disorders the loss of depth perception combined with impaired cognitive processing means that contrasts or patterns could be especially challenging. It was felt that having a monotone coloured path across the crossing could help pedestrians that may have deficits in their visual processing abilities to cross. Also maintaining the paint on white stripes to reduce the possibility of black patches could also be useful.

It was found that people with learning difficulties and cognitive disorders rely on their environment to stay relatively constant and any changes could lead to confusion or make them feel anxious since they may not know how to interact with the changes. Several participants therefore raised the point that if any changes are made to the crossing design, these need to be brought to the attention of people in the diagnosed person's support network so that they can help them to learn how to interact with the new crossing design.

Participants felt that the use of the black and white stripe design meant that the crossing would be recognisable as a crossing and would therefore elicit normal crossing behaviour. Having the crossing located on the desired walk line made it visible to the pedestrian and it would be likely that they would use the crossing.

Concerns were raised about the safety of people using the crossing. These included issues around the pedestrian needing to be able to process information in front, to the sides and behind them. It was felt that many participants may not be able to do this, and therefore may not be aware of vehicles turning into the sideroad from the main road. Participants felt that the crossing could be moved slightly down the side-road, so that pedestrians only need to be concerned about looking left and right, or that a central refuge could be provided so that the pedestrian could make the crossing in stages, therefore reducing the amount of visual processing required at any one time.

Additionally, three participants were concerned that the crossing may not be visible to drivers of vehicles turning into the side-road from the far-side lane of the main road since oncoming vehicles could obscure it and because the driver turning right into the side road may be focused on looking for a gap in the approaching traffic. The lack of a place for the vehicle to stop before the crossing means that the vehicle could potentially be exposed to oncoming traffic in the main road or could interact with a pedestrian on the crossing. Moving the crossing slightly further down the side road or using yellow hatched markings to warn drivers and to ensure that the crossing remained visible were some of the suggestions made by participants. However, one participant felt that having the crossing at the mouth of the junction made it more visible to drivers.

5.5 Summary of responses from representatives of the mental health conditions group

Mental health conditions cover a wide range of conditions which differ in symptoms and experiences. The impact on of some of these conditions, such as anxiety, phobias and depression, tend to cause someone to feel distress or worry when interacting with their environment. These conditions also make it difficult for a person to concentrate and process information. People tend to feel more safe and secure when they have a routine and are in a familiar environment.

This means that the use of familiar elements in the crossing design, such as the black and white stripes, acted as familiar and recognisable cues to people with mental health conditions that would help them to know how to interact with the crossing. Further, having the crossing on the desired walk line of the pedestrian was felt to be convenient and make the crossing visible and easier to use. All the participants felt that the crossing would be very convenient to use and that it was "*a natural place to cross anyway*". However, one participant felt that the ease of use may be a drawback since some people with ADHD may not consider the crossing a hazard and just cross it "*without breaking stride*".

Participants felt that it would be helpful if pedestrians and their healthcare professionals and organisations were made aware of the implementation of the new crossing design before it happens. This could help people with mental health conditions to become accustomed to the changes and get the support they need to interact with their environment. It would also further help to provide clear guidance on how people and drivers are expected to use the new crossing design, clarifying the rights and responsibilities of the different road users.

Even though most participants could see the value of having the crossing in the direction of the desired walk line, concerns were raised about the safety of the crossing close to the main road. These tended to be around a possible lack of visibility of the crossing and pedestrians, and the lack of a safe stopping point for vehicles turning into the sideroad from the main road. In this respect, some of the suggestions made by participants to improve the design included moving the crossing a car's length down the sideroad, using measures to reduce the speed of vehicles on the main road, and assessing the suitability of the environment in terms of traffic volume and speed before using the new crossing design on a sideroad.

6 Implications

Perceptions towards the proposed crossing design varied between disability groups. However, participants agreed that consultations with disability groups were essential for the successful redesign of the crossing point and were impressed that TfGM was taking a proactive and inclusive approach.

Familiarity

Participants in different research groups commented on the importance of being familiar with an environment. Responses from Blind and partially sighted participants, and representative of those with learning disabilities and cognitive disorders explained that being familiar with a crossing would make the pedestrian feel more comfortable using the crossing point. Similarly, a crossing point that included familiar design features was seen to be more recognisable to pedestrians with disabilities. Familiarity is therefore extremely important, especially seeing as people with mental health disorder are uncomfortable with change as it can cause anxiety, stress or confusion.

It would be advisable to utilise local disability networks and organisation in order to educate people with disabilities in the design of the new crossing to ensure familiarity. Videos and social media could also provide a good method for raising awareness to the new crossing design.

Layout of crossing

Although tactile surfaces provide essential information to Blind or partially sighted pedestrians, they can be unsettling to people with learning disabilities or cognitive disorders. As such, a trade off must be made between the needs of these two groups, while ensuring that the tactile surface comply with regulations.

Research conducted with people who had mobility impairments highlighted the obvious importance of implementing dropped kerbs correctly. Similarly, Blind and partially sighted pedestrians explained their reliance on dropped kerbs pointing them accurately in the correct direction, so as to avoid drifting 'off course' into the adjacent carriageway. This is of particular importance with the location of the proposed crossing being close to the mouth of the junction.

Coincidentally, participants from two separate research groups discussed introducing an additional feature to the crossing point. Blind and partially sighted participants explained that a tactile path running from one side of the road to another would help mobility cane users maintain a straight line when crossing the road. People representing those who have learning disabilities and cognitive disorders also explained that changes in surface colour, such as black and white stripes, can be unsettling to some people. They suggested including a continuous pathway across the crossing point to eliminate this uneasiness.

Participants who were representing people with learning disabilities and cognitive disorders raised concerns about the design of the crossing potentially contributing to sensory overload. This was due to the crossing being located on the junction of two roads. Blind and partially sighted participants similarly expressed concern about potential sound overload due to the crossing point being located so close to the main road. They described this sound overload as a sound bleed. In addition to sound overload, participants also explained that if some pedestrians were required to look in multiple directions, including over their shoulder / behind them, it could lead to potential dizziness. The geometry of the potential junctions selected could have an impact on the likelihood of this occurring. For example, a side road that meets the main road at a tight angle would not require a pedestrian look as far round as one where a side road meets the main road at a wide / open sweeping mouth of a junction. This is something that could be considered when selecting appropriate locations for the proposed crossing point.

Although there some concerns about locating the crossing right next to the main carriageway, there were also positive comments on its convenience. One participant said the crossing was "*a natural place to cross anyway*". In the mental health conditions research group, most people said that they would prefer to have a crossing than not to have one. "*And in a way it gives them a positive reinforcement message that: 'You pedestrians are important, and we realise and acknowledge that…*".

Surrounding environments

Removing unnecessary street furniture was a recommendation made within many of the research groups. By doing so, it would simplify the crossing point, reduce the amount of cognitive processing required and reduce the number of potential collision hazards for those with impaired vision. Although the removal of unnecessary street furniture was recommended, it was also considered important to have inclusive signage to help

pedestrians navigate the crossing. Participants suggested including pictures or icons to help those people who were unable to read text confidently.

Other road users

Other road users were discussed by all research groups. The amount, speed and density of traffic could impact how safe participants felt if they were to use the crossing point. In busy areas, with fast moving and high-density traffic, some pedestrians said that they would consider walking further down a side road before crossing. Concerns about larger vehicles such as HGVs were raised by people representing those with learning difficulties and cognitive impairments, and people representing people with mental health disorders. They believed that they could feel fearful or become overwhelmed by the noise. For the group with mental health disorders, they went on to say that the presence of large vehicles could contribute to people feeling unsafe. For Blind or visually impaired people, their concern was that noise from large vehicles, such as HGVs, often drowned out the sound of other road users. This meant that if a large vehicle paused to let them cross, they would find it extremely difficult to determine if the rest of the road was safe to cross.

At the other end of the spectrum, cyclists were considered a challenge due to the absence of noise. Participants representing those with mental health disorders, along with participants who were Blind or partially sighted, explained that they might not be able to hear cyclists approaching the crossing point. There were also concerns from other research groups that cyclist would not give priority to pedestrians. Participants went on to discuss the need for signage directed at drivers / other road users to ensure that priority at the crossing point was unambiguous.

Safety concerns

An interesting point raised in the research with representatives for mental health disorders, and representatives for learning disabilities and cognitive disorders was that people may put too much faith in the safety of the crossing point. This raised questions about whether pedestrians should be encouraged to check their surrounding and proceed cautiously. However, conversely, one participant believed that people with disabilities are often more careful as they are aware of their own limitations caused by their impairments.

Blind or partially sighted participants were also concerned about cars blocking the crossing as they waited to make their manoeuvre. Other participants expressed concern about the proximity of the crossing point to the mouth of the junction. Visually impaired pedestrians explained that accurately walking in a straight line became safety critical when the crossing was positioned close to the main road. They feared that a slight error in their trajectory could lead to them walking out into a live lane of traffic. Others were concerned about how visible pedestrians would be to drivers, in particular HGV drivers. Participants recommended ensure clear visibility of pedestrians when at the crossing point.

Participants who were mobility impaired discussed the convenience of the positioning of the crossing. They explained that it meant they were not required to divert and walk down a side road in order to reach a crossing point, which they believed was positive.

Appendix A Online survey (mobility impaired)

Key to reading this survey (not to be shown to participants)

*	Denotes a compulsory question
☐	Denotes response options for multiple-choice questions, from which a participant can select only one response
Text in Red	Instructions for creating an online version of the survey (not to be shown to participants)

Info and consent

Thank you for taking the time to fill in this questionnaire.

What will I be required to do?

This questionnaire is about your thoughts, attitudes, and experiences concerning a particular situation that you might encounter when crossing side roads.

The questionnaire includes two sections where you will be shown a few images before answering a set of questions. Most of the questions will ask you to choose one answer from the options provided. Sometimes there is space for you to provide a written explanation of your answer, please complete this giving as much detail as you can.

There are no right or wrong answers – please answer honestly. Your answers will remain anonymous and confidential. Your answers will be combined with those from other participants to understand general trends and patterns.

Please provide your name and email address if you wish to be entered into the **prize draw**. You do not need to provide your contact details if you do not wish to enter the prize draw.

How long will it take?

We expect this questionnaire to take approximately 20 minutes.

What are the possible benefits of taking part?

Your contribution to this research will help us and our client (Transport for Greater Manchester) to understand how to improve future crossing designs.

There is no payment for completing this form. You will have the opportunity to enter a prize draw for an Amazon voucher worth £100 at the beginning of the questionnaire. Entry to the prize draw is optional. You do not need to provide your contact details if you do not wish to enter the prize draw.

In addition, we hope that participation in this study will be interesting.

What are the possible disadvantages or risks of taking part?

During the questionnaire, you will be shown some images from your point of view of you crossing the road at a side road crossing. It will be followed by questions about your thoughts, opinions, and experiences concerning the particular situations that you might encounter when crossing the road at such a location.

While the questionnaire has been designed in a way to avoid provoking distress or anxiety, it is still possible that answering questions about the accessibility and safety of road infrastructure might cause some people to become stressed

If you feel distressed at any time or feel that you require support, you can seek mental health support via your GP, or by contacting mental health organisations or identifying a local psychotherapist or counsellor through the following links:

- Individual counsellors and psychotherapists in their area via the British Association for Counselling and Psychotherapy (BACP) Register of Counsellors & Psychotherapists
- Individual Clinical or Counselling Psychologists via the Health and Care Professions Council practitioners' register
- The Samaritans (by phone: 116 123)
- Saneline (by phone: 03003 047000)
- The Mix (by phone: 08088 084994)

We would like to remind you that participation in this study is entirely voluntary and you can withdraw at any time, without providing a reason by closing this page on your web browser.

Who can take part in this questionnaire?

TRL is contacting disability groups, and individuals who have disabilities, to request their participation in the project. Participants need to be 18 years old or over. For this online questionnaire, we are looking for individuals who have a mobility impairment.

What data will be collected?

The personal data we will collect from you are:

- Your name, and email address (collected as part of this survey) so that we can contact you to issue the price draw of £100 Amazon voucher should your name be drawn. It is optional to participate in the prize draw. Your name and email address will not be collected if you do not wish to participate in the prize draw.
- Information about your age, gender, and the region you live in (collected as part of this survey) so that we can ensure we explore the thoughts and feelings of people from various backgrounds
- Information about any disabilities you may have (collected as part of this survey) so that we can explore how various barriers to travel impact thoughts and feelings towards travelling (providing us with this information is optional)

Will my data be kept confidential?

We will treat any information about you, obtained during the course of this research, in the strictest confidence and in line with the General Data Protection Regulations (GDPR). Hard copies of any personal identifying data will be kept in a locked file or transferred to an electronic database and then destroyed confidentially. The data will only be accessible to members of the research team who need access to it. Personal data (such as payment receipts and consent forms) collected during the study will be destroyed at the end of the project. When reporting the findings of the study, individuals will not be identified. Anonymous quotations collected during the research may be included.

TRL's privacy notice is available at https://trl.co.uk/permanent-landing-pages/privacy-notice. Any personal information that we hold will be processed as described in this document and for the purpose of achieving the research objectives.

What happens now?

If you are interested in taking part, we will ask you a few questions about yourself and we will begin the questionnaire.

1. **Are you aged 18 years old or above?**
   - ☐ Yes [proceed to 3]
   - ☐ No [enter prize draw and close]
2. **Do you consent to take part in this survey? ***
   - ☐ Yes [proceed to 3]
   - ☐ No [enter prize draw and close]
3. **Do you agree to the use of anonymised quotes in reports? ***
   - ☐ Yes [proceed to 3]
   - ☐ No [enter prize draw and close]
4. **Do you understand that you are free to withdraw from this questionnaire at any time without providing any reason? ***

   [In description box] You can withdraw at any stage of the questionnaire by closing this page on your web browser.
   - ☐ Yes [proceed to 3]
   - ☐ No [enter prize draw and close]

Contact information for Amazon vouchers.

5. **Prize draw: Would you like to be entered into a prize draw to win a £100 Amazon voucher? ***

   [In description box] You will need to provide your contact details to be entered into the prize draw. You do not need to provide your contact details if you do not wish to enter the prize draw.

   ☐ Yes [go to enter personal details]

   ☐ No [thanks and close]

6. **Please provide your below details:** If above is yes, this question is compulsory

First name	
Surname	
Email address	
Confirm email address	

Background information

7. Please indicate your gender *

- ☐ Male
- ☐ Female
- ☐ Other, please describe: _____
- ☐ Prefer not to say

8. Please indicate your age group *

- ☐ 17 years or younger *[thanks and close]*
- ☐ 18-24 years
- ☐ 25-34 years
- ☐ 35-44 years
- ☐ 45-54 years
- ☐ 55-64 years
- ☐ 65-74 years
- ☐ 75 years or older

9. Disability or impairment

Please provide details of any relevant factors or conditions which you feel affect your mobility (e.g. are you a wheelchair user, or have a hearing impairment?) *[optional]*

Please describe how your mobility is affected:

_____

10. Please indicate the region you live in

- ☐ East Midlands
- ☐ Greater London
- ☐ North East
- ☐ North West
- ☐ South East
- ☐ South West
- ☐ West Midlands
- ☐ Others: [please state]

11. How did you hear about this survey?

- ☐ An email from TRL
- ☐ Facebook
- ☐ Twitter
- ☐ Other [please state]

Questionnaire

In this questionnaire you will be presented with a series of images of the proposed crossing. This will be followed by some questions.

A traditional zebra crossing has a series of alternate black and white stripes on the carriageway; a yellow globe is positioned at each end of the crossing (commonly referred to as a Belisha beacon); and the crossing area is marked with a line of studs; give ways lines and zigzag markings. The minimum distance a zebra crossing can be set-back from the mouth of a side road is about 5 meters.

The proposed crossing excludes some or all the following: studs, zigzag markings and Belisha beacons. By removing some of the features, the crossing markings can be located at the mouth of the road junction. This means that pedestrians remain on their desired walking line and gives them a direct route across the mouth of the junction

Proposed crossing design

Traditional zebra crossing design

Understanding and behaviour

Present all images

The car approaches the junction from the side road.

The car is making a right-hand turn from the main road into the side road.

The car is making a left-hand turn from the main road into the side road.

The car approaches the junction from the side road.

The car is making a left-hand turn from the main road into the side road.

The car is making a right-hand turn from the main road into the side road.

[Next page]

Present one image for reference during questionnaire.

12. Imagine these proposed crossings were introduced at junctions in your area. How likely are you to use these crossings? *

- ☐ Highly likely
- ☐ Likely
- ☐ Not sure
- ☐ Unlikely
- ☐ Highly unlikely

Please explain the reasons for your answer:

_____

13. Imagine these proposed crossings were introduced at junctions in your area. How convenient or inconvenient would you find the position of these crossings? *

- ☐ Very inconvenient
- ☐ Inconvenient
- ☐ Not sure
- ☐ Convenient
- ☐ Very convenient

Please explain the reasons for your answer:

_____

14. We would like to understand how different types of vehicle may influence your feelings of safety when using the crossing. The following 6 questions will present to you a scenario, followed by a question on your feelings of safety.

a. If a cyclist was approaching the junction from the side road, how safe or unsafe do you think you would feel using this crossing in the real-world? *

☐ Very unsafe

☐ Quite unsafe

☐ Neither safe nor unsafe

☐ Quite safe

☐ Very safe

☐ Not sure

Please explain the reasons for your answer:

_____

b. If a cyclist was approaching the junction into the side road, how safe or unsafe do you think you would feel using this crossing in the real-world? *

☐ Very unsafe

☐ Quite unsafe

☐ Neither safe nor unsafe

☐ Quite safe

☐ Very safe

☐ Not sure

Please explain the reasons for your answer:

_____

c. If a car was approaching the junction from the side road, how safe or unsafe do you think you would feel using this crossing in the real-world? *

☐ Very unsafe

☐ Quite unsafe

☐ Neither safe nor unsafe

☐ Quite safe

☐ Very safe

☐ Not sure

Please explain the reasons for your answer:

_____

d. If a car was approaching the junction into the side road, how safe or unsafe do you think you would feel using this crossing in the real-world? *

☐ Very unsafe

☐ Quite unsafe

☐ Neither safe nor unsafe

☐ Quite safe

☐ Very safe

☐ Not sure

Please explain the reasons for your answer:

_____

e. If a large vehicle was approaching the junction from the side road, how safe or unsafe do you think you would feel using this crossing in the real-world? *

☐ Very unsafe

☐ Quite unsafe

☐ Neither safe nor unsafe

☐ Quite safe

☐ Very safe

☐ Not sure

Please explain the reasons for your answer:

_____

f. If a large vehicle was approaching the junction into the side road, how safe or unsafe do you think you would feel using this crossing in the real-world? *

☐ Very unsafe

☐ Quite unsafe

☐ Neither safe nor unsafe

☐ Quite safe

☐ Very safe

☐ Not sure

Please explain the reasons for your answer:

_____

15. **Do you have any comments on how the proposed crossing may affect your safety?***

    If yes, please describe your concerns:

    _____

16. **Do you have any comments on how the proposed crossing may affect how easily you could cross the road? ***

    If yes, please describe your concerns:

    _____

17. **Would you like to see any changes to the design of this crossing? ***

    ☐ Yes

    ☐ No

    a. If yes, please describe the changes you would like to see:

    _____

18. **How likely are you to cross at the junction if there is no crossing installed? ***

    ☐ Highly likely

    ☐ Likely

    ☐ Not sure

    ☐ Unlikely

    ☐ Highly unlikely

    Please explain the reasons for your answer:

    _____

    Thank you [End]

Thank you for completing this questionnaire.

TRL's privacy notice is available at https://trl.co.uk/permanent-landing-pages/privacy-notice, any personal information that we hold will be processed as described in this document for the purpose of achieving the research objectives.

For more details about the questionnaire please contact trials@trl.co.uk with the subject matter 'Zebras RQ2'

Appendix B Online survey (deaf or hearing impaired)

Key to reading this survey (not to be shown to participants)

*	Denotes a compulsory question
☐	Denotes response options for multiple-choice questions, from which a participant can select only one response
Text in Red	Instructions for creating an online version of the survey (not to be shown to participants)

Info and consent

Thank you for taking the time to fill in this questionnaire.

What will I be required to do?

This questionnaire is about your thoughts, attitudes, and experiences concerning a particular situation that you might encounter when crossing side roads.

The questionnaire includes two sections where you will be shown a few images before answering a set of questions. Most of the questions will ask you to choose one answer from the options provided. Sometimes there is space for you to provide a written explanation of your answer, please complete this giving as much detail as you can.

There are no right or wrong answers – please answer honestly. Your answers will remain anonymous and confidential. Your answers will be combined with those from other participants to understand general trends and patterns.

Please provide your name and email address if you wish to be entered into the **prize draw**. You do not need to provide your contact details if you do not wish to enter the prize draw.

How long will it take?

We expect this questionnaire to take approximately 20 minutes.

What are the possible benefits of taking part?

Your contribution to this research will help us and our client (Transport for Greater Manchester) to understand how to improve future crossing designs.

There is no payment for completing this form. After you complete the questionnaire, you will have the opportunity to enter a prize draw for an Amazon voucher worth £100. Entry to the prize draw is optional. You do not need to provide your contact details if you do not wish to enter the prize draw.

In addition, we hope that participation in this study will be interesting.

What are the possible disadvantages or risks of taking part?

During the questionnaire, you will be shown some images from your point of view of you crossing the road at a side road crossing. It will be followed by questions about your thoughts, opinions, and experiences concerning the particular situations that you might encounter when crossing the road at such a location.

While the questionnaire has been designed in a way to avoid provoking distress or anxiety, it is still possible that answering questions about the accessibility and safety of road infrastructure might cause some people to become stressed

If you feel distressed at any time or feel that you require support, you can seek mental health support via your GP, or by contacting mental health organisations or identifying a local psychotherapist or counsellor through the following links:

- Individual counsellors and psychotherapists in their area via the British Association for Counselling and Psychotherapy (BACP) Register of Counsellors & Psychotherapists
- Individual Clinical or Counselling Psychologists via the Health and Care Professions Council practitioners' register
- The Samaritans (by phone: 116 123)
- Saneline (by phone: 03003 047000)
- The Mix (by phone: 08088 084994)

We would like to remind you that participation in this study is entirely voluntary and you can withdraw at any time, without providing a reason.

Who can take part in this questionnaire?

TRL is contacting disability groups, and individuals who have disabilities, to request their participation in the project. Participants need to be 18 years old or over. For this online questionnaire, we are looking for individuals who are deaf or have a hearing impairment.

What data will be collected?

The personal data we will collect from you are:

- Your name, and email address (collected as part of this survey) so that we can contact you to issue the price draw of £100 Amazon voucher should your name be drawn. It is optional to participate in the prize draw. Your name and email address will not be collected if you do not wish to participate in the prize draw.
- Information about your age, gender, and the region you live in (collected as part of this survey) so that we can ensure we explore the thoughts and feelings of people from various backgrounds
- Information about any disabilities you may have (collected as part of this survey) so that we can explore how various barriers to travel impact thoughts and feelings towards travelling (providing us with this information is optional)

Will my data be kept confidential?

We will treat any information about you, obtained during the course of this research, in the strictest confidence and in line with the General Data Protection Regulations (GDPR). Hard copies of any personal identifying data will be kept in a locked file or transferred to an electronic database and then destroyed confidentially. The data will only be accessible to members of the research team who need access to it. Personal data (such as payment receipts and consent forms) collected during the study will be destroyed at the end of the project. When reporting the findings of the study, individuals will not be identified. Anonymous quotations collected during the research may be included.

TRL's privacy notice is available at https://trl.co.uk/permanent-landing-pages/privacy-notice. Any personal information that we hold will be processed as described in this document and for the purpose of achieving the research objectives.

Accessible format

If you would like to request a British Sign Language Interpreter to support you with this questionnaire, please contact us via email at trials@trl.co.uk.

What happens now?

If you are interested in taking part, we will ask you a few questions about yourself and we will begin the questionnaire.

19. Are you aged 18 years old or above?

- ☐ Yes [proceed to 3]
- ☐ No [enter prize draw and close]

20. Do you consent to take part in this survey? *

- ☐ Yes [proceed to 3]
- ☐ No [enter prize draw and close]

21. Do you agree to the use of anonymised quotes in reports? *

- ☐ Yes [proceed to 3]
- ☐ No [enter prize draw and close]

22. Do you understand that you are free to withdraw from this questionnaire at any time without providing any reason? *

[In description box] You can withdraw at any stage of the questionnaire by closing this page on your web browser.

- ☐ Yes [proceed to 3]
- ☐ No [enter prize draw and close]

Contact information for Amazon vouchers.

23. Prize draw: Would you like to be entered into a prize draw to win a £100 Amazon voucher? *

[In description box] You will need to provide your contact details to be entered into the prize draw. You do not need to provide your contact details if you do not wish to enter the prize draw.

- ☐ Yes [go to enter personal details]
- ☐ No [thanks and close]

24. Please provide your below details: If above is yes, this question is compulsory

First name	
Surname	
Email address	
Confirm email address	

Background information

25. Please indicate your gender *

- ☐ Male
- ☐ Female
- ☐ Other, please describe: _____
- ☐ Prefer not to say

26. Please indicate your age group *

- ☐ 17 years or younger *[thanks and close]*
- ☐ 18-24 years
- ☐ 25-34 years
- ☐ 35-44 years
- ☐ 45-54 years
- ☐ 55-64 years
- ☐ 65-74 years
- ☐ 75 years or older

27. Disability or impairment

Please provide details of any relevant factors or conditions which you feel affect your mobility (e.g. are you a wheelchair user, or have a hearing impairment?) *[optional]*

Please describe how your mobility is affected:

_____

28. Please indicate the region you live in

- ☐ East Midlands
- ☐ Greater London
- ☐ North East
- ☐ North West
- ☐ South East
- ☐ South West
- ☐ West Midlands
- ☐ Others: [please state]

29. How did you hear about this survey?

- ☐ An email from TRL
- ☐ Facebook
- ☐ Twitter
- ☐ Other [please state]

Questionnaire

In this questionnaire you will be presented with a series of images of the proposed crossing. This will be followed by some questions.

A traditional zebra crossing has a series of alternate black and white stripes on the carriageway; a yellow globe is positioned at each end of the crossing (commonly referred to as a Belisha beacon); and the crossing area is marked with a line of studs; give ways lines and zigzag markings. The minimum distance a zebra crossing can be set-back from the mouth of a side road is about 5 meters.

The proposed crossing excludes some or all the following: studs, zigzag markings and Belisha beacons. By removing some of the features the crossing markings can be located at the mouth of the road junction. This means that pedestrians remain on their desired walking line and gives them a direct route across the mouth of the junction.

Proposed crossing design

Traditional zebra crossing design

Show all images. Before questionnaire.

Understanding and behaviour

Present all images

The car approaches the junction from the side road.

The car is making a right-hand turn from the main road into the side road.

The car is making a left-hand turn from the main road into the side road.

The car approaches the junction from the side road.

The car is making a left-hand turn from the main road into the side road.

The car is making a right-hand turn from the main road into the side road.

[Next page]

Present one image for reference during questionnaire.

30. Imagine these proposed crossings were introduced at junctions in your area. How likely are you to use these crossings? *

- ☐ Highly likely
- ☐ Likely
- ☐ Not sure
- ☐ Unlikely
- ☐ Highly unlikely

Please explain the reasons for your answer:

_____

31. Imagine these proposed zebra crossings were introduced at junctions in your area. How convenient or inconvenient would you find the position of these crossings? *

- ☐ Very inconvenient
- ☐ Inconvenient
- ☐ Not sure
- ☐ Convenient
- ☐ Very convenient

Please explain the reasons for your answer:

_____

32. We would like to understand how different types of vehicle may influence your feelings of safety when using the crossing. The following 6 questions will present to you a scenario, followed by a question on your feelings of safety.

a. If a cyclist was approaching the junction from the side road, how safe or unsafe do you think you would feel using this crossing in the real-world? *

☐ Very unsafe

☐ Quite unsafe

☐ Neither safe nor unsafe

☐ Quite safe

☐ Very safe

☐ Not sure

Please explain the reasons for your answer:

_____

b. If a cyclist was approaching the junction into the side road, how safe or unsafe do you think you would feel using this crossing in the real-world? *

☐ Very unsafe

☐ Quite unsafe

☐ Neither safe nor unsafe

☐ Quite safe

☐ Very safe

☐ Not sure

Please explain the reasons for your answer:

_____

c. If a car was approaching the junction from the side road, how safe or unsafe do you think you would feel using this crossing in the real-world? *

☐ Very unsafe

☐ Quite unsafe

☐ Neither safe nor unsafe

☐ Quite safe

☐ Very safe

☐ Not sure

Please explain the reasons for your answer:

_____

d. If a car was approaching the junction into the side road, how safe or unsafe do you think you would feel using this crossing in the real-world? *

☐ Very unsafe

☐ Quite unsafe

☐ Neither safe nor unsafe

☐ Quite safe

☐ Very safe

☐ Not sure

Please explain the reasons for your answer:

_____

e. If a large vehicle was approaching the junction from the side road, how safe or unsafe do you think you would feel using this crossing in the real-world? *

☐ Very unsafe

☐ Quite unsafe

☐ Neither safe nor unsafe

☐ Quite safe

☐ Very safe

☐ Not sure

Please explain the reasons for your answer:

_____

f. If a large vehicle was approaching the junction into the side road, how safe or unsafe do you think you would feel using this crossing in the real-world? *

☐ Very unsafe

☐ Quite unsafe

☐ Neither safe nor unsafe

☐ Quite safe

☐ Very safe

☐ Not sure

Please explain the reasons for your answer:

_____

33. Do you have any comments on how the proposed crossing may affect your safety?*

If yes, please describe your concerns:

_____

34. Do you have any comments on how the proposed crossing may affect how easily you could cross the road? *

If yes, please describe your concerns:

_____

35. Would you like to see any changes to the design of this crossing? *

☐ Yes

☐ No

b. If yes, please describe the changes you would like to see:

_____

36. How likely are you to cross at the junction if there is no crossing installed? *

☐ Highly likely

☐ Likely

☐ Not sure

☐ Unlikely

☐ Highly unlikely

Please explain the reasons for your answer:

_____

Thank you [End]

Thank you for completing this questionnaire.

TRL's privacy notice is available at https://trl.co.uk/permanent-landing-pages/privacy-notice, any personal information that we hold will be processed as described in this document for the purpose of achieving the research objectives.

For more details about the questionnaire please contact trials@trl.co.uk with the subject matter 'Zebras RQ2'.

Appendix C Topic guide (Blind or visually impaired)

Information

Thank you for agreeing to help us with our research.

We expect this interview to last approximately 30-60 minutes. There are no right or wrong answers, so please be as honest as you can. You are free to withdraw at any time without giving a reason.

The information we collect through these interviews will be compiled in a way that no individual or organisation will be identifiable. The answers you give will not be linked with you and you will not be personally identifiable within any reports published as part of this study. Any data used will be anonymised.

I would like to record the interview with your permission. We will only use this recording to help with writing our report on the research.

Do you have any questions?

Consent

Yes/No

1. Do you confirm that you have gone through the information provided on the Information sheet, and that you have understood the information and have had the opportunity to ask questions, and you have had any questions answered.
2. Do you understand that your participation is voluntary and that you are free to withdraw at any time, without giving reason? Any data you have provide up till that point will be omitted.
3. Are you aged 18 years old or above?
4. Do you agree to take part in the study?
5. Do you agree to this interview being audio recorded?
6. Do you agree to the use of anonymised quotes in any publications arising from this research?

_____	_____	_____
Name of participant	Date	Signature
_____	_____	_____
Name of researcher	Date	Signature

Introduction

Thank you for making time to speak with me today. As you are aware, TRL is conducting research for Transport for Greater Manchester looking at a proposed design for side road crossings. The outputs from this research will be used to update future crossing designs. We will be using a 3D tactile model to facilitate the interview. We would like to hear your perceptions and understanding of the proposed crossing.

You will have received a 3D tactile model in the post. Please can you confirm that you have received the tactile model and have it with you before we begin the interview. You have also been sent a small vehicle. Using this vehicle is optional, but you may find it helps to understand how traffic will interact with the crossing point.

All transcripts and data captured during the study will be fully anonymised, and you will not be identifiable in the published reports. We may use specific quotes from the interview, but these will not be attributed to your name, job title or organisation.

Many thanks for agreeing to participate in this interview

Background information

	Background information	
1.	Please can you confirm your: ☐ Name ☐ Age ☐ Gender	
2.	Please indicate the region you live in ☐ East Midlands ☐ Greater London ☐ North East ☐ North West ☐ South East ☐ South West ☐ West Midlands ☐ Others: [please state]	
3.	Could you please can you provide details of your visual impairment?	
4.	Are you assisted by a guide dog or do	

	you use a mobility cane? *[Interviewer note:* *Symbol cane - have low but useful vision.* *Guide cane - to find obstacles.* *Long cane - to avoid obstacles if you have restricted or no vision.* *Red and white banded cane -to show you have low hearing and vision]*	
5.	Do you feel that your visual impairment impacts your mobility? If so, how?	

Description of proposed crossing

I am going to begin by giving you some information about the 3D model. Let's start by orientating the model – please can you place the model horizontally in front of you so that it runs from left to right. Please have the longest part of the model at the top so that it forms a wide 'T' shape.

The model shows a junction where a smaller side road meets a larger main road. The main road runs horizontally across the top of the model. The side road runs from the bottom middle of the model and goes up to the main road. Only half of the main road is shown on the model – it is approximately one of the two lanes that you would expect to find at a junction like this. Both lanes on the side road are shown.

The model also includes pavements. These are slightly raised above the road. The pavements run alongside the main road and curves 90° down alongside the side road on both sides of the model. Pavements are present on both sides of the model – on the left and right.

At the mouth of the junction where the side road meets the main road you will find junction markings. These can be found as raised lines on the model. There are 2 parallel dashed lines on the left-hand side of the side road. There is only 1 dashed line on the right-hand side of the side road. These are known as give way lines.

On each side of the model there are two areas that represent tactile / blister paving. These are located at the edge of the pavement just before the side road. Between the two areas of tactile paving, you will find a crossing point. This is represented by 6 raised rectangles depicting where the proposed crossing would be located.

Differences between traditional zebra crossings and proposed zebra crossing

A traditional zebra crossing has a series of alternate black and white stripes on the carriageway; a yellow globe is positioned at each end of the crossing (commonly referred to as a Belisha beacon); and the crossing area is marked with a line of studs; give ways lines and zigzag markings. The minimum distance a zebra crossing can be set-back from the mouth of a side road is about 5 meters.

The proposed crossing excludes the following: studs, zigzag markings and Belisha beacons. By removing these features the crossing can be located at the mouth of the road junction. This means that pedestrians can remain on their desired walking line and gives them a direct route across the mouth of the junction.

Junction scenarios

Using the 3D model, we will now explore a number of possible vehicle scenarios that could occur at this junction. Talking through these scenarios will help to give you an understanding of how this crossing will work and how traffic will approach the junction. Scenarios include:

- Vehicles on the side road turning onto main road (either turning left or right)
- Vehicles on the main road turning left into the side road
- Vehicles on the main road turning right into the side road

There are details to note on some of these scenarios, including:

- Some of these manoeuvres require vehicles to cross another lane e.g. turning right into or out of the side road
- When vehicles on the side road turn onto the main road, the vehicle will cross onto the proposed crossing markings to reach the give way markings at the end of the road, before then making the manoeuvre
- The level of traffic will vary. There could be multiple vehicles completing a variety of manoeuvres simultaneously.

	Likelihood of use	
6.	On a scale of 1 (*Very unlikely*) – 5 (*Very likely*), how likely or unlikely do you think you would be to cross the junction using this crossing point? • 1 – Very unlikely • 2 – Quite unlikely • 3 – Neutral • 4 – Quite likely • 5 – Very likely • Not sure	

7.	Please explain the reason for your answer	
8.	How likely or unlikely do you think it would be for others who are blind or partially sighted to cross the road using this crossing point?	
	Safety	
9.	Compared with having no crossing, how safe or unsafe do you think someone who was blind or partially sighted would feel when using this crossing?	
10.	On a scale of 1 (*Very Unsafe*) – 5 (*Very Safe*), how safe or unsafe do you think you would you feel if using this crossing? • 1 – Very unsafe • 2 – Quite unsafe • 3 – Neither safe nor unsafe • 4 – Quite safe • 5 – Very safe • Not sure	
11.	Please explain the reason for your answer	
12.	We would like to understand how different types of traffic may influence how someone who is blind or has a visual impairment could experience crossing the road at this type of road crossing. • If a cyclist was approaching the junction? Could you please explain. • If a cyclist was approaching the junction into the side road,	

	how safe or unsafe do you think you would feel using this crossing in the real-world? Could you please explain. • If a car was approaching the junction from the side road, how do you think someone who is blind or has a visual impairment may react? Would they cross the road or give priority to the vehicle? Could you please explain. • If a car was approaching the junction into the side road, how safe or unsafe do you think you would feel using this crossing in the real-world? Could you please explain. • If a large vehicle was approaching the junction from the side road, how do you think someone who is blind or has a visual impairment may react? Would they cross the road or give priority to the large vehicle? Could you please explain. • If a large vehicle was approaching the junction into the side road, how safe or unsafe do you think you would feel using this crossing in the real-world? Could you please explain.	
	Convenience	
13.	Compared with having no crossing, how convenient or inconvenient is the position of this crossing for someone who is blind or partially sighted?	
14.	On a scale of 1 (*Very Inconvenient*) – 5 (*Very Convenient*), how convenient or inconvenient do you think this crossing is? • 1 – Very Inconvenient	

	• 2 – Quite Inconvenient • 3 – Neither Convenient nor Inconvenient • 4 – Quite Convenient • 5 – Very Convenient • Not sure	
15.	Please explain the reason for your answer	
	Possible changes	
16.	Would you like to see any changes to the design of this crossing in order to improve safety for the someone who is blind or partially sighted? *How would this improve safety?*	
17.	Would you like to see any other changes to the design of this crossing? *How would these changes benefit people?*	
	Comparison to a junction with no crossing	
18.	On a scale of 1 (*Very unlikely*) – 5 (*Very likely*), how likely or unlikely do you think you would be to cross the junction if there was no formal crossing point? • 1 – Very unlikely • 2 – Quite unlikely • 3 – Neutral • 4 – Quite likely • 5 – Very likely • Not sure	
19.	Please explain the reason for your answer	
	End of interview	
20.	That's the end of my questions, is	

	there anything else that you would like to share that we did not cover in this interview?	

End of interview

Thank you for your time! If you have any further questions or concerns about anything that has been discussed in this interview then you can contact us at TRL on ablunden@trl.co.uk

Please confirm your name and email address so that we can send you a £30 Amazon voucher. This will be sent to you within the next 2 weeks.

Name	
Email address	

Finally, you will find a stamped addressed hard-backed envelope in the package you received through the post. We would be grateful if you could return the 3D tactile model if it is easy to do so. Just place the model into the envelope, seal by removing the tape and put it into a post box. Please note that it is not mandatory to return the models.

Many thanks once again.

Appendix D Topic guide (learning disability and cognitive disorders)

<Statement to be read prior to interview commencing>

Thank you for agreeing to take part in this study. Transport for Greater Manchester has asked us to do research into how people understand and would anticipate behaving around a proposed new type of side road crossing. The results from this study will be used to inform future crossing designs.

You have been invited to participate in this interview as someone who could provide valuable insights into how learning disabilities/cognitive disorders could impact on the experience of someone crossing the road using the proposed new crossing design. We will show you some images of this type of crossing and explain the differences between these crossings and traditional zebra crossings. We will ask you to consider this design in relation to not having a zebra crossing at the junction.

There are no right or wrong answers – we're just keen to hear your opinions in your own words.

As mentioned in the information sheet the interview will take no more than 30 minutes. I will take notes during this interview and, if you agree, record the interview. The recording will act as a back-up and a resource for me to check my notes after the interview - it will be deleted after the project is complete. We will mostly report the 'themes' (or general topic areas emerging) from interviews, although we may use some quotations to illustrate the main points. Any quotations of what you have said will not include your name, so that they are not able to be linked back to you or your organisation.

Do you have any questions about this study or the interview?

I'd just like to take you through our consent form before we begin, please could you say yes or no to express agreement to the following points:

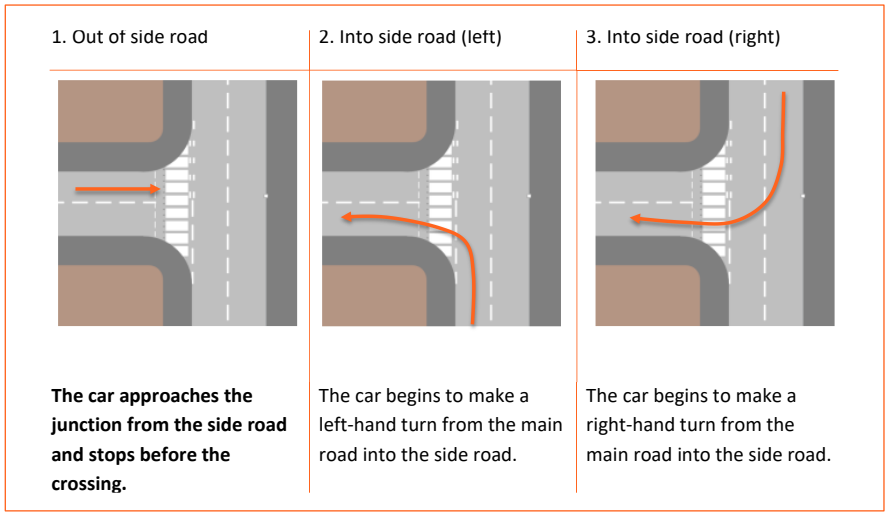
	Yes	No
1. I confirm that I have gone through the information provided on the Information sheet. I have understood the information and have had the opportunity to ask questions, and I have had any questions answered.		
2. I understand that my participation is voluntary and that I can withdraw at any time, without giving a reason. I understand that if I decide to withdraw, any data that I have provided up to that point will be deleted.		
3. I agree to the interview being audio recorded		

4. I consent to anonymised quotations to be used		
5. I agree to take part in the study		

If you are happy to proceed, I will start recording.

[If the stakeholder says "No" to question 3] If you are happy, we will start, and I will make notes during the interview.

Interview



<Image presented on shared screen Slide 2>

Differences between traditional zebra crossings and proposed zebra crossing

A traditional zebra crossing has a series of alternate black and white stripes on the carriageway; a yellow globe is positioned at each end of the crossing (commonly referred to as a Belisha beacon); and the crossing area is marked with a line of studs; give ways lines and zigzag markings. The minimum distance a zebra crossing can be set-back from the mouth of a side road is about 5 meters.

The proposed crossing excludes some or all the following: studs, zigzag markings and Belisha beacons. By removing some of the features the crossing markings can be located at the mouth of the road junction. This means that pedestrians remain on their desired walking line and gives them a direct route across the mouth of the junction.

Here are some images of what the proposed crossing may look like.

<Slide 3>

Do you have any questions?

To get a better understanding, could you please tell us a bit more about how someone with a learning disability/cognitive disorder may experience road or street environments differently? How would this be different for people with different learning disabilities/cognitive disorders? [Are there any additional variables or challenges that needs to be considered?]

What do you think are the implications of this for the proposed crossings?

If it is okay, I would now like to ask you about the factors that could have an impact on how someone with a learning disability may expect to interact with this type of crossing.

<Slide 4>

1. Safety

Compared with having no crossing, what factors could influence how safe someone with a learning disability/cognitive disorder may feel when having to use this crossing? How

would this be different for people with different learning disabilities/cognitive disorders? [How, why and when?]

2. Convenience

Compared with having no crossing, what factors may impact someone with a learning disability/cognitive disorder using the crossing? [When would they prefer to cross somewhere else instead?] **Could you please explain.**

<Slide 5>

3. Feedback/Inputs

Considering our discussion so far, how do you think the crossing design could be changed to improve its safe use for someone with a learning disability/cognitive disorder?

- How would this improve safety?

How do you think the crossing design could be changed to make it easier and more convenient to use for someone with a learning disability/cognitive disorder? Please explain.

Would you like to see any changes to the design of this crossing for any other reasons?

4. Understanding

<Slide 6>

To understand the impact of the design in practical terms, imagine someone with a learning disability/cognitive disorder was faced with the situation presented to you in the image. As a pedestrian, how do you think they may react?

- Proceed on their route
- Cross the road straight ahead
- Stop at the side of the road to give way to cars, then cross when clear
- Cross the road at another location?

- Could you please explain why?

5. Scenarios

<Slide 7>

We would like to understand how different types of traffic may influence how someone with a learning disability/cognitive disorder could experience crossing the road at this

type of crossing. To provide some context, I will first propose a scenario and then ask you some questions. There are 3 scenarios.

Scenario 1

If a X was approaching from the side road, how do you think someone with a learning disability/cognitive disorder may react? Would they cross the road or give priority to the X? Could you please explain.

a. Cyclist
b. Vehicle
c. Large vehicle

How would this be different for people with different learning disabilities/cognitive disorders?

Scenario 2

<Slide 8>

If a X was making a left turn into the side road from the main road, how do you think someone with a learning disability/cognitive disorder may react? Would they cross the road or give priority to the X? Could you please explain.

a. Cyclist
b. Vehicle
c. Large vehicle

How would this be different for people with different learning disabilities/cognitive disorders?

Scenario 3

<Slide 9>

If a X was making a right turn into the side road from the main road, how do you think someone with a learning disability/cognitive disorders may react? Would they cross the road or give priority to the X? Could you please explain.

a. Cyclist
b. Vehicle
c. Large vehicle

How would this be different for people with different learning disabilities/cognitive disorders?

6. Closing the interview

That's the end of my questions, is there anything else that you would like to share that we did not cover in this interview?

After our discussion, do you have any questions about the interview or the study? Would you like the contact details of the technical lead for this study so that you could contact them if you have any further questions or concerns?

Thank you very much for participating in this study, we really appreciate all the feedback we get. We will email the £30 Amazon voucher to you within the next week.

Thank you for your time!

If the participant would like to have the contact details: Amy's info ablunden@trl.co.uk

Appendix E Topic guide (mental health conditions)

<Statement to be read prior to interview commencing>

Thank you for agreeing to take part in this study. Transport for Greater Manchester has asked us to do research into how people understand and would anticipate behaving around a proposed new type of side road crossing. The results from this study will be used to inform future crossing designs.

You have been invited to participate in this interview as someone who could provide valuable insights into how mental health conditions could impact on the experience of someone crossing the road using the proposed new crossing design. We will show you some images of this type of crossing and explain the differences between these crossings and traditional crossings. We will ask you to consider this design in relation to not having a zebra crossing at the junction.

There are no right or wrong answers – we're just keen to hear your opinions in your own words.

As mentioned in the information sheet the interview will take no more than 30 minutes. I will take notes during this interview and, if you agree, record the interview. The recording will act as a back-up and a resource for me to check my notes after the interview - it will be deleted after the project is complete. We will mostly report the 'themes' (or general topic areas emerging) from interviews, although we may use some quotations to illustrate the main points. Any quotations of what you have said will not include your name, so that they are not able to be linked back to you or your organisation.

Do you have any questions about this study or the interview?

I'd just like to take you through our consent form before we begin, please could you say yes or no to express agreement to the following points:

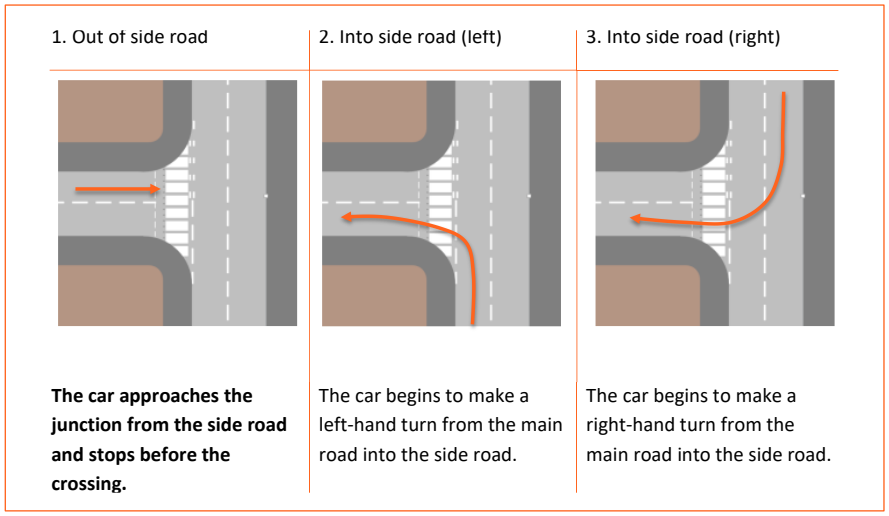
	Yes	No
1. I confirm that I have gone through the information provided on the Information sheet. I have understood the information and have had the opportunity to ask questions, and I have had any questions answered.		
2. I understand that my participation is voluntary and that I can withdraw at any time, without giving a reason. I understand that if I decide to withdraw, any data that I have provided up to that point will be deleted.		
3. I agree to the interview being audio recorded		

4. I consent to anonymised quotations to be used		
5. I agree to take part in the study		

If you are happy to proceed, I will start recording.

[If the stakeholder says "No" to question 3] If you are happy, we will start, and I will make notes during the interview.

Interview



<Image presented on share screen Slide 2>

Differences between traditional zebra crossings and proposed zebra crossing

A traditional zebra crossing has a series of alternate black and white stripes on the carriageway; a yellow globe is positioned at each end of the crossing (commonly referred to as a Belisha beacon); and the crossing area is marked with a line of studs; give ways lines and zigzag markings. The minimum distance a zebra crossing can be set-back from the mouth of a side road is about 5 meters.

The proposed crossing excludes some or all the following: studs, zigzag markings and Belisha beacons. By removing some of the features the crossing markings can be located at the mouth of the road junction. This means that pedestrians remain on their desired walking line and gives them a direct route across the mouth of the junction.

Here are some images of what the proposed crossing may look like.

<Slide 3>

Do you have any questions?

To get a better understanding, could you please tell us a bit more about how someone with a mental health condition may experience road or street environments differently? How would this be different for people with different mental health conditions? [Are there any additional variables or challenges that needs to be considered?]

What do you think are the implications of this for the new proposed zebra crossings?

If it is okay, I would now like to ask you about the factors that could have an impact on how someone with a mental health condition may expect to interact with this type of zebra crossing.

<Slide 4>

1. Safety

Compared with having no crossing, what factors could influence how safe someone with a mental health condition may feel when having to use this crossing? [How, why and when?]

2. Convenience

Compared with having no crossing, what factors may impact on someone with a mental health condition using the crossing? [When would they prefer to cross somewhere else instead?] **Could you please explain.**

<Slide 5>

3. Feedback/Inputs

Considering our discussion so far, how do you think the crossing design could be changed to improve its safe use for someone with a mental condition?

- How would this improve safety?

How do you think the crossing design could be changed to make it easier and more convenient to use for someone with a mental health condition? Please explain.

Would you like to see any changes to the design of this crossing for any other reasons?

4. Understanding

<Slide 6>

To understand the impact of the design in practical terms, imagine someone with a mental health condition was faced with the situation presented to you in the image. As a pedestrian, how do you think they may react?

- Proceed on their route
- Cross the road straight ahead
- Stop at the side of the road to give way to cars, then cross when clear
- Cross the road at another location?

- Could you please explain why?

5. Scenarios

<Slide 7>

We would like to understand how different types of traffic may influence how someone with a mental health condition could experience crossing the road at this type of crossing.

To provide some context, I will first propose a scenario and then ask you some questions. There are 3 scenarios.

Scenario 1

If a X was approaching from the side road, how do you think someone with a mental health condition may react? Would they cross the road or give priority to the X? Could you please explain.

a. Cyclist
b. Vehicle
c. Large vehicle

How would this be different for people with different mental health conditions?

Scenario 2

<Slide 8>

If a X was making a left turn into the side road from the main road, how do you think someone with a mental health condition may react? Would they cross the road or give priority to the X? Could you please explain.

a. Cyclist
b. Vehicle
c. Large vehicle

How would this be different for people with different mental health conditions?

Scenario 3

<Slide 9>

If a X was making a right turn into the side road from the main road, how do you think someone with a mental health condition may react? Would they cross the road or give priority to the X? Could you please explain.

a. Cyclist
b. Vehicle
c. Large vehicle

How would this be different for people with different mental health conditions?

5. Closing the interview

That's the end of my questions, is there anything else that you would like to share that we did not cover in this interview?

After our discussion, do you have any questions about the interview or the study? Would you like the contact details of the technical lead for this study so that you could contact them if you have any further questions or concerns?

Thank you very much for participating in this study, we really appreciate all the feedback we get. We will email the £30 Amazon voucher to you within the next week.

Thank you for your time!

If the participant would like to have the contact details: Amy's info ablunden@trl.co.uk

Non-prescribed Zebra crossings at side roads

Transport for Greater Manchester (TfGM) commissioned TRL to conduct a programme of research into the potential use of non-prescribed zebra crossing markings, positioned flush against the mouths of side roads in urban areas, to provide direct but safe crossing options for pedestrians. This technical annex presents the findings from research into the perceptions of people with impaired mobility, vision or hearing and with learning disabilities, cognitive disorders and mental health conditions. Participants with mobility and hearing impairments were recruited for online surveys using visual representations of the crossing, while visually impaired participants were interviewed while using hand-held tactile models. Interviews were conducted with representatives of organisations acting on behalf of people with learning disability, cognitive disorders and mental health conditions. The research assessed participants' perceptions of safety and convenience concerning the proposed crossing, in comparison with a side-road with no formal crossing. Participants commented on how they would use the crossing and suggested changes to its design.

Titles in this subject area

PPR1003 Non-prescribed zebra crossings at side roads. Final Report. Jones M., Matyas M. and Jenkins D. 2021

PPR1004 Non-prescribed zebra crossings at side roads. Technical Annex 1: Analysis of collision records at existing sites. Hammond J. and Simms G. 2019

PPR1005 Non-prescribed zebra crossing at side roads. Technical Annex 2: User surveys at existing sites. Verwey L., Novis K., Wallbank C. and Stuttard N. 2020

PPR1006 Non-prescribed zebra crossing at side roads. Technical Annex 3: Effectiveness of alternative markings. Novis K., Hyatt T., Stuttard N. and Wallbank C. and Verwey L. 2020

PPR1007 Non-prescribed zebra crossing at side roads. Technical Annex 4: Road user perceptions and understanding. Blunden A., Gupta B., Matyas M., Mazzeo F., Wallbank C. and Wardle A. 2021

PPR1008 Non-prescribed zebra crossing at side roads. Technical Annex 5: Implications for people with disability. Blunden A., Gupta B., Verwey L., Butler, R. and Wallbank C. 2021

PPR1009 Non-prescribed zebra crossing at side roads. Technical Annex 6: Driver simulator trials. Jenkins D., Ramnath R., Stuttard N. and Chowdhury S. 2021

PPR1010 Non-prescribed zebra crossing at side roads. Technical Annex 7: Observations of conflict and giving-way during on street trials. Greenshields S., Ognissanto F., Lee R. and Macgregor E. 2021

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ISBN 978-1-913246-74-7

ISSN 2514-9652

PPR1008