

The effect of re-timed invitation to cross periods on road users at signalised junctions in London

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The effect of re-timed invitation to cross periods on road users at signalised junctions in London

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Executive summary

It has been proposed that re-timing of certain traffic signals in London could provide improvements in junction capacity, vehicular throughput and reduce cycle times that would also benefit pedestrians. This re-timing would involve reducing the duration of the pedestrian 'invitation to cross' (or green man) period at traffic signals which have all-red pedestrian stages.

An experimental trial has been undertaken which involved reducing the invitation to cross green man period at a sample of signal controlled junctions and assessing the effects on accessibility, safety and behaviour of pedestrians and other road users. In this study no other changes were made to the junctions.

National guidance for signal timings describes a green man invitation to cross period followed by a blackout or clearance period sufficient for a pedestrian to cross at 1.2 metres per second (m/s) before conflicting traffic movements are released. However, there is some scope for local interpretation and variation in the application of the invitation to cross period.

At some traffic signals in London the green invitation to cross period is currently greater than the 6 seconds recommended by Department for Transport guidance (DfT, 2006). The proposed re-timing involves reducing the green invitation to cross period at these signals to 6 seconds.

The objective was to undertake an experimental trial and to investigate:

- Pedestrian compliance with the signals.
- Whether or not there was any change in the numbers of pedestrians who waited on in the central refuge when they had started crossing on the green man.
- The crossing times and speeds of pedestrians (for comparison with the assumed rate of 1.2m/s).
- The severities of conflict interactions, and the frequency with which they occur, at junctions before and after re-timing.
- Consideration of the possible effects on junction capacity and vehicle throughput.
- Congestion on footways and within any central refuge areas.
- Consideration of how pedestrians perceive junction accessibility and ease of use before and after the signals are re-timed.
- Whether the re-timing affects pedestrians with a range of impairments.

The study was conducted at 9 sites. Pedestrian behaviour, conflict studies and network data analysis were undertaken using video footage of the trial sites. Video footage was obtained during before and after periods. The before period was during January 2009 and the after period was during February 2009 and followed the re-timing of the signals, the junctions then returned to their before timings.

The short duration of the trial meant that analysis of incident or collision data was not an option for evaluation of any safety implications which might have been associated with the change because the numbers would be too small. However, it was possible to undertake a conflict study as a proxy for incident data. A conflict study involves the observing, evaluating and recording of 'near misses' and, in this instance, comparing the situation before and after the re-timing.

The pedestrian interviews were conducted at the same junctions before and after the signal timings had been changed. Interviews were conducted during the same before and after periods as the other components of the study.

The accompanied walks involved pedestrians with a range of impairments being accompanied whilst crossing at a sample of junctions. They were subsequently interviewed about their experience.

Pedestrian Behaviour

The re-timing of the traffic signals in the after period was associated with an increase in the numbers of pedestrians who failed to comply with the signals and began to cross either during the blackout period or when a red man was displayed.

Both before and after the re-timing, about 95% of pedestrians who stopped in the central refuge had begun to cross whilst a red man was displayed. The increase in the number of pedestrians crossing on a red man following the signal re-timing was associated with a similar increase in pedestrians stopping in the central refuge. However, the re-timing was not associated with any observed increases in crowding of footways or central refuges.

Pedestrians' crossing speeds were found to vary considerably between sites and between pedestrians. However, they were little changed between the before and after periods. The vast majority of pedestrians exceeded the assumed walking speed in national guidance on designing traffic signal timings and the data indicated that the crossing speeds of slower pedestrians or pedestrians with mobility impairments approximates to the assumed crossing speed of 1.2m/s.

Accessibility

Most pedestrians did not notice the change to the re-timed green man and their levels of satisfaction with the waiting time for the crossings was unchanged. Nevertheless, there was a reduction in the numbers who were satisfied with the time provided for crossing.

There was also an increase in the numbers of pedestrians with mobility impairments who felt rushed or unsafe at the sites where the signals had been re-timed.

In the accompanied walks all participants felt that they had to wait a long time for the green man and felt uneasy and rushed when crossing at the re-timed sites.

Network Operation

During the study there were variations between sites in the vehicle throughput observed on the studied junction arm. Overall, there was a 6.5% increase in the number of vehicles passing through most sites under the experimental timings.

Safety

Although the total number of conflicts was very similar in the before and after periods, there was a notable increase in the number of one of the more minor classifications of conflict (grade 2) (see Table 3.6).

Approximately 90% of the observed conflicts involved a pedestrian crossing whilst a red man was displayed and the increase in the occurrence of grade 2 conflicts was associated with pedestrians who were crossing well into the red man period (see Table 3-9 and Figure 3-12). Consequently, the change did not appear to be associated with the re-timing.

No conclusive change was noted in the rate of involvement of any particular type of vehicle or the age or mobility of pedestrians in the observed conflicts.

The results of the study suggest that the re-timing at nine experimental junction locations was safety neutral.

Abstract

An experimental trial was undertaken which involved reducing the invitation to cross (green man) period at a sample of nine signal controlled junctions in London and assessing the effects on accessibility, safety and behaviour of pedestrians and other road users.

The study was undertaken using video footage which was obtained during before and after periods. Conflict studies were undertaken which involved observing, evaluating and recording 'near misses'. A sample of pedestrians was interviewed including pedestrians with special mobility needs who were accompanied whilst crossing junctions.

Approximately 90% of conflicts involved a pedestrian crossing whilst a red man was displayed. The total number of conflicts was very similar in the before and after periods.

There was an increase in the number of one of the more minor classifications of conflict although this did not appear to be associated with the re-timing.

The number of pedestrians who failed to comply with the signals increased.

Pedestrian speeds were unaffected. Most pedestrians exceeded the assumed speed used in national guidance and the speeds of slower pedestrians approximated to this.

There was a small increase in the number of vehicles passing through most of the sites. The increase was statistically significant.

Most pedestrians did not notice the change to the timing and their levels of satisfaction with the waiting time were unchanged. Nevertheless, there was a reduction in the numbers who were satisfied with the crossing time and an increase in the numbers of pedestrians with mobility impairments who felt rushed or unsafe at the sites where the signals had been re-timed.

1 Introduction

The Mayor of London has asked Transport for London (TfL) to deliver a plan for re-timing traffic signals in order to improve vehicular traffic flow. A further requirement is that this plan should not prejudice the safety of pedestrians or the needs of other vulnerable road users (Greater London Authority, 2008).

It has been proposed that reducing the duration of the 'invitation to cross' (or green man) period, in line with national guidance (DfT, 2006), could provide improvements in vehicular capacity and throughput at certain signal controlled junctions in London. The 'blackout' clearance period following the green man would not be changed.

An experimental trial has been undertaken in order to investigate the effects of the proposed re-timing and any safety implications it may have. This has involved reducing the invitation to cross green man period at a sample of signal controlled junctions for the duration of the study and assessing the effects on accessibility, safety and the behaviour of all road users.

The short duration of the trial meant that analysis of incident or collision data was not available for evaluation for any safety implications that might have occurred because of the change. However, it was possible to undertake a conflict study as a proxy for safety. A conflict study involves observing, evaluating and recording 'near misses' between road users and, in this instance, comparing the situation before and after the re-timing. During the trial interviews with pedestrians and qualitative accompanied walks were also undertaken.

The following issues were identified as potentially being of particular interest to the investigation of the experimental trial:

- Pedestrian compliance with the signals.
- Whether or not there was any change in the numbers of pedestrians who waited in the central refuge when they had started crossing on the green man.
- The crossing times and speeds of pedestrians (for comparison with the assumed rate of 1.2m/s).
- The severities of conflict interactions, and the frequency with which they occur, at junctions before and after re-timing.
- Consideration of the possible effects on junction capacity and vehicle throughput.
- Congestion on footways and within any central refuge areas.
- Consideration of how pedestrians perceive junction accessibility and ease of use before and after the signals are re-timed.
- Investigation of the effect the re-timing had on pedestrians with a range of impairments.

This report begins by describing the research methods in section 2. The methods used involved collecting data from three sources; video filming, pedestrian interviews and accompanied walks with mobility impaired pedestrians. The results obtained from each of these data sources are presented in sections 3, 4 and 5 respectively. Section 6 discusses the findings and the conclusions are in section 7.

2 Methodology

2.1 Proposed Re-timing

The proposed re-timing involves TfL changing the guidance it uses to design signalised junctions in London. The proposed re-timing is to reduce the 'invitation to cross' (green man) period.

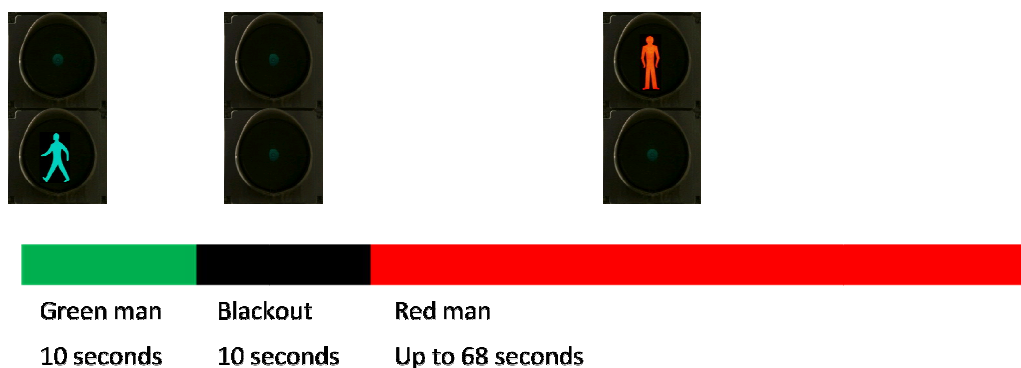
National guidance from the Department for Transport (DfT,2006) for signal timings describes a green invitation to cross period followed by a blackout or clearance period sufficient for a pedestrian to cross at 1.2 m/sec before conflicting traffic movements are released. However, there is some scope for local interpretation and variation in the application of the invitation to cross period.

Organisations which preceded TfL's Directorate of Traffic Operations (DTO) developed a London standard which, for wide roads, provided an extended invitation to cross period which was greater than the 6 seconds recommended by DfT guidance. The additional time ensures that the total invitation to cross green man period is sufficient for a typical pedestrian to walk 55% of the way across a road and beyond any central refuge.

The blackout period following the green man 'invitation to cross' period is sufficient for a pedestrian who steps off the kerb at the last moment of green man to clear the total road width (if walking at 1.2 m/sec).

The blackout period was not changed by the green man re-timing and remained the same length. The signal timings are shown indicatively below in Figure 2-1.

Existing Timings



Study Timings

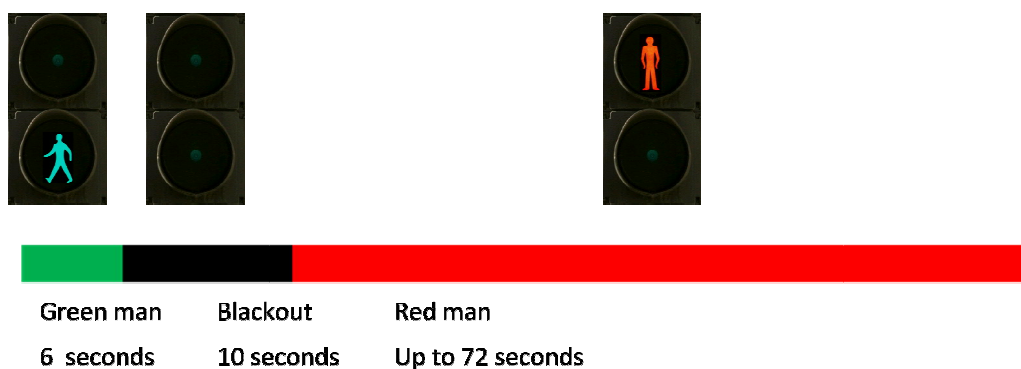


Figure 2-1 – Indicative representation of before and after trial signal timings

2.2 Study Sites

TfL selected 9 sites on their network for TRL to study that had a range of pedestrian and vehicular flows, that had an all red pedestrian phase (no vehicle movements permitted) and all had similar invitation to cross periods. These sites were inspected by TRL personnel and suitable arms for surveying were agreed.

Various details concerning the character of these sites are summarised in Table 2-1. The locations of the sites are given in Figures 2-2 to 2-10. A map showing the locations of these sites is shown in Appendix H.

Table 2-1 Study sites

Site	Traffic Flows	Pedestrian Flows	Central Refuge	Survey Arm
00/022	High	High	Yes	South
00/025	Medium	High	Yes	South-West
00/052	High	High*	Yes	East
05/066	High	High	Yes	North
08/028	Medium	High	Yes	North
09/021	High	High	Yes	North-East
10/007	High	Medium	Yes	South-West
10/013	High	Medium	No	South
10/123	High	Low*	Yes	West

*No information supplied by TfL. Assessment made by TRL during analysis of video footage.

Table 2-2 indicates the changes that were made to the pedestrian timings between the before and after studies.

Table 2-2 Pedestrian trial site signal timings, before and after

Site	Green man		Blackout	
	Before (seconds)	After (seconds)	Before (seconds)	After (seconds)
00/022	9	6	9	9
00/025	8	6	9	9
00/052	9	6	9	9
05/066	9	6	9	9
08/028	9	6	9	9
09/021	10	6	10	10
10/007	10	6	10	10
10/013	9	6	6	6
10/123	9	6	9	9

The following images are taken from the video footage at all of the study sites.



Figure 2-2 00/022 Bishopsgate – Threadneedle Street



Figure 2-3 00/025 Bishopsgate – Wormwood Street

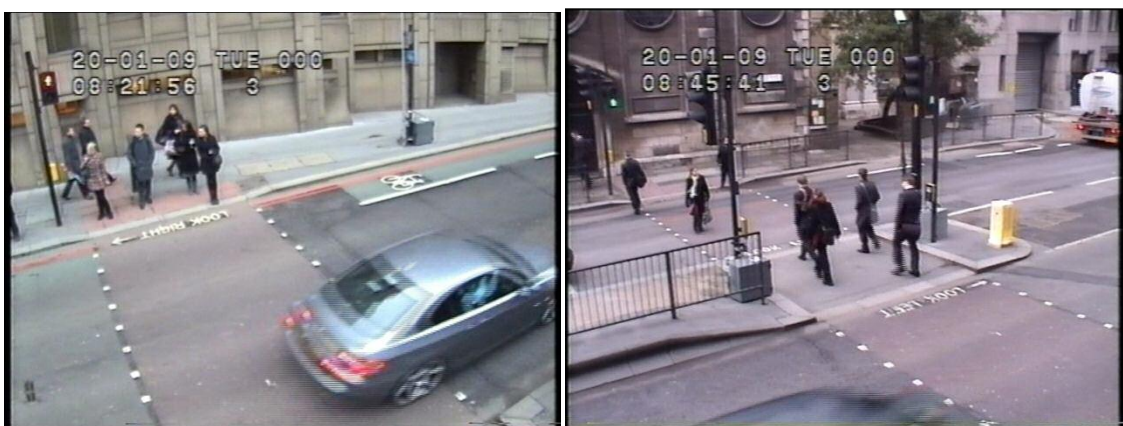


Figure 2-4 00/052 Lower Thames Street – Fish Street Hill



Figure 2-5 05/066 The Highway – Dock Street – East Smithfield



Figure 2-6 08/028 Blackfriars Road – The Cut – Union Street



Figure 2-7 09/021 Clapham Road – Stockwell Road – Binfield Road – South Lambeth Road



Figure 2-8 10/007 Balham High Road – Ritherdon Road



Figure 2-9 10/013 Battersea Park Road – York Road – Falcon Road - Battersea High street



Figure 2-10 10/123 Nine Elms Lane – Ponton Road

2.3 Data Collection

All data was obtained during before and after periods. The before period was during January 2009 and the after period was during February 2009 and followed the re-timing of the signals. Once the after data had been collected the signal timings were changed back to their original settings. In addition to studying the effect of the re-timed invitation to cross period from video data, a questionnaire survey was undertaken and qualitative data were collected.

Video footage was obtained for four hours during the morning peak at each site before and after the signal timings had been changed.

Two cameras were mounted at each site and these were located at a minimum height of about 3-4 metres on existing street furniture or on free-standing poles so as to provide an optimal view of the crossing. One camera was on each side of the carriageway with both cameras directed transversely across the road at the pedestrian crossing point (see Figure 2-11).



Figure 2-11 – Camera mounted on free-standing pole

The recordings therefore captured pedestrian behaviour whilst waiting to cross and whilst crossing the road. Vehicular traffic was captured whilst in the immediate vicinity of the crossing location such that flows and conflicts could be considered.

The pedestrian interviews were conducted at the same junctions before and after the signal timings had been changed. The accompanied walks involved vulnerable pedestrians or pedestrians with special mobility needs being accompanied whilst crossing at a sample of re-timed junctions. They were subsequently interviewed about their experience.

2.4 Data Analysis

In designing the study to investigate the re-timed green man period three approaches were used.

- Pedestrian Observations
- Pedestrian Interviews
- Accompanied Pedestrian Walks

2.4.1 Pedestrian Observations

2.4.1.1 Objectives

Pedestrian behaviour was observed and analysed to investigate the number of pedestrians using the crossing and their behaviour in relation to other road users during the different traffic signal phases. Surveys were undertaken during the before and after periods to record any changes in behaviour.

2.4.1.2 Pedestrian compliance with traffic signals

Samples of video footage were reviewed to establish numbers and rates of non compliance at the crossing itself. That is, the numbers and rates of pedestrians who started to cross outside the invitation to cross (green man) period (i.e. either during the blackout or whilst the red man was displayed).

This allows non compliance rates before the re-timing to be compared to those after the re-timing. The survey also included a count of the number of pedestrians who began a crossing manoeuvre during each of the three possible pedestrian signal conditions (red, green or blackout).

This provides a method for considering the number of observed conflicts in context of risk exposure. That is, for any crossing condition, it should be possible to consider the rate of conflicts per crossing undertaken.

2.4.1.3 Pedestrians crossing times and speeds

This assessment was to check the reliability of the assumed crossing speed (1.2m/s) which equates in imperial terms to about 4ft/second. If the rationale behind the setting of green times and blackout times is based on an assumed walking speed faster or slower than actual crossing speeds then it is possible that observed behaviour might not be related to the amount of the road which it is assumed can be crossed during each phase. It was also of interest to know whether or not crossing speeds vary between sites because this could explain, in full or in part, any observed differences in pedestrian behaviour between different sites.

Accurate measurements of crossing times and, also, the widths of the roads was necessary in order to calculate accurate crossing speeds; road width information was obtained from TfL. Crossing widths were measured straight across the road in the middle of the crossing studs. For this investigation, it was sufficient to consider a sample of pedestrians and so pedestrians were observed during one crossing every hour (a maximum of five pedestrians during each crossing which was reviewed). This provided up to twenty pedestrians per site during the before and after periods and this was sufficient to obtain an overall average speed and to indicate whether crossing speeds differ from site to site (in order to consider the suitability of the assumed 1.2m/s rate).

2.4.1.4 Pedestrians waiting in the central refuge

The survey counted the number of times the pedestrian stage actually ran during the sample time, how many pedestrians began a crossing manoeuvre during each of the three possible pedestrian signal conditions (red man, green man or blackout) and how many pedestrians who start under each of these conditions take refuge in the centre and therefore has to wait for a second pedestrian phase to complete their crossing.

Congestion on footways and within any central refuge was of particular interest and consideration was given to whether either waiting area was so busy that some pedestrians were unable to start crossing the road until after the invitation period had expired. Congestion of the central refuge was also of interest in case pedestrians

stopping in the middle of the crossing were forced to wait in the carriageway because the refuge was full.

The survey form included in Appendix A was used to record whether such congestion occurred during the 15 minute sample observation undertaken for each hour of video footage.

The incidence of pedestrians turning back mid-crossing is considered in the conflict study part of this report.

As with some other aspects of this project, this particular assessment clearly involves an element of subjective judgement. However, because the purpose of the assessment was to compare the situation before and after a change to the signal timing, this subjectivity was acceptable provided that it was both expert and consistent. Therefore, the same researcher was used to review conditions before and after.

2.4.2 Conflict Analysis

2.4.2.1 Objectives

A conflict analysis was carried out to investigate whether there was any effect on safety after the junctions had been re-timed.

2.4.2.2 Conflict Analysis

A conflict study involves the observing, evaluating and recording of 'near misses' and, in this instance, comparing the situation before and after the re-timing.

Where collision numbers are low or not yet available, this form of study can lead to insights from which risk events can be better understood. This, of course, assumes that the set of interactions that are categorised as encounters or conflicts are similar in nature to the smaller number of more severe collisions.

As such, a conflict study formed a proxy for collision and incident data in this trial and provides an indication of safety risk implications which might have been associated with the signal re-timing.

Conflict studies can be undertaken by making, and recording, observations from the roadside. However, for the purposes of this investigation conflict analysis was undertaken by observing interactions between pedestrians and vehicular traffic as recorded on video before and after changes were made to the signal timings.

One definition of a conflict (from Ross Silcock 1998) is: two traffic participants maintain such a course and speed that a sudden evasive manoeuvre of one of the two participants is required to avoid a collision. Walker *et al* (2005) used a conflict definition similar to this and split interactions between pedestrians and vehicles into three increasingly severe categories: encounters, conflicts and collisions.

It was anticipated that relatively few serious conflicts were likely to be observed at the sites being studied as they are rare events and that it would therefore be necessary to consider less severe types of interactions between pedestrians and vehicular traffic.

In Walker *et al* (2005) the frequency of encounters and conflicts from the Ross Silcock research was quoted. From a total of 32,000 pedestrians observed 5% were involved in an encounter and 0.3% were involved in a conflict. Similar figures were obtained during this study.

2.4.2.3 Conflict types

The most likely form of a conflict or encounter at signalised junctions is between a pedestrian and a vehicle. It is also possible for pedestrians to be in conflict with other

pedestrians or for vehicles to be in conflict with other vehicles. The sheet used for recording conflicts during this study is included as Appendix B of this report.

A conflict or encounter usually involves a pedestrian and a specific vehicle. However, a conflict could equally involve a pedestrian generally taking evasive action from vehicular traffic. In some instances, the vehicle or vehicles involved were beyond the field of view of camera and could not be identified.

Evasive behaviour could, for example, take the form of pedestrians abandoning crossings and stopping in the central refuge, or retreating to the central refuge or returning to the kerb, or pedestrians seeking refuge on hatching or other unsuitable areas.

These types of evasive action were considered as forms of conflict and the situation was assessed by comparison of before and after conflict rates and conflict severities. Risk exposure is also an important consideration.

2.4.2.4 *Conflict severities and rates*

In order to make comparisons between sites it is necessary to consider the severities of conflicts which might occur at any site and also the rate of risk exposure. Consequently, conflicts were assessed and categorised according to severity and information about pedestrian and vehicular flow rates was gathered so that conflict rates could be calculated.

2.4.2.5 *Conflict definitions*

For the purposes of this study, following Walker *et al* (2005), five classifications of conflict were used as follows:

1. **Encounter, Precautionary action**
(e.g. Pedestrian stopping in carriageway to allow vehicle to pass)
2. **Controlled action**
(e.g. Pedestrian deviates from route or vehicle undertakes controlled braking)
3. **Near miss**
(e.g. Rapid deceleration, lane change or stopping)
4. **Very near miss**
(e.g. Emergency braking or violent swerve)
5. **Collision**
(e.g. Contact between two parties)

Illustrated examples of the encounters and conflicts observed in the study can be seen in sections 2.4.2.6 to 2.4.2.9.

The assessment of conflicts clearly involves an element of subjective judgement. However, because the purpose of the assessment was to compare the situations at different junctions before and after a change to the signal timing, this subjectivity was acceptable provided that it was both expert and consistent. Therefore, the same researcher was used to undertake all of the conflict study reviews.

The following screenshots from video footage show examples of conflicts graded 1 to 4. There were no conflicts graded as a 5 (a collision) in the video data collected. All the examples shown here have been chosen from the same site for consistency.

2.4.2.6 Conflict grade 1

Encounter, Precautionary action

(e.g. Pedestrian stopping in carriageway to allow vehicle to pass)

The example in Figure 2-12 was taken from site 00/025 Bishopsgate by Wormwood Street junction. It represents the type of incident that was categorised as being a conflict grade 1. In this example the pedestrian was crossing the carriageway whilst the pedestrian signals were indicating a red man. They modified their pace to allow the motorcyclist to pass behind them and the cyclist to cross in front of them.



Figure 2-12 Conflict grade 1

2.4.2.7 Conflict grade 2

Controlled action

(e.g. Pedestrian deviates from route or vehicle undertakes controlled braking)

Figure 2-13 represents an incident which has been categorised as being a conflict grade 2. In this example the pedestrian uses controlled action to speed up and avoid being in the path of the approaching motorcyclist. The video footage does not suggest that the motorcyclist needed to change his path or speed as a result of the pedestrian's presence.



Figure 2-13 Conflict grade 2

2.4.2.8 Conflict grade 3

Near miss

(e.g. Rapid deceleration, lane change or stopping)

An example of a conflict graded as a 3 under this study, can be seen in Figure 2-14. It shows many pedestrians crossing the carriageway under red man conditions. As the taxi approaches from Wormwood Street heading South onto Bishopsgate, the pedestrian rapidly changes his path and his speed to avoid the conflict. Additionally the taxi slowed.



Figure 2-14 Conflict grade 3

2.4.2.9 Conflict grade 4

Very near miss

(e.g. Emergency braking or violent swerve)

Figure 2-15 is a screenshot from the video footage that shows a conflict graded 4 under this study. It shows the cyclist travelling north on the southbound carriageway to avoid the queued traffic. The pedestrians have crossed the road under a red man period and have waited on the central refuge. Having checked for traffic on their left, they have proceeded to cross. The conflict shows a very near miss between them and the cyclist, a collision is only avoided because one of the pedestrians stops abruptly to avoid the cyclist.



Figure 2-15 Conflict grade 4

2.4.3 Network Operation

2.4.3.1 Objectives

A key question was to consider what, if any, effects the junction re-timing has on capacity and vehicle throughput.

2.4.3.2 Vehicular Aspects of Network Operation

Vehicle behaviour was observed as part of this study, but in lesser detail than pedestrian behaviour and with the focus being on junction throughput.

Consideration of aspects of vehicular flow such as capacity, delay, queuing, displacement, etc would not be possible from video footage alone. Nevertheless, data on throughput (in terms of number of vehicles per cycle or time period) could be obtained from the footage.

A comparison of before and after vehicular flows was also relevant to this study because it provides a measure of risk exposure. That is, it provides a context in which the frequency of conflicts (or other observed events) can be considered.

Nevertheless, it should be noted that the inevitable day-to-day variability of traffic flows means that considerable caution should be exercised when comparing the traffic flows observed during 15 minute long survey samples taken during the 4-hour before periods and the 4-hour after periods.

The survey form included in Appendix A was used to record details of total 2-way traffic flows for 15 minute survey samples for each hour of video footage.

2.4.3.3 Pedestrian Aspects of Network Operation

The length of the overall cycle time (i.e. the time taken for the signals to go through each stage) was not changed. However, depending on network performance pedestrians would generally have the red man shown to them for a longer period of time in the after period of the study.

Congestion on footways and within any central refuges was of particular interest and consideration was given to whether either waiting area was so busy that some pedestrians were unable to start to cross the road until the invitation period had expired.

The objectives of the study were therefore dealt with by considering whether the footway was congested and, in particular, whether any footway congestion was so severe that it resulted in pedestrians being unable to reach the carriageway during the invitation to cross period. Similarly, consideration was given as to whether the central refuge area became congested.

The survey form included in Appendix A records whether such congestion occurred during the 15 minute sample observation undertaken for each hour of video footage.

2.4.4 Pedestrian interviews

2.4.4.1 Objectives

Pedestrian interviews were carried out by interviewers in order to gauge pedestrians' perception of the crossing, their satisfaction with crossing time, their feeling of safety whilst crossing, their understanding of the blackout period and if they had noticed any changes to the junction recently.

2.4.4.2 Sample and sampling

For robust results, a total of at least 60 interviews were required at each site, in both the before and after surveys. To achieve a range of demographics, two shifts were conducted at each site, in each survey:

- 07:00 – 13:00 weekday;
- 13:00 – 19:00 weekday.

These different shifts covered different times of the day and week in order to include a mixture of commuters and leisure pedestrians.

Within these times random sampling was employed to sample pedestrians. The following minimum quotas were imposed at each site, and quota sampling was employed to fulfil the quotas if necessary.

- 40% male
- 40% female
- 20% under 25 years
- 30% 25 to 59 years
- 30% 60+ years
- 40% commuters
- 40% leisure
- 15% vulnerable (e.g. sight or mobility impaired)

All interviews were conducted in accordance with the Code of Conduct of the Market Research Society. Respondents were told the nature of the research, the name of the client and the expected duration of the interview before the interview took place and were assured of their confidentiality. The before and after interviews were carried out on the same day of the week, and at the same time of the day for each of the survey sites. The interviews were undertaken once the pedestrian had used the crossing facility.

2.4.4.3 Procedure

The questionnaire (see Appendix F) was specifically designed for the purpose of assessing pedestrians' views of the crossing and changes made during the study. It was designed to take no more than five minutes and consisted of mostly closed questions where the pedestrian was given a five-scale list of possible answers: strongly agree to strongly disagree or very safe to very unsafe, for example.

Out on site, the questionnaire was completed on a PDA. The interviewers read the questions to the pedestrians, giving them all the possible answers and filled in their responses. There are a number of benefits to using PDAs for completing questionnaires out on the street, including automatic routing and the removal of transcription errors.

Each day the questionnaire responses were downloaded to a central database, and at the end of the surveys these data were analysed in SPSS. Initial analysis was completed to check whether quotas had been reached at each site. Following this, cross tabulations were made of responses at each site before and after the changes to pedestrian timings. The distributions of these responses are shown in Section 4.

For questions that were directly related to the crossing time, chi-squared tests were carried out to observe if the distribution of responses before the changes were different in the after survey compared to the before (original timing) survey. The results from the chi-squared tests are presented at the bottom of the relevant tables as follows:

- $p > 0.10$: not significantly different, i.e. it was not possible to state that pedestrians views had changed due to the crossing re-phasing;
- $p < 0.10$: borderline significantly different, i.e. there was some evidence to suggest that pedestrians views may have changed between the before and after periods;
- $p < 0.05$: significantly different (at 95% level), i.e. there was a change in the responses made by pedestrians after the changes compared to before;
- $p < 0.01$: highly significantly different (at 99% level) i.e. there was a large change in the responses made by pedestrians after the changes compared to before;

In addition, the responses made by impaired people were analysed separately, and similar tests were carried out on these data, where the numbers were not too small.

2.4.5 Accompanied Walks

2.4.5.1 Objectives

The objective for the qualitative data gathered during the Accompanied Walks was to complement the quantitative data obtained from the Pedestrian Interviews. Also, any particular issues faced by pedestrians with special needs, in particular due to mobility but also sensory impairment would be highlighted.

2.4.5.2 Sample and Recruitment

A total of nine accompanied walks were conducted. All participants were paid £25 for their participation and travel expenses were reimbursed. Participants with special mobility needs or other relevant impairments were recruited from disability organisations and societies. The organisations and societies were asked to find volunteers and obtain permission from them to pass on their contact details to TRL. A requirement of taking part was the ability of the participant to move independently in the street environment. Prospective participants were contacted by TRL researchers and a description of the research was given with an opportunity for them to ask questions. Their eligibility was confirmed and a date and time for the accompanied walk arranged. A letter or email of confirmation was sent to participants at this stage. The characteristics of the nine participants are summarised in Table 2-3.

Table 2-3 Characteristics of participants

Participant	Age (estimated)	Gender	Disability/condition	Affect on daily life ¹
1	Over 60	Female	Vision impairment	10
2	Over 60	Female	Vision impairment	8
3	40-59	Male	Mobility impairment	10
4	Over 60	Male	Mobility impairment	5 or 6
5	40-59	Female	Mobility impairment	2 or 3
6	20-39	Female	Vision impairment	7
7	Over 60	Female	Vision and hearing impairment	3 or 4
8	40-59	Male	Mobility impairment	8
9	40-59	Male	Hearing impairment and learning disability	10

¹ On a scale of 1-10 where 1 is only make journey when essential and 10 not restricted.

2.4.5.3 Procedure

Two researchers, experienced in conducting qualitative research, accompanied participants on the walks. The researchers wore high-visibility waistcoats for reasons of safety and identification. The route included four signal controlled junction arms consisting of two experimental crossings where the timings had changed and one control junction on which two arms were used.

The four junction arms are shown in Table 2-4:

Table 2-4 Crossings used in Accompanied Walks

Crossing	Site	Junction	Junction Arm
Test 1	00/025	Bishopsgate, Wormwood Street	South
Test 2	00/022	Bishopsgate, Threadneedle Street	South
Control 1	00/024	Old Broad Street, Wormwood Street	East
Control 2	00/024	Old Broad Street, Wormwood Street	West

Photographs of each of the crossings used in the guided walks can be seen below in Figure 2-16, Figure 2-17, Figure 2-18, and Figure 2-19.



Figure 2-16 Crossing Test 1: west-east view of the southern arm



Figure 2-17 Crossing Test 2: east-west view of the southern arm



Figure 2-18 Crossing control 1: south-north view of eastern arm



Figure 2-19 Crossing control 2: north-south view of western arm

Each accompanied walk participant was guided around all four junction arms, with half of the participants guided in a clockwise route and the other half in an anticlockwise route in order to counter-balance the order to reduce bias due to an order effect. This also ensured that half of the participants crossed from one direction on the same crossing while the other half crossed in the opposite direction. The routes participants were taken on can be seen in Appendix D.

Each walk and interview took up to two hours and took place either between 10am-12noon or between 1.30-3.30pm during a weekday in February 2009. Permission was sought from the participant by the researcher to record observations of the walk and all questions and answers with a digital voice recorder. Before the walk, the participants were asked about their experience with signal controlled crossings in London and to describe the challenges they face and how they feel accessing the street environment. Participants were then guided to each junction arm in turn, and asked to cross the road in the way that they normally would, then wait away from the road on the other side. The researcher observed the crossing behaviour and verbally recorded observations on the voice recorder. The researcher then crossed the road and asked the participant about their experience of the crossing to obtain their immediate impressions of that particular crossing. They then continued to the next crossing and were asked to cross as before. At the end of the route, the researcher asked the participant in more detail about their experiences with each crossing, paying particular attention to their feelings of confidence and safety during the different phases of the signals. The topic guide in Appendix C shows the questions and answers covered during the guided walks and the procedure followed by the researchers.

3 Results - Pedestrian Behaviour, Conflict Studies and Network Operation

3.1 Pedestrian Behaviour

The following sections detail the results of the pedestrian behaviour analysis at each of the study sites before and after the change in signal timings. This includes results for the following topics; compliance with pedestrian signals, crossing times and speed, pedestrians using the central refuge, the number of pedestrians crossing in the invitation periods and conflict analysis.

3.1.1 Compliance with pedestrian signals

For the purposes of this study, pedestrians are considered to comply with the pedestrian signals when they start to cross on a green man and when they do not start to cross during the blackout period or if a red man is displayed.

The table below shows the numbers of pedestrians who started to cross in the red man, green man and blackout periods of the pedestrian signals. These figures were taken from a 15 minute sample for each hour of the study, both before and after. Table 3-1 shows the cumulative totals from all sites, representative of the whole four hour study periods. Over the course of the study 72 hours of video were studied. In this period a total of 26,431 pedestrians crossed the junctions, 49% against the red man and 42% on the green man.

Table 3-1 Compliance with pedestrian signals

Site	Red Man			Green Man			Blackout		
	Before	After	% change	Before	After	% change	Before	After	% change
00/022	560	548	-2.1%	388	204	-47.4%	116	72	-37.5%
00/025	1,932	2,148	11.2%	640	500	-21.9%	192	240	25.0%
00/052	408	596	46.1%	920	844	-8.3%	84	100	19.0%
05/066	148	128	-13.5%	48	36	-25.0%	36	20	-44.4%
08/028	2,480	2,724	9.8%	3,460	3,316	-4.2%	660	700	6.1%
09/021	372	528	41.9%	288	168	-41.7%	120	148	23.3%
10/007	32	64	100.0%	20	24	20.0%	0	4	-
10/013	100	112	12.0%	80	68	-15.0%	4	12	200.0%
10/123	7	27	285.7%	0	5	-	0	0	-
All sites	6,039	6,875	13.8%	5,844	5,165	-11.6%	1,212	1,296	6.9%

- There is a similar total number of pedestrians for the before and after periods (13,095 before and 13,336 after);
- The number of pedestrians crossing on a red man increased by 13.8% (836). This was a statistically significant increase ($p < 0.01$);
- The number crossing on a green man decreased by 11.6% (679). This was a statistically significant decrease ($p < 0.01$);

- The number crossing during the blackout period increased by 6.9% (84). This was a statistically significant increase ($p < 0.01$).

Clearly, rates of pedestrian compliance with the signals deteriorated.

Figure 3-1 and Figure 3-2 show the variation between the before and after studies. In the first study, when the pedestrian invitation period was set at its original level the proportion of pedestrians that crossed under red man and green man periods was roughly equal. In the second study however, the results show that the numbers of pedestrians obeying the signals and waiting for the invitation period before crossing has reduced in comparison to those crossing under the red man period. In both the before and after study the proportion of pedestrians crossing under the blackout period was similar.

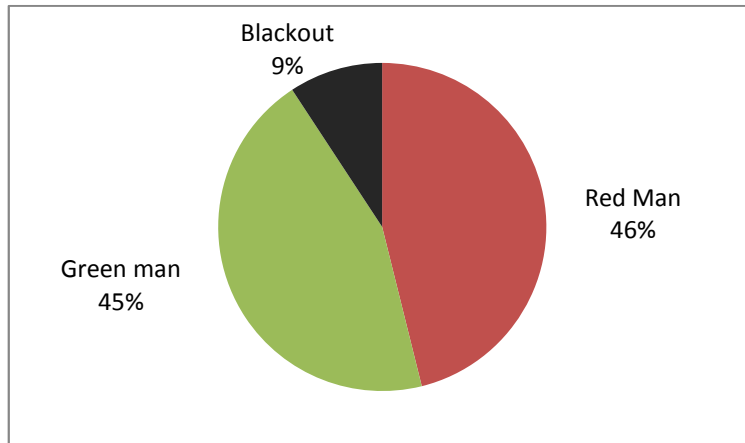


Figure 3-1 Compliance with pedestrian signals, Before period

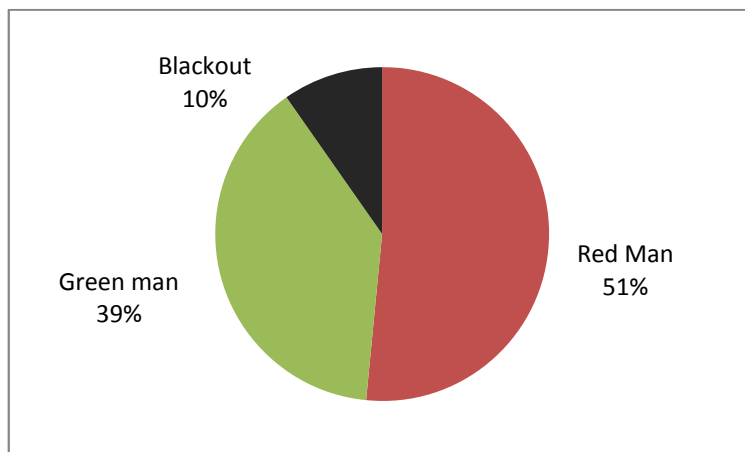


Figure 3-2 Compliance with pedestrian signals, After period

Table 3-2 shows the timings used in the before and after studies represented as a percentage of the cycle time. Overall the time a red man was displayed to pedestrians increased from 79% of the total cycle time to 83%.

Table 3-2 Before and after timings as a percentage of the cycle time

Site	Green Man				Blackout				Red Man			
	Before		After		Before		After		Before		After	
	(s)	%	(s)	%	(s)	%	(s)	%	(s)	%	(s)	%
00/022	9	11%	6	8%	9	11%	9	11%	62	78%	65	81%
00/025	8	9%	6	7%	8	9%	8	9%	72	82%	74	84%
00/052	9	10%	6	6%	9	10%	9	9%	70	80%	89	86%
05/066	9	10%	6	7%	9	10%	9	10%	70	80%	73	83%
08/028	9	9%	6	6%	9	9%	9	9%	78	81%	81	84%
09/021	12	15%	6	8%	10	13%	10	13%	58	73%	64	80%
10/007	10	13%	6	8%	10	13%	10	13%	60	75%	64	80%
10/013	9	9%	6	6%	6	6%	6	6%	81	84%	84	88%
10/123	9	11%	6	8%	9	11%	9	11%	62	78%	65	81%
all sites	9	11%	6	7%	8.8	10%	8.8	10%	67.9	79%	71.3	83%

3.1.2 Crossing times and speeds

Crossing times and speeds were investigated to give a comparison against the assumed rate of pedestrians crossing that is used for the calculation of blackout timings.

Additionally the data has been collected to provide a comparison between the crossing speeds of pedestrians before and after the timing change was made.

Table 3-3 below shows the average crossing times of pedestrians recorded from the video footage. For this data collection, only pedestrians crossing under the green man period were timed. It was anticipated that those crossing when they did not have right of way would be more likely to hurry their crossing.

Table 3-3 Crossing times and speeds

Site	Road width of crossing (m)	Average crossing time (s)		Average Crossing speed (m/s)	
		Before	After	Before	After
		00/022	16.3	11.4	10.6
00/025	16.5	10.5	10.7	1.57	1.54
00/052	18.5	10.8	12.1	1.71	1.53
05/066	13.4	10.6	9.8	1.26	1.37
08/028	17.5	13.1	10.5	1.34	1.67
09/021	12.5	11.9	11.5	1.05	1.09
10/007	20.3	11.6	13.5	1.75	1.50
10/013	12.0	7.6	9.0	1.58	1.33

Site number 10/123, Nine Elms Lane – Ponton Road was not included in this data collection as the numbers of pedestrians crossing at that site under green man conditions were too few to obtain a reliable average time.

The 15th Percentile crossing speeds for the before and after periods are as follows:

Before 1.14 m/s

After 1.32 m/s

A significant increase in the 15th percentile speed was observed ($p < 0.05$).

The average crossing speeds for the before and after periods are as follows:

Before 1.46 m/s

After 1.45 m/s

No significant difference was detected between the before and after mean crossing speeds ($p > 0.10$).

The 85th Percentile crossing speeds for the before and after periods are as follows:

Before 1.79 m/s

After 1.73 m/s

No significant difference was detected between the before and after 85th percentile crossing speeds ($p > 0.10$).

The sample size used for the pedestrian crossing times and speeds investigation varied slightly between before and after studies. In the before study there were 111 recorded crossing speeds. In the after study, however, there were 104. The 15th percentile speeds indicate that the crossing speeds for slower pedestrians or pedestrians with mobility impairments approximates to the assumed crossing speed.

The carriageway widths used for calculating the walking speeds were supplied by TfL.

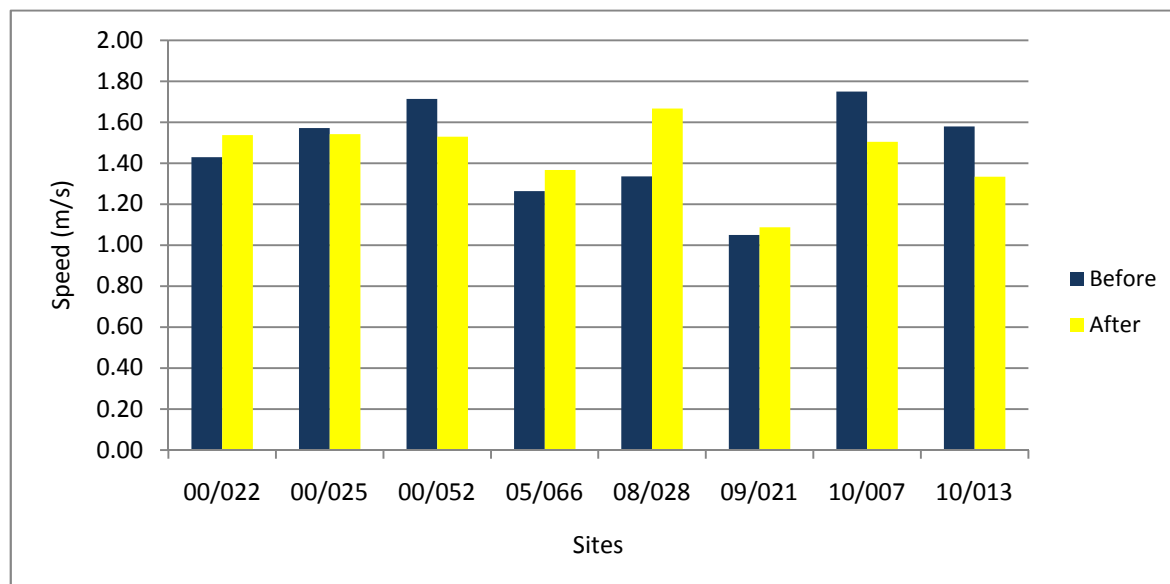


Figure 3-3 Average crossing speeds

Figure 3-3 shows that the average pedestrian crossing speed varied somewhat from site to site. There was a range in raw figures of 0.91 to 3.13 m/s in the before study and 0.93 to 2.51 m/s in the after study. It should be noted that the frequency of pedestrians crossing at the slowest speeds was extremely small. Figure 3-4 shows the distribution of the crossing speeds observed at all sample sites.

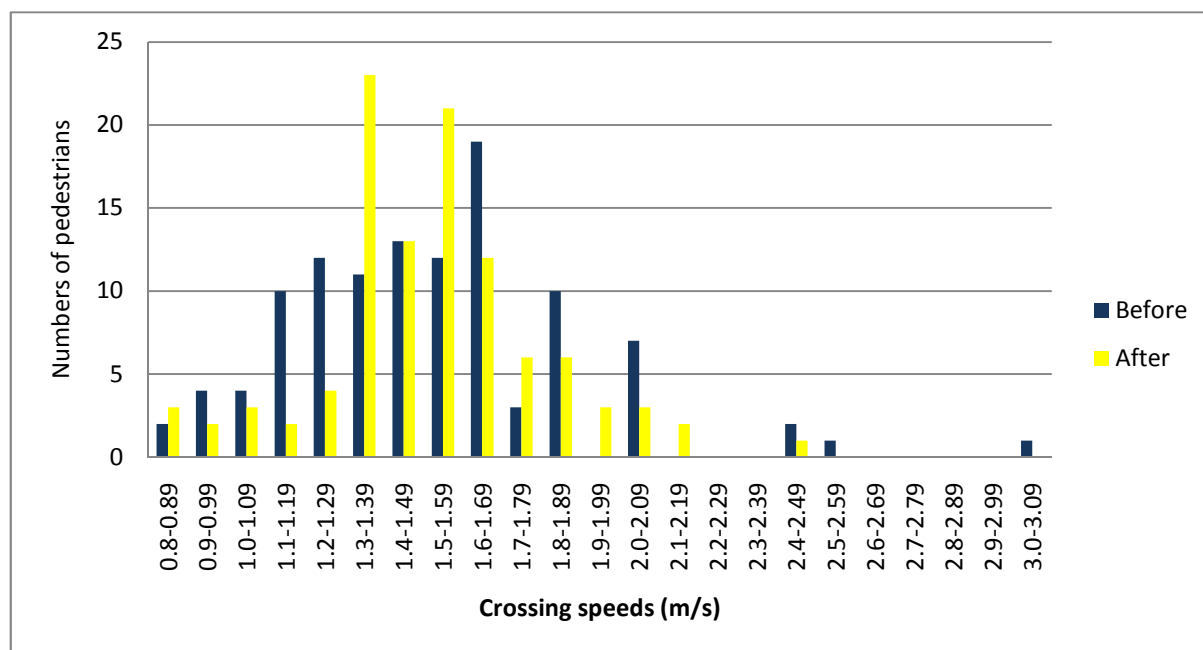


Figure 3-4 Distribution of crossing speeds at all sites

The overall average speed, and the average speeds at individual sites, did not change significantly and was generally well in excess of the assumed crossing speed of 1.2m/s. This indicates that slower pedestrians or pedestrians with mobility impairments should be effectively provided for by the assumed crossing speed.

3.1.3 Pedestrians using central refuge

The data presented in Table 3-4 considers pedestrians who stopped in the central refuge (where applicable). Specifically, the period of the pedestrian signals cycle in which individuals started to make their crossing movement was noted.

Table 3-4 Usage of central refuge

Site	Red Man			Green Man			Blackout		
	Before	After	% change	Before	After	% change	Before	After	% change
00/022	180	188	4.4%	0	12	-	0	8	-
00/025	820	788	-3.9%	28	8	-71.4%	4	4	0
00/052	196	368	87.8%	0	0	-	0	4	-
05/066	48	12	-75.0%	0	0	-	0	0	-
08/028	1,084	1,260	16.2%	16	92	475.0%	40	8	-80%
09/021	196	236	20.4%	4	0	-100.0%	4	20	400%
10/007	4	24	500.0%	0	0	-	0	0	-
10/123	3	10	233.3%	0	0	-	0	0	-
All sites	2,531	2,886	14.0%	48	112	133.0%	48	44	-8.3%

Figure 3-5, shows a cumulative number for all sites for both the before and after studies.

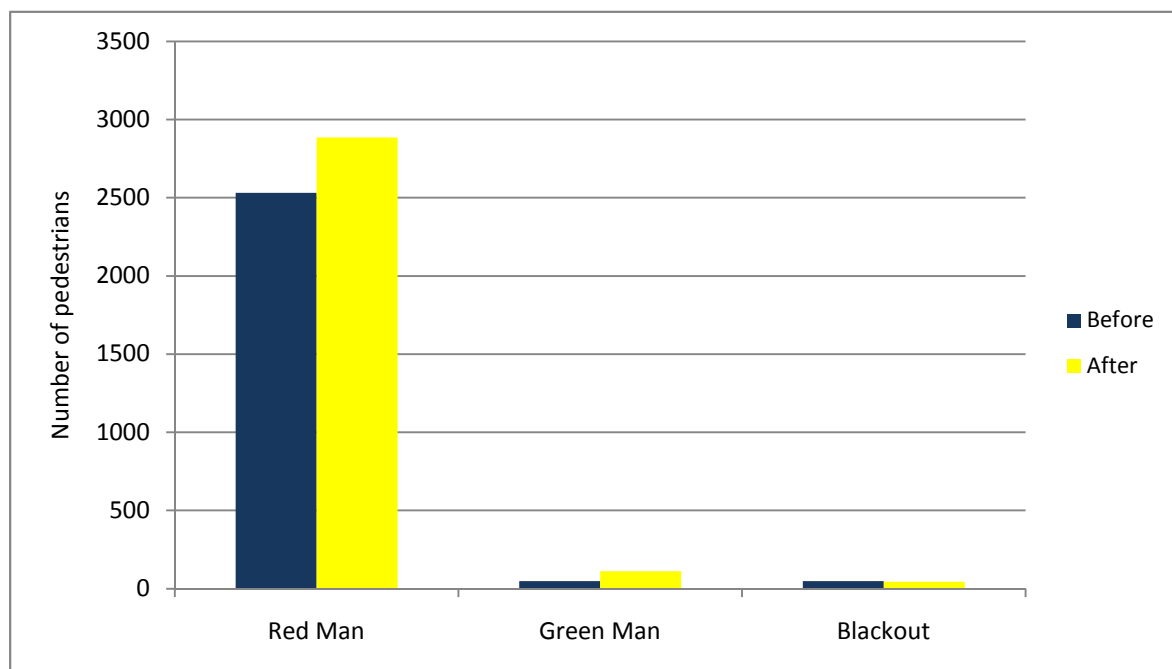


Figure 3-5 Pedestrians stopping in the central refuge, after starting to cross in the red man, green man and blackout periods

Table 3-4 and Figure 3-5 show that there was an overall increase of 15.8% in the number of pedestrians who stopped in the central refuge (3,042 compared to 2,627).

The overall number of pedestrians increased by 1.8% (from 13,095 pedestrians during the before period compared to 13,336 in the after period). As such, the increase in pedestrians stopping in the central refuge (15.8%) cannot be attributed to the relatively small increase in overall pedestrian traffic (1.8%).

Most pedestrians using the central refuge (more than 95%) began to cross when a red man was displayed.

The changes in the proportion of pedestrians seeking refuge who started to cross on green man, red man and during the blackout period are therefore of interest.

- There was an increase of 14.0% in the numbers who began to cross on a red man and stopped in the central refuge.

This compares to an increase in the total number of pedestrians crossing on a red man of 13.8%.

There was a statistically significant increase ($p < 0.01$) in the proportion of pedestrians who started crossing on red in the after period compared to the before period.

- There was an increase of 133% in the numbers who began to cross on a green man and stopped in the central refuge (albeit from a relatively small base figure).

This compares to a decrease in the total number of pedestrians crossing on a green man of 11.6%.

There was a statistically significant increase ($p < 0.01$) in the proportion of pedestrians who started crossing on green in the after period compared to the before period.

- There was a decrease of 8.3% in the numbers who began to cross during the blackout and stopped in the central refuge (again, from a relatively small base figure).

This compares to a decrease in the total number of pedestrians crossing during the blackout of 6.9%.

The proportion of pedestrians who started crossing on green in the before period was not statistically significantly different ($p > 0.10$) when compared to the after period.

The above suggests that the increase in pedestrians crossing on the red man who stop in the central refuge is a consequence of an increase in the incidence of pedestrians crossing on the red man. A similar pattern is observed for pedestrians who start to cross during the blackout period.

However, there was a substantial increase in the numbers of pedestrians crossing on the green man who stop in the refuge and this is despite a decrease in the incidence of pedestrians crossing on the green man.

3.1.4 Numbers of pedestrians crossing in the invitation period

The variation in the numbers of pedestrians and how many times pedestrian stages ran on a site by site basis was studied to consider crowding at individual sites and to help put conflicts and behaviour figures in context. Naturally sites which have a high pedestrian usage are likely to show a greater total of conflicts. Likewise sites with longer cycle times (where pedestrians are required to wait longer to be given right of way) will have fewer pedestrian stages per unit of time and could encourage pedestrians to become impatient and cross during the red man period.

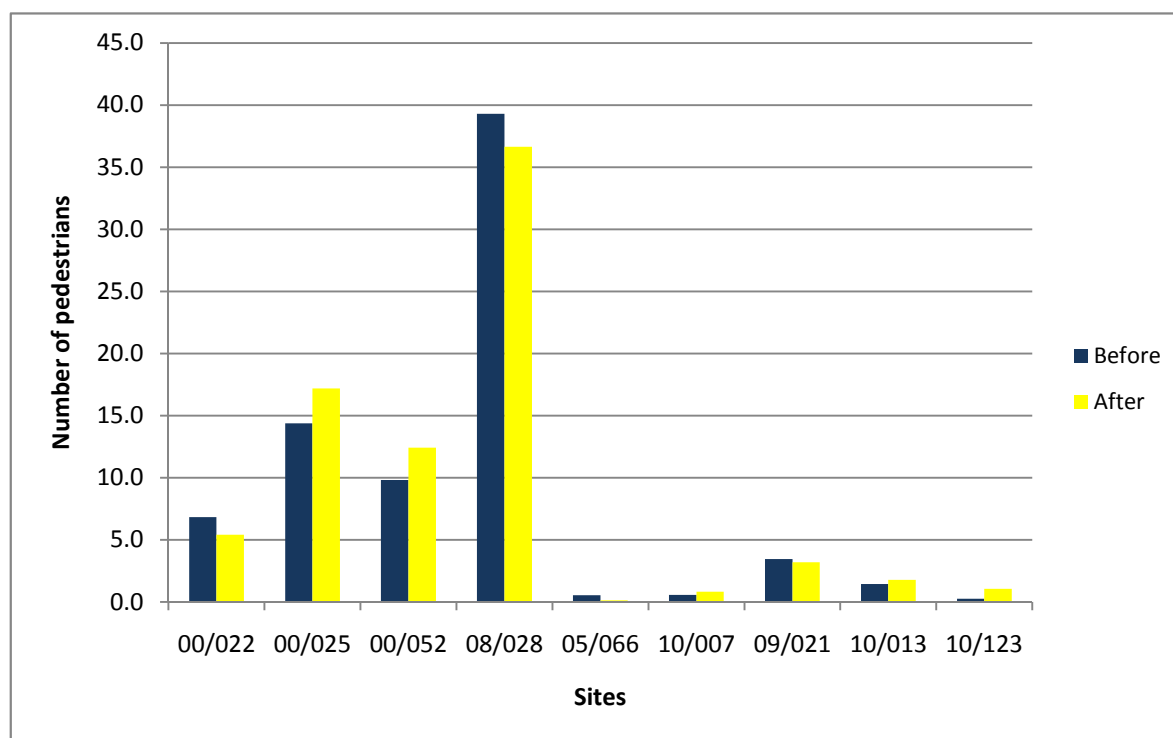


Figure 3-6 Number of pedestrians crossing on each green man period

Figure 3-6 shows that by plotting the average numbers of pedestrians crossing per green man invitation period for both the before and after study, it can be seen that this rate has not fluctuated much between the two studies. It is also clear that some of the study sites were considerably busier than others.

3.2 Conflict Analysis

The following section discusses the findings from the conflict analysis of video data recorded in the before and after study periods. Observations and grading of conflicts and encounters were made by one researcher to regulate the subjective nature of conflict analysis.

3.2.1 Total numbers of conflicts

Figure 3-7 shows the total numbers of conflicts that were observed in the before and the after studies. It shows that reducing the pedestrian invitation period was not associated with the total numbers of conflicts changing very much. The before study observed a total of 813 conflicts whereas the after study recorded 810 conflicts.

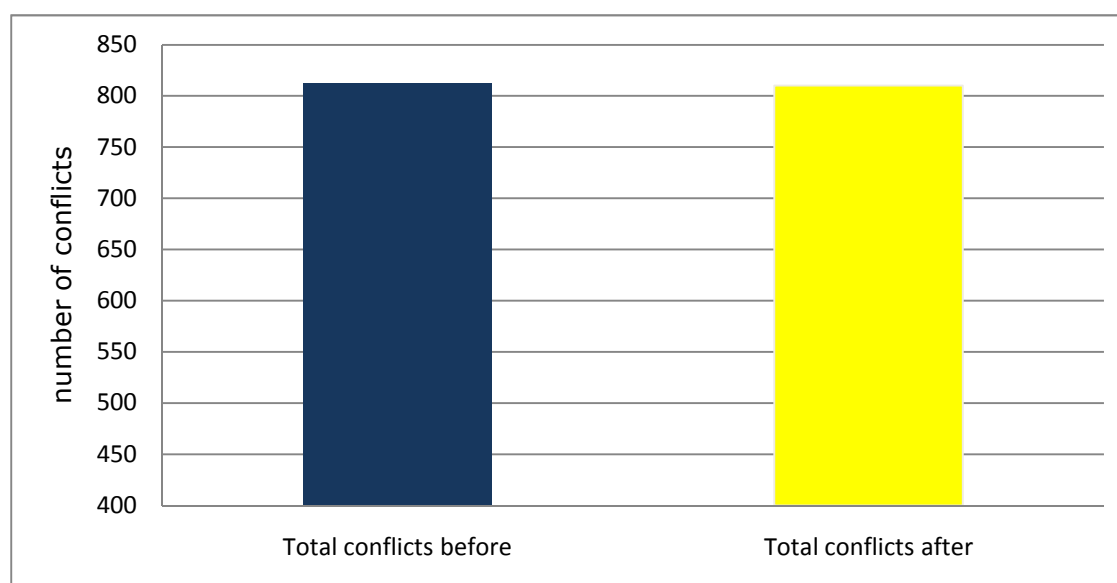


Figure 3-7 Total number of conflicts, all sites

Table 3-5 All conflict grades, before and after, by site.

Site	Conflicts grade 1		Conflicts grade 2		Conflicts grade 3		Conflicts grade 4	
	Before	After	Before	After	Before	After	Before	After
00/022	70	67	6	6	2	0	2	2
00/025	264	234	13	28	6	4	2	0
00/052	83	83	5	10	2	1	1	0
05/066	209	205	14	17	3	4	3	2
08/028	11	18	3	4	2	2	0	0
09/021	15	17	0	1	0	1	0	0
10/007	49	56	10	10	0	1	0	0
10/013	29	26	0	2	0	0	0	1
10/123	9	8	0	0	0	0	0	0

3.2.2 Variation in conflict severity

Figure 3-8 shows the proportion of each grade of conflict for all sites, in both the before study and the after. As would be expected, there were more minor conflicts than serious ones. There were no conflicts graded as a 5 (collisions) recorded.

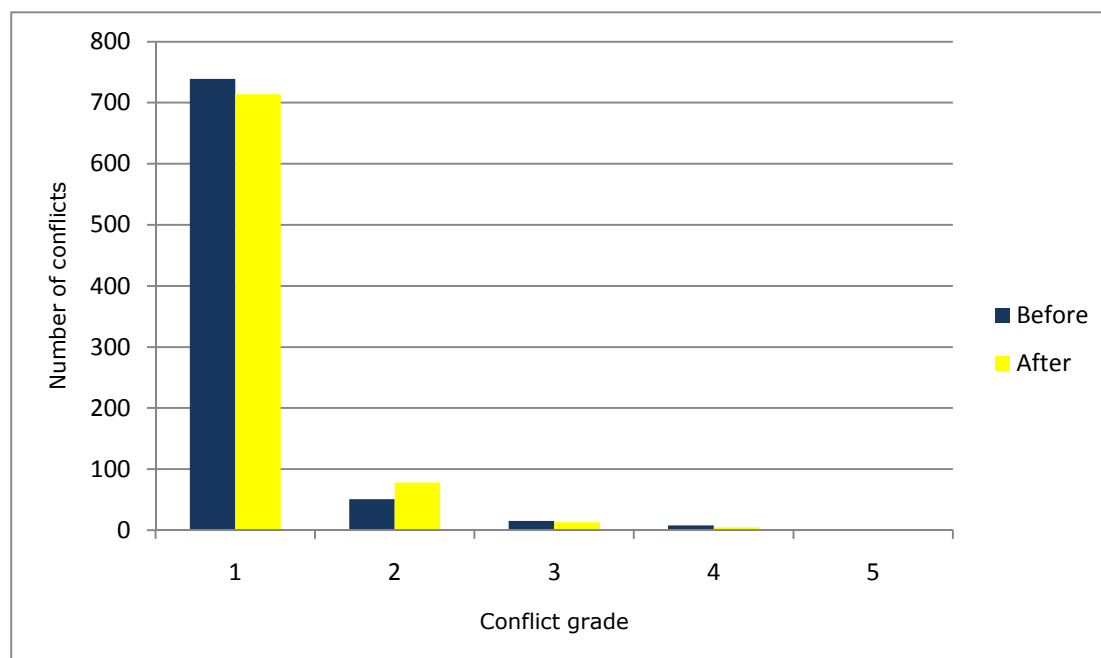


Figure 3-8 Conflict severity

It can be seen that there is an increase in those graded as a level two conflict in the after study. Looking at the exact figures (51 in the before and 78 in the after study) shows that there has been a statistically significant ($p < 0.01$) increase of 53%.

The changes in the various grades of conflict in the before and after study are shown in Table 3-6. It should be noted however that there were fewer occurrences of the higher grade conflicts, and as a result the impact of each individual conflict will be greater upon the percentage change. Combining the number and proportions of conflicts of grade 3 and above shows no significant difference between the before and after periods ($p > 0.10$).

Table 3-6 Numbers of conflicts by severity

Severity	Number of Conflicts		% change
	Before	After	
Grade 1	739	714	-3.12%
Grade 2	51	78	52.9%
Grade 3*	15	13	-
Grade 4*	8	5	-
Grade 5*	0	0	-

* Sample too small to quote percentage change

3.2.3 Compliance of pedestrians from conflict analysis

In considering pedestrian rates of compliance it was appropriate to consider the signal that was displayed when the pedestrian began their crossing. This data differs from the compliance figures shown in section 3.1.1 because it only focuses on the compliance of the individuals who were involved in conflicts. Data was excluded from the site 10/123 in the after period for pedestrians crossing in a north to south direction because of a failed red man display unit. Pedestrians crossing from south to north had an operational red man unit and are included in the analysis. It was noted that a large majority of conflicts occur when the pedestrian begins to cross in the red man period.

Whilst the levels of compliance of the pedestrians in conflict is of interest, the variation between the before study and after study is of primary importance. Table 3-7 and Figure 3-9 show that during the after study a greater number of the pedestrians who were involved in conflicts started to cross during the red man period. Likewise there was an associated reduction in the green man and blackout categories.

Table 3-7 Compliance of pedestrians involved in conflicts

Site	Red Man			Green Man			Blackout		
	Before	After	% change	Before	After	% change	Before	After	% change
00/022	65	62	-4.6%	9	4	-55.5%	6	9	50.0%
00/025	261	252	-3.4%	10	7	-30.0%	14	7	-50.0%
00/052	83	90	8.4%	2	3	50.0%	6	1	-83.3%
05/066	16	24	50.0%	0	0	-	0	0	-
08/028	203	221	8.9%	14	3	-100.0%	12	4	-66.7%
09/021	54	59	9.3%	2	4	100.0%	3	4	33.3%
10/007	10	13	30.0%	4	2	-50.0%	1	4	300.0%
10/013	25	28	12.0%	3	0	-100.0%	1	1	0
10/123	9	7	-11.1%	0	0	-	0	1	-
All sites	726	756	4.0%	44	23	-47.7%	43	31	-27.9%

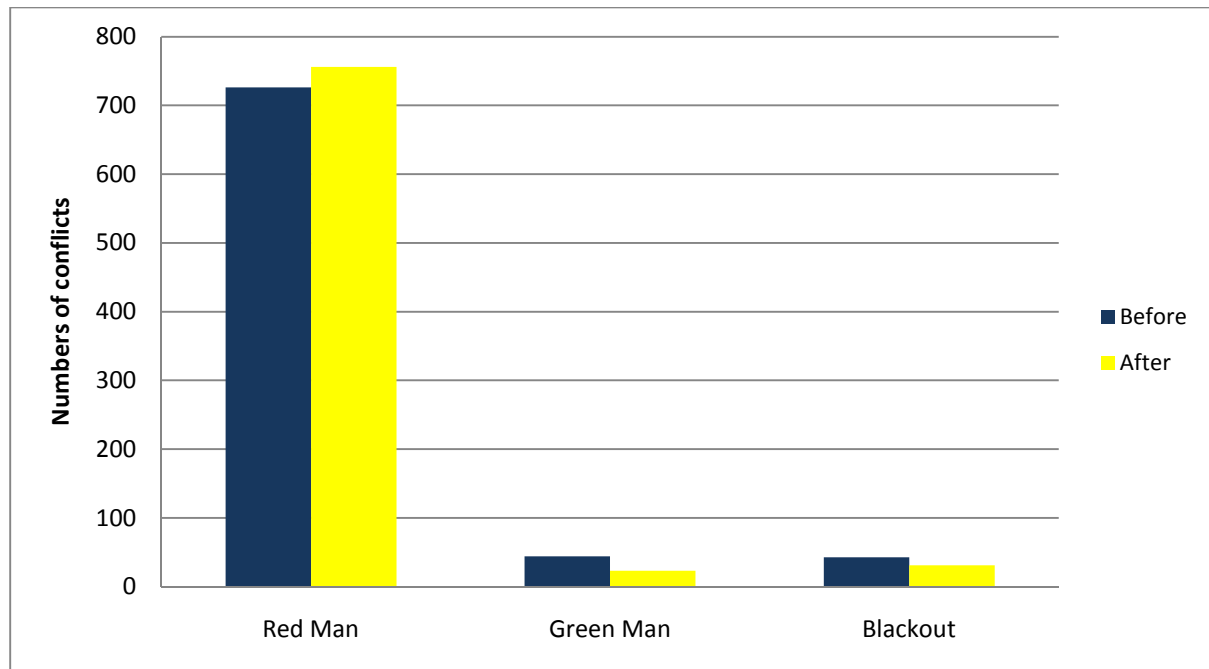


Figure 3-9 Compliance of pedestrians involved in conflicts

The results show that approximately 90% of conflicts occurred when the pedestrian began to cross when the pedestrian signals were red. This is perhaps unsurprising as during the green man and blackout periods pedestrians have right of way and therefore should not experience any conflicts with traffic. The conflicts recorded during this time were a result of vehicles turning during the intergreen and not clearing the crossing in time, as well as cyclists disobeying red signals. The problem of vehicles not clearing the crossings before the pedestrians were given right of way was noted at site 00/025 Bishopsgate – Wormwood Street.

It is also notable that there was an increase in the number and proportion of conflicts associated with pedestrians crossing on a red man and a corresponding decrease in the number and proportion of conflicts associated with pedestrians crossing on a green man or during the blackout period in the after study.



Figure 3-10 Bishopsgate green man conflict

Figure 3-10 shows the silver van has been waiting to turn from Wormwood Street (eastbound) onto the South bound carriageway of Bishopsgate. As this movement is opposed the driver was not able to turn until the opposing movement stopped. This left them to make their manoeuvre after the vehicular green had expired. As the photo shows the pedestrians had already been given right of way by this time.

Another issue noted during the conflict analysis was the level of cyclists disobeying the red signal. This gave rise to many of the conflicts which occurred during the green man period.

A sample of 200 before and 199 after grade one conflicts were analysed in order to consider at which point of the signal cycle they occurred. All grade 2 conflicts were analysed in the same way. All grade 2 conflicts which involved a pedestrian were analysed in the same way. The vehicle to vehicle conflicts were discounted from this analysis. This left a total of 50 grade 2 conflicts in the before study and 69 in the after.

Table 3-8 and Figure 3-11 below show the difference between the before and after studies with regard to when during each signal period the conflicts occurred. These results have been broken down by conflict grades one and two.

Table 3-8 Number of conflicts grade 1 per time segment

Period	Green Man		Blackout		Red Man							
	0 to 5	6 to 11	0 to 5	6 to 10	0 to 5	6 to 10	11 to 15	16 to 20	21 to 25	26 to 30	31 to 60	61+
Before	5	6	9	1	5	15	19	5	15	17	72	31
After	6	0	6	5	7	12	12	11	13	25	69	33

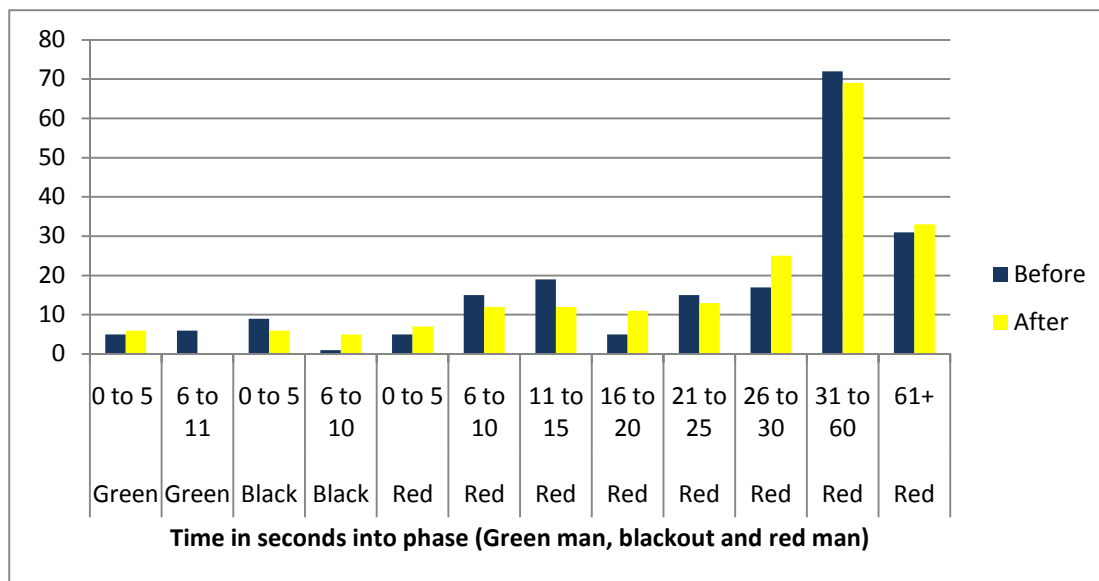


Figure 3-11 Number of conflicts grade 1 per time segment

For both the before and after studies the majority of the conflicts of grade one occurred within the red man period (90% and 91% respectively). Three-quarters of these conflicts occurred after 20 seconds of the red man phase had elapsed in both the before (135/179) and after (140/182) studies.

Table 3-9 and Figure 3-12 show the times within each signal period that the grade 2 conflicts occurred.

Table 3-9 Number of conflicts grade 2 per time segment

Period	Green Man		Blackout		Red Man							
	0 to 5	6 to 11	0 to 5	6 to 10	0 to 5	6 to 10	11 to 15	16 to 20	21 to 25	26 to 30	31 to 60	61+
Before	3	3	3	1	0	13	4	3	1	4	11	3
After	1	0	2	0	2	12	8	2	5	10	16	11

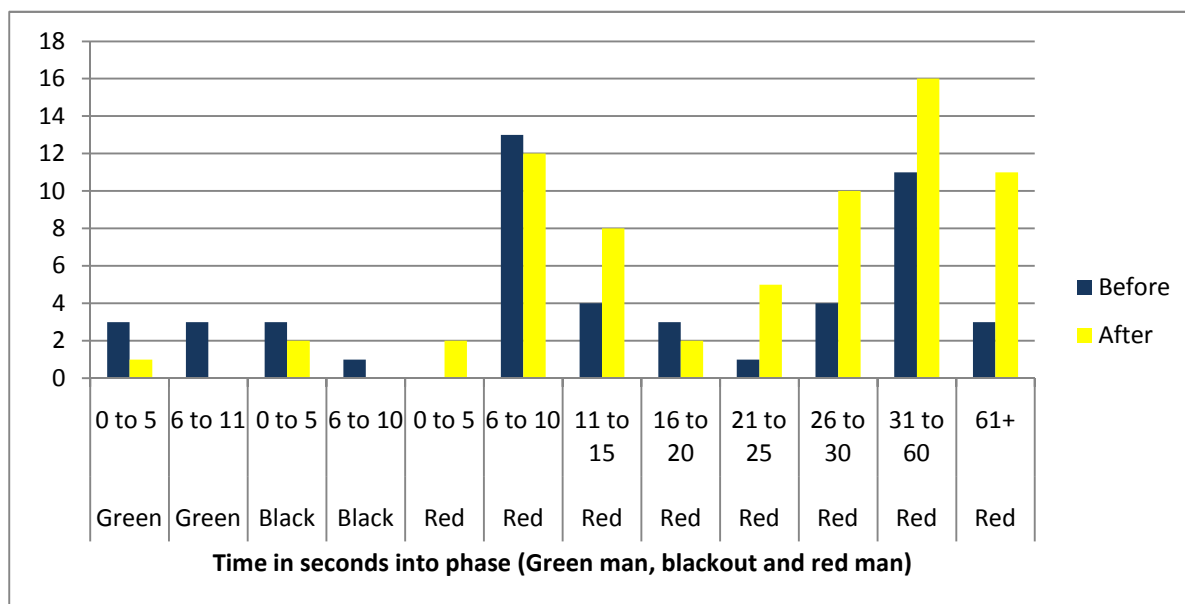


Figure 3-12 Number of conflicts grade 2 per time segment

For both the before and after studies the majority of the conflicts of grade two occurred within the red man period (79% and 95% respectively). The proportions of these conflicts that occurred after 20 seconds of the red man phase had elapsed was 49% (19/39) in the before study and 64% (42/66) in the after study. The additional grade 2 conflicts observed in the after study occurred well into the red man period and do not appear to be associated with the re-timing.

3.2.4 Conflict rates

Simply comparing the numbers of conflicts before the invitation period was lowered with those recorded after this change was made does not take into account the variation of pedestrian usage and vehicular traffic between the two study days. To investigate this further, a pedestrian and traffic count was undertaken from the video footage. This enabled a conflict rate to be established.

It should be noted that site number 10/123 has been excluded from the graphs and calculations in this section because, even after considering data for complete hours rather than 15 minute samples, the numbers of pedestrians and conflicts (all grade 1) at that site were very small and any difference in the rates of conflict at this site could lead to misleading conclusions.

3.2.4.1 Rate of conflict per pedestrian

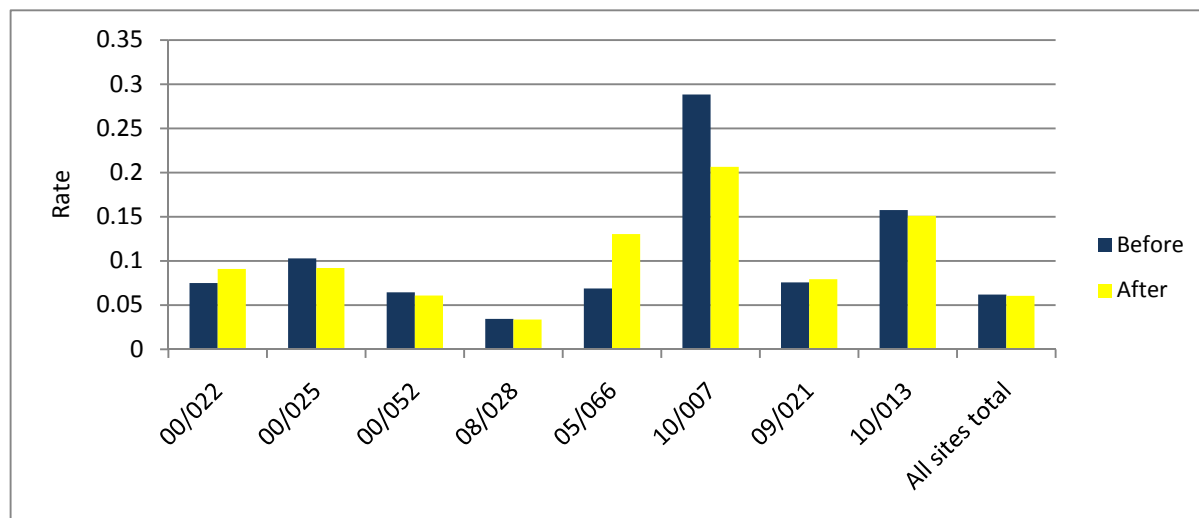


Figure 3-13 Rate of conflict per pedestrian

Figure 3-13 shows that the rate of conflicts per pedestrian has not altered by much between the before and after studies.

When all sites were considered, the rates of conflicts per pedestrian were as follows:

- Rate of conflict / pedestrian Before - =0.0621
- Rate of conflict / pedestrian After - =0.0607

This shows that there was a very small reduction in the rate of conflicts per pedestrian in the after study. Tests show that this reduction is not statistically significant ($p > 0.10$)

3.2.4.2 Rate of conflict per vehicle

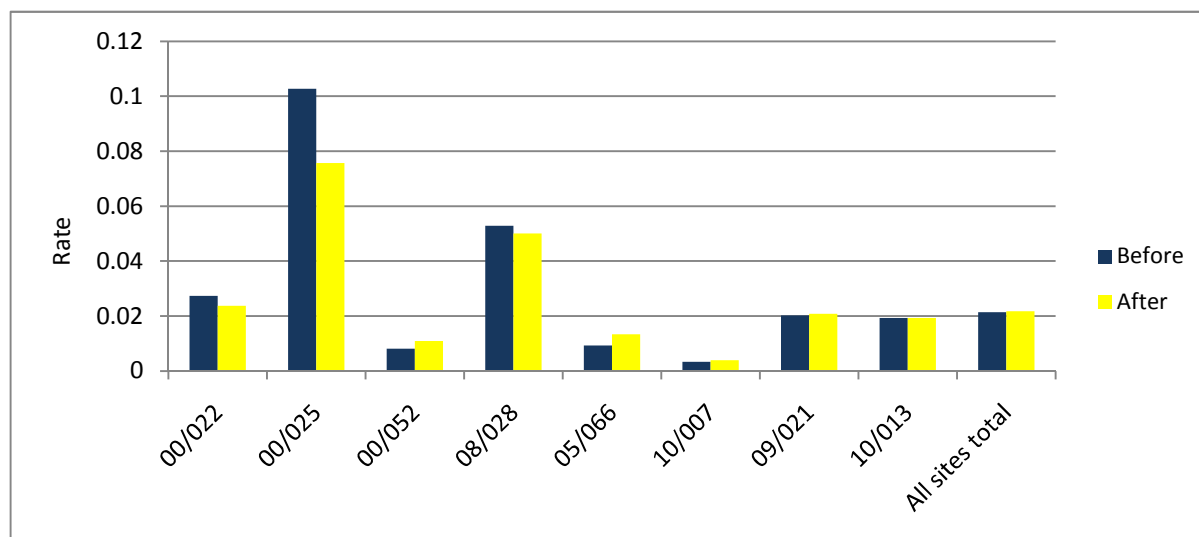


Figure 3-14 rate of conflict per vehicle

Figure 3-14 shows there were both positive and negative variations in the rates of conflicts per vehicle between the before and after studies. To smooth the site specific

fluctuations an overall rate of conflict for all sites is more appropriate. The results are as follows:

- Rate of conflict / vehicle Before - =0.0214
- Rate of conflict / vehicle After - =0.0217

There was a very small increase in rate of conflicts per vehicle in the after study, however this change is not statistically significant ($P>0.10$)

3.2.4.3 Rate of conflict per cyclist

Figure 3-15 shows the rate of conflict per cyclist at each site. From the data collected during the conflict study, it was noted that cyclists made up 31.4% of the vehicles in conflict during the before study and 27.4% during the after study. This data is presented in greater depth in section 3.2.5.

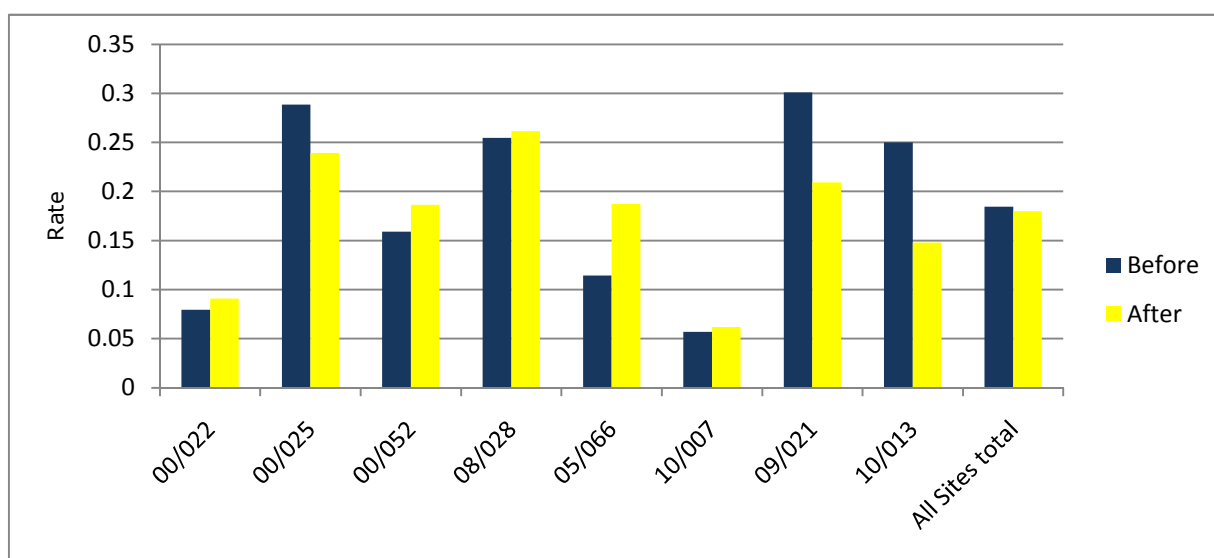


Figure 3-15 rate of conflict per cyclist

In a similar way to the previous two conflict rate categories, the conflict rate per cyclist shows site to site variation between the before and after data. For example site 05/066 has seen a large increase in conflict rate per cyclist, whereas site 09/021 has seen a similar sized decrease. Therefore to smooth this variation the overall rate of conflict per cyclist is important, the before and after results are as follows:

Rate of conflict / cyclist Before - =0.184

Rate of conflict / cyclist After - =0.180

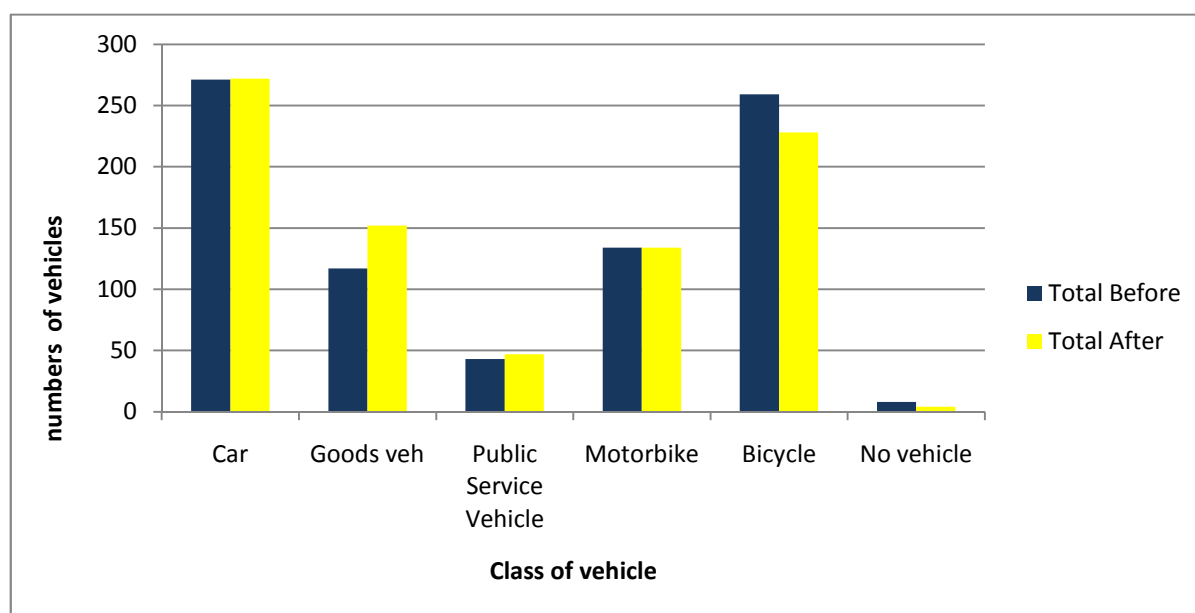
This shows that there has been a decrease in rate of conflict per cyclist in the after study when compared with that of the before. This decrease, however, is not statistically significant ($P>0.10$)

3.2.5 Class of vehicles involved in conflicts

As Figure 3-16 shows there was a 29.9% increase of good vehicles in conflict during the after study. By looking at the raw data, this was largely due to a big increase seen at site 00/052 – Lower Thames Street, Fish Street Hill junction. It is not clear why this large increase was experienced.

Table 3-10 Class of vehicle involved in conflicts

	Car	Goods vehicle	Public Service Vehicle	Motorbike	Bicycle	No vehicle visible
Total Before	271	117	43	134	259	8
Total After	272	152	47	134	228	4

**Figure 3-16 Vehicle class in conflict with pedestrians**

It can also be seen that there has been a notable decrease in the numbers of conflicts involving cyclists during the after study. This 13.5% decrease is even more dramatic when considering that during the after study the throughput of cyclists was recorded as being higher than that of the before.

The 'no vehicle' category was used during the conflict analysis to record situations where pedestrians displayed the characteristics of someone hurrying mid crossing, or taking some form of precautionary action, but no vehicle could be seen from the camera footage.

3.2.6 Classification of pedestrians in conflicts

A total pedestrian head count for the before and after studies was obtained in order to allow rates to be calculated. This data showed that 13,095 pedestrians were recorded in the before study, and 13,336 in the after study.

Pedestrians involved in conflicts were studied in greater detail, and were classified as 'pedestrian adult', 'pedestrian child' and 'pedestrian with mobility impairments'. This has been done to focus on the needs of pedestrians who require a longer period of time to complete their crossing of the carriageway.

Table 3-11 shows the classification of the pedestrians who were involved in the conflicts.

Table 3-11 Classification of pedestrians involved in conflicts

Site	Adult		Child		Mobility Impaired	
	Before	After	Before	After	Before	After
00/022	72	74	0	0	0	0
00/025	284	257	0	1	0	0
00/052	88	92	0	0	0	0
05/066	9	14	1	0	0	0
08/028	229	223	1	6	0	0
09/021	57	58	1	12	0	0
10/007	10	16	2	3	2	1
10/013	25	28	1	2	2	0
10/123	7	7	0	0	2	0
All sites	781	769	6	24	6	1

Note: pedestrians were only classified as adult, child or mobility impaired if involved in a conflict. The total number of pedestrians in each of these categories was not recorded.

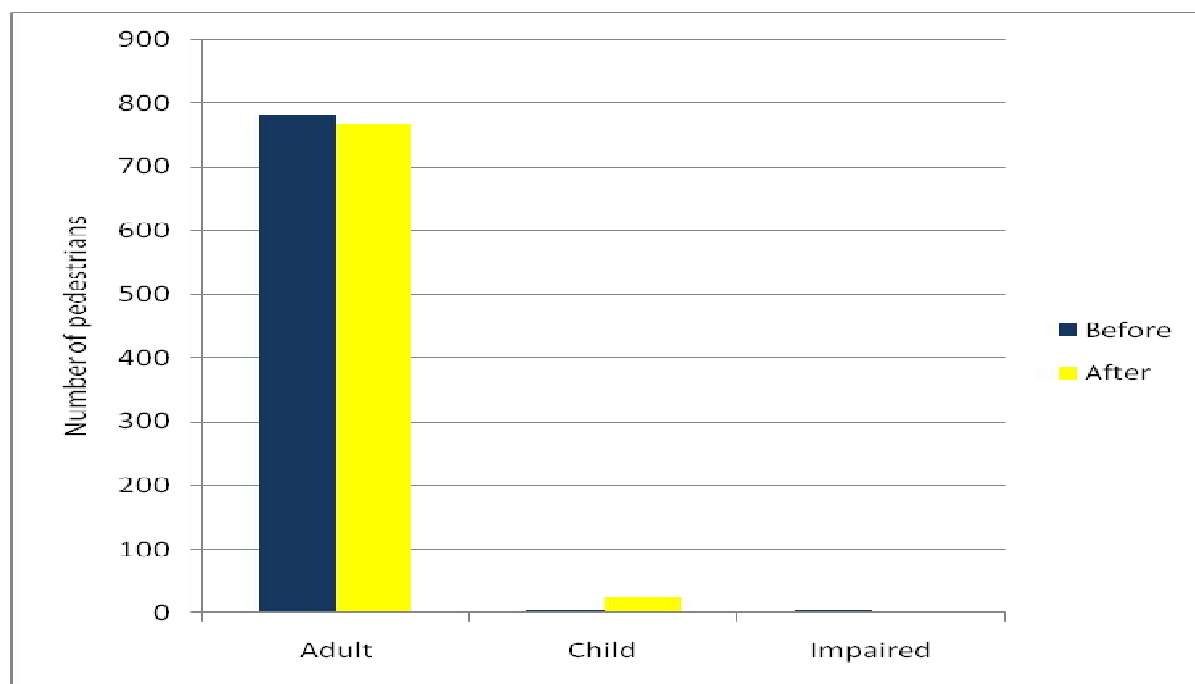
**Figure 3-17 Classification of pedestrians involved in conflicts**

Figure 3-17 shows that the numbers of mobility impaired pedestrians who were involved in conflicts has fallen, likewise so has the 'All other pedestrians' category. Whilst the numbers of children involved in conflicts shows an increase, Table 3-11 above shows that this increase is almost entirely due to two individual sites (08/028 and 09/021). The remaining seven sites showed no change, or a reduction in the after data. It is unclear as to why this pattern has emerged. Importantly however, the total numbers of children involved in conflicts only makes up 0.7% of the pedestrians in the before study, and 3% of the pedestrians in the after study.

3.2.7 Vehicle to vehicle conflicts

It was anticipated that the primary focus of this study should be on conflicts between pedestrians and vehicles rather than between individual vehicles. This was verified by the numbers of vehicle to vehicle conflicts that were observed. Table 3-12 below shows that there were only 19 such conflicts in the before data and 28 in the after.

Table 3-12 Numbers of vehicle to vehicle conflicts

Site	Before	After
00/022	6	1
00/025	1	9
00/052	3	2
05/066	7	10
08/028	0	1
09/021	0	2
10/007	1	0
10/013	0	1
10/123	1	2
All sites	19	28

3.3 Network Operation

3.3.1 Throughput of vehicles

Figure 3-18 shows that during the after study, when the invitation to cross period had been shortened, there was an increased throughput of vehicles at all sites except 10/123 Nine Elms Lane – Ponton Road.

The increased throughput at seven of the nine sites is consistent with the view that by reducing the invitation period to pedestrians, an increase in capacity can be achieved for vehicular traffic. Site 00/052 (the most busy site) showed a substantial decrease in vehicle throughput during the after study. This decrease was sufficiently large to offset the total gain in throughput at all the other sites. It has been noted that during the after study there were long term streetworks some distance upstream from site 00/052 which were beyond the field of view of the video camera and which resulted in a loss of lane capacity from two lanes down to one. The results from this site have therefore been discounted as they have been shown to be anomalous. Overall (excluding site 00/052) a significant ($p < 0.01$) increase in vehicle throughput was observed in the after study.

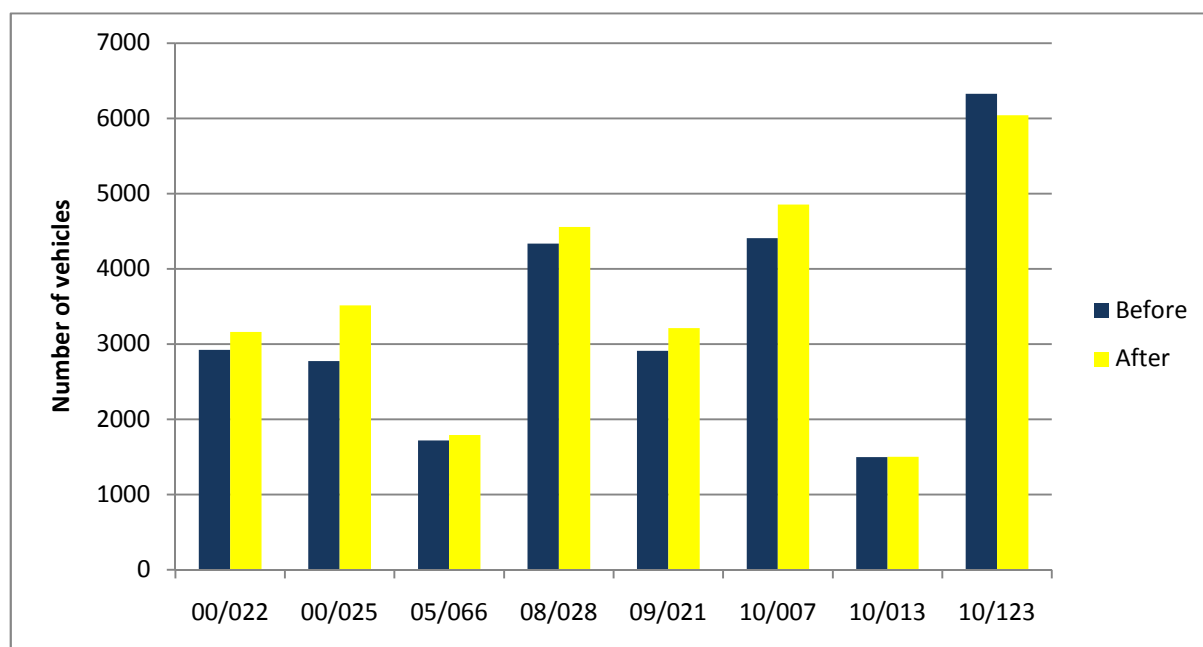


Figure 3-18 Vehicle throughput

The total vehicle throughput for the sites shown in Figure 3-18 showed a 6.5 % increase between the before and after studies, from 26,900 vehicles in the before study to 28,636 in the after.

3.3.2 Congestion of pedestrian waiting areas

Figure 3-20 shows the numbers of times that the footway was classed as congested in the four-hour period in both the before and after studies. This is a cumulative figure for all sites and has been extrapolated from the 15 minute sample period. Figure 3-19 indicates the type of scenario that was classified as being congested. The waiting area was considered congested when the pedestrians waiting to cross could not fit within the width of the tactile paving area.

It was noted however, that congestion only occurred at some of the study sites. Specifically these were the three located in the City of London (00/022, 00/025 and 00/052) and the two located directly outside of Underground Stations (08/028 and 09/021).



Figure 3-19 Illustration of congestion in waiting area

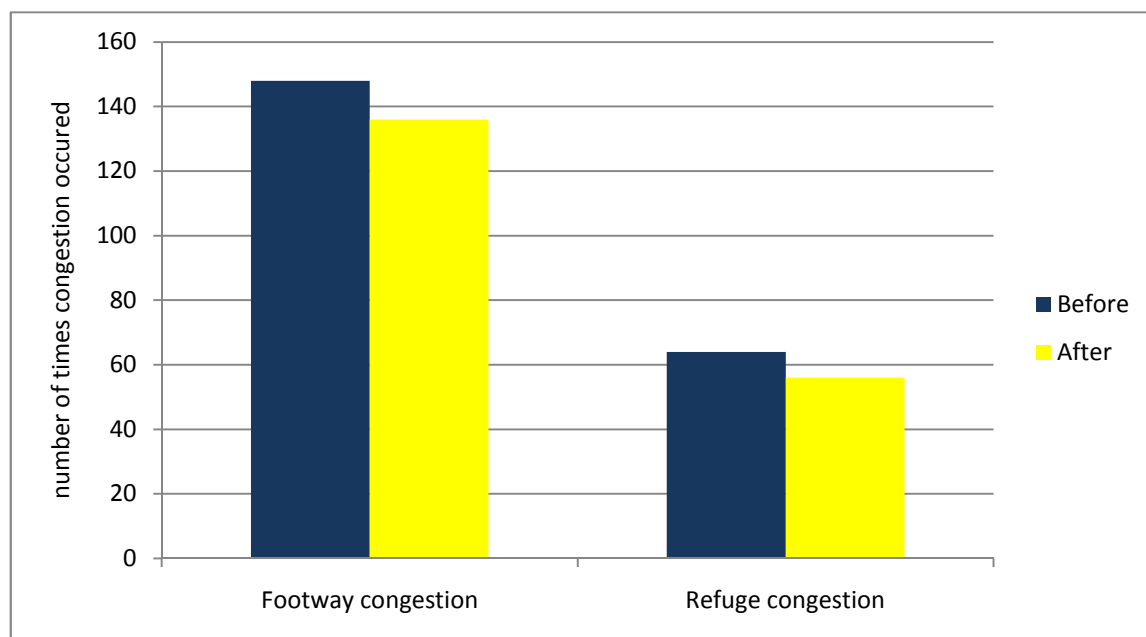


Figure 3-20 Congestion of pedestrian waiting areas

Figure 3-20 shows that footway congestion was recorded as being less frequent in the after study than in the before study. This is against expectations given that there were a greater number of pedestrians using the study sites in the after period than in the before period. In view of the reduced green man period in the after study, it could reasonably have been expected that there would have been an increased frequency of congestion but this was not found to have occurred.

3.3.3 Pedestrians aborting their crossing movements

As part of the conflict analysis a plain language description was noted for each of the conflict scenarios. From this it was possible to identify pedestrians who began crossing, stopped and returned to the footway or central refuge. As Table 3-13 shows there was variation between the study sites in numbers of pedestrians retreating after having started to cross. The total number of times this was recorded was relatively low, and there was only a very small difference between the occurrence in the before study compared with the after.

Table 3-13 Numbers of pedestrians aborting crossing movements

Site	Before	After
00/022	4	4
00/025	20	18
00/052	9	4
05/066	0	1
08/028	4	10
09/021	3	3
10/007	1	0
10/013	2	1
10/123	0	0
All sites	43	41

3.4 Summary; Pedestrian Behaviour, Conflict Studies and Network Operation

Evaluation of pedestrian behaviour and conflicts at the study sites identified the following points of interest.

Rates of compliance

The number of pedestrians who began their crossing whilst a green man was displayed decreased by 11.6% (from 5,844 to 5,165).

The number of pedestrians who began their crossing whilst a blackout was displayed increased by 6.9% (from 1,212 to 1,296).

The number of pedestrians who began their crossing whilst a red man was displayed increased by 13.8% (from 6,039 to 6,875).

Overall, the total numbers observed were broadly similar. As such, rates of pedestrian compliance with the signals deteriorated.

Crossing times

Actual crossing times were considered in order to compare these to the assumed speed of 1.2m/s.

Speeds varied considerably from site to site but were little changed between the before and after periods. The average before speeds ranged from 1.17m/s to 1.71m/s and the after average speeds ranged from 1.21m/s to 1.65m/s. The overall average speed was 1.46m/s before and after.

The assumed speed of 1.2m/s therefore appears to provide appropriately for the slower pedestrian.

Stopping within the central refuge

More than 95% of pedestrians who stopped in the central refuge had begun crossing whilst a red man was displayed. There was an overall increase of 15.8% in the number of pedestrians who stopped in the central refuge. However, the overall number of pedestrians increased by just 1.8%. As such, the increase in pedestrians stopping in the central refuge cannot be attributed to an increase in overall pedestrian traffic.

The increase in pedestrians crossing on the red man who stopped in the refuge is broadly proportionate to the increase in the incidence of pedestrians crossing on the red man. A similar pattern is observed for pedestrians who start to cross during the blackout period.

However, there is a substantial increase in the numbers of pedestrians crossing on the green man who stopped in the refuge and this is despite a decrease in the incidence of pedestrians crossing on the green man.

Numbers of pedestrians at each invitation period - crowding and congestion

There was considerable variation in the numbers of pedestrians crossing at each of the study sites. There was also little change in the numbers crossing at each invitation between the before and after periods.

Nevertheless, there was a small reduction in the incidence of pedestrian congestion, or crowding, observed in the after period compared to the before period. This applied to both footways and central refuges and was unexpected given that there were a similar number of pedestrian using the study sites during the before and after studies.

The reasons for this apparent improvement are not clear. However, it was noted that congestion was only observed at 5 of the 9 study sites.

Incidence of conflicts

The total number of conflicts observed was similar during the before and after periods and, as would be expected, most conflicts were minor.

The total number of conflicts recorded was similar reducing from 813 to 810.

The more serious conflicts, grades 3 and 4 (none were recorded at grade 5), reduced in number but this improvement was from too small a figure to draw reliable inferences.

The number of grade 2 conflicts increased from 51 in the before period to 78 in the after period and there was a corresponding reduction from 739 to 714 grade 1 conflicts.

There was therefore an increase in the severity of the more minor grades of conflicts recorded during the study periods.

Status of pedestrian signal when conflicts occurred

The vast majority of the conflicts occurred when a red man was displayed and the total number of conflicts were almost the same during the before and after periods.

However, the number of conflicts which involved pedestrians who began crossing on a red man increased (from 726 to 756) whilst the numbers who began crossing on a green man or during the blackout decreased (from 44 to 23 and from 43 to 31 respectively).

This increase in the incidence of conflicts associated with crossing whilst the red man was displayed is consistent with the increase in the numbers of pedestrians failing to comply with the signals (i.e. those who commence their crossing during the blackout period or when a red man is displayed).

Rates of conflicts

There was very little change in the overall rates of conflict per pedestrian between the before and after periods (although the rate of grade 2 conflicts increased). There was also very little change in the overall rates of conflict per vehicle.

There was a decrease in the overall rate of conflicts per cyclist and there was an increase in the rate of conflicts per goods vehicle (although this was largely due to a big increase in goods vehicle conflicts at one site).

Classification of pedestrians in conflicts

The numbers of pedestrians with mobility impairments observed as involved in conflicts was small and decreased from 6 in the before period to 1 in the after period.

The number of children increased from 6 to 24 although this change was associated with just two sites and it was noted that overall children were involved in less than 2% of observed conflicts.

Vehicle to vehicle conflicts

More than 97% of observed conflicts at the pedestrian crossing points involved pedestrians. Less than 3% were vehicle to vehicle and although there was some variation between sites and between the before and after periods, this did not appear to be associated with the re-timing.

Network Operation

When considering all sites as a whole (with site 00/052 excluded due to on streetworks disruption) the results showed an increase in the throughput of vehicles during the after study. Specifically there was a 6.5% increase in throughput between the before and after results.

4 Results - Pedestrian Interviews

4.1 Introduction

The following section details the results of the interviews carried out at the study sites before and after the change in signal timings. Pedestrian interviews were carried out, once the pedestrians had used the crossings, by interviewers and consisted of 22 questions covering the interviewee's satisfaction of crossing time, feeling of safety whilst crossing, any changes noticed and demographics. The questionnaire used can be found in Appendix F

4.2 Results

4.2.1 Demographics of interviewees

The following section confirms that a representative sample of pedestrians were interviewed and these distributions were similar in the before and after period. A total of 629 people were interviewed before and 660 were interviewed after the re-timing of the signals. At each site similar numbers of people were interviewed before and after the re-timing, and an equal amount of men and women were interviewed overall (see Appendix F). Figure 4-1 shows the distribution of age groups across the combined sites. The majority of interviewees were in the age groups of 25-34 and 35-59 years, and similar proportions were interviewed in the before and after periods. Almost all interviewed pedestrians were travelling alone (90% before and 89% after).

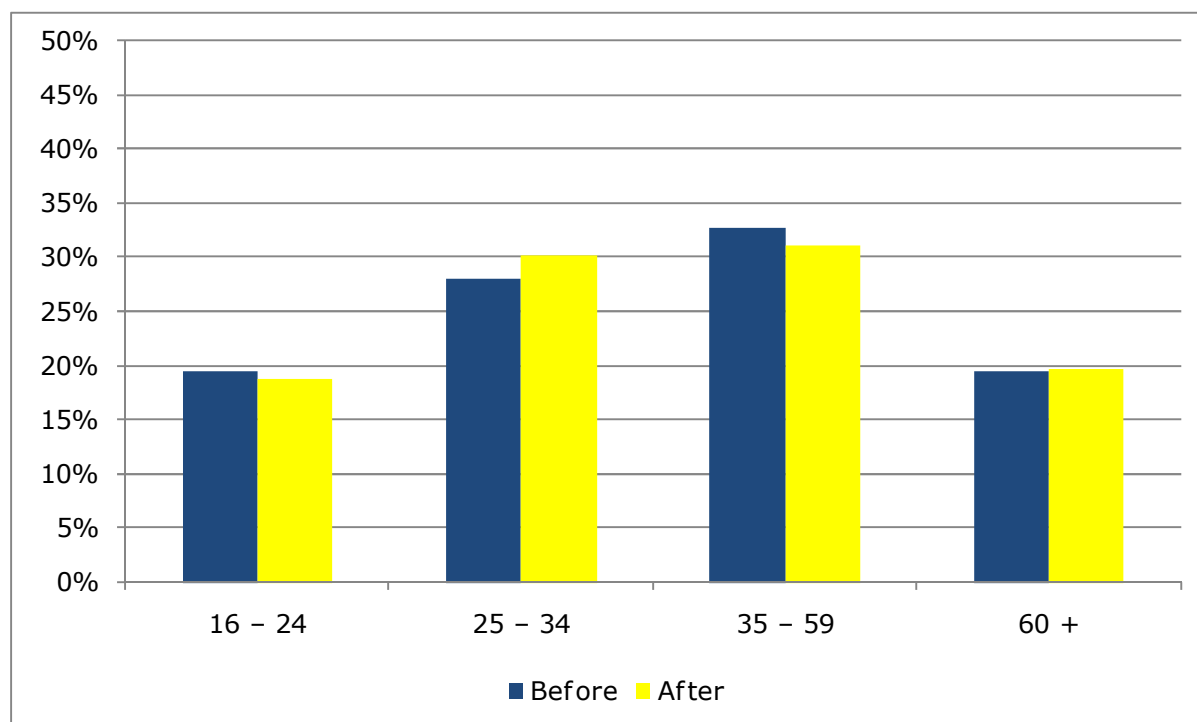


Figure 4-1: Distribution of ages (all sites)

An important consideration when evaluating the safety implications of an intervention is the effect on people with impairments. Figure 4-2 shows the total numbers of people interviewed who had different, self defined, impairments or were accompanied by a person with an impairment. There were 72 pedestrians with impairments or who were accompanied by an impaired person interviewed in the before period and 52 in the after

period. The responses from these interviewees are analysed separately later in this section.

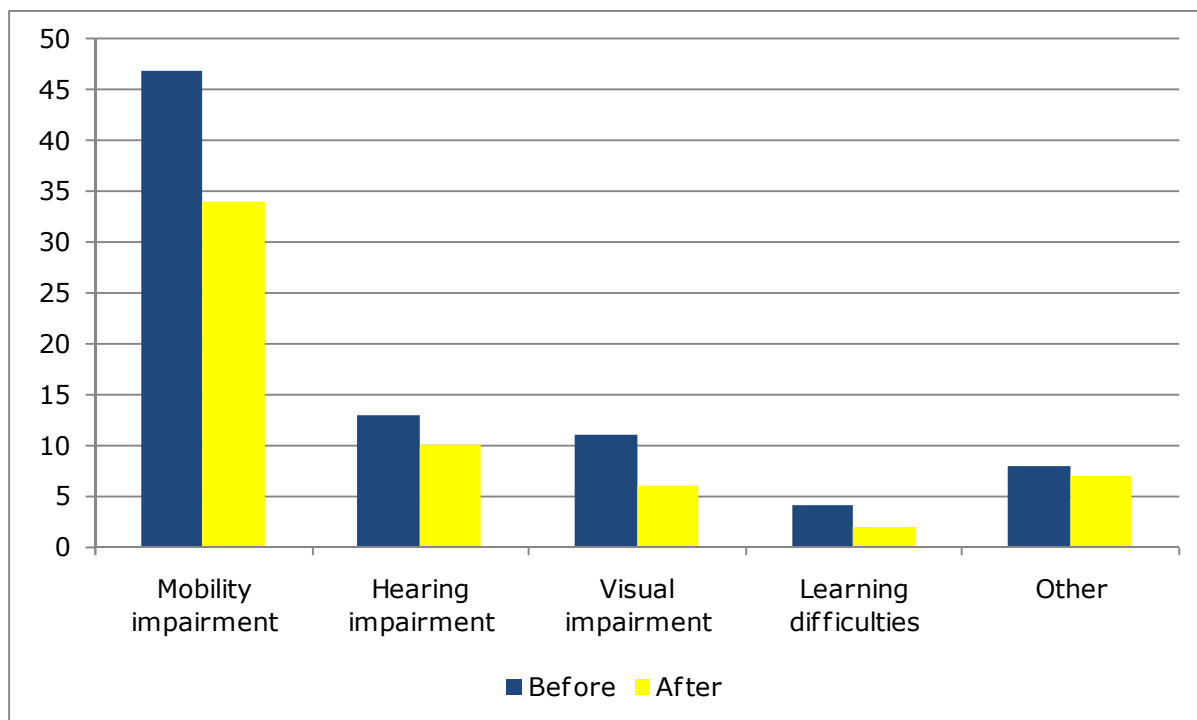


Figure 4-2: Number of interviewees with impairments (all sites)

Figure 4-3 shows the overall distribution of reasons for being in the area. Some interviewees had several reasons for being in the area and so more than one response was possible for this question, therefore percentages add up to more than 100%. At most sites individually (see Appendix F) and overall the majority of those interviewed either worked or lived in the area, and these distributions did not change dramatically between the before and after periods.

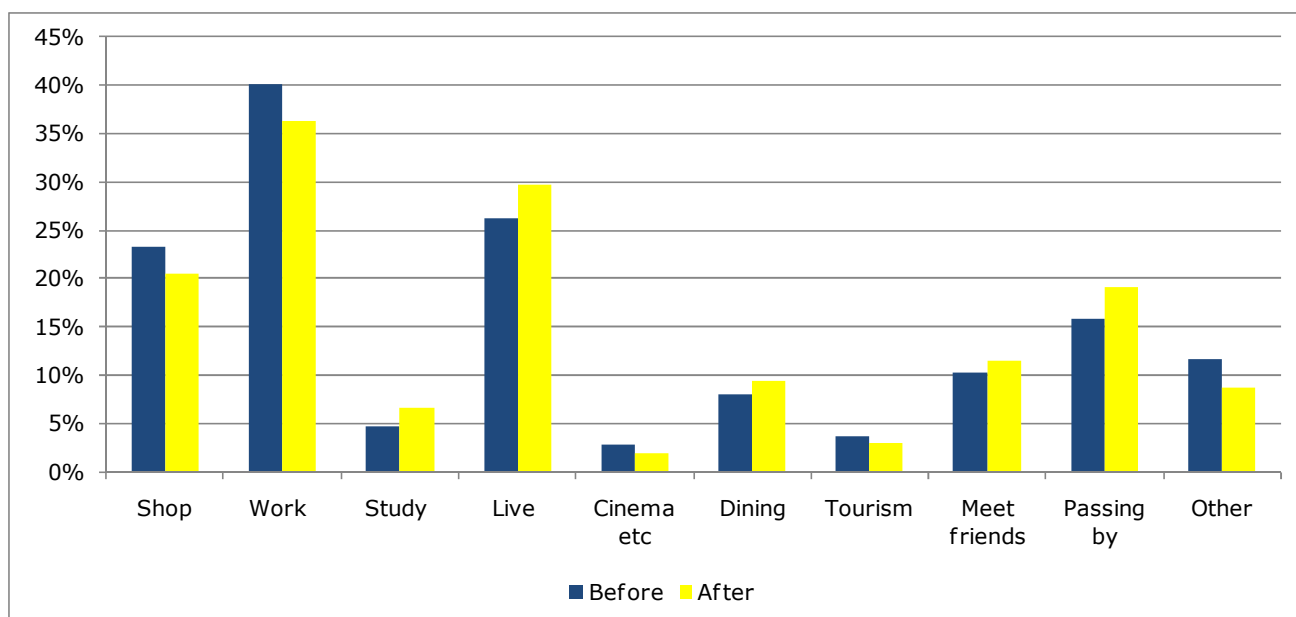


Figure 4-3: Distribution of activities for all sites

The distribution of use of the crossings by interviewees is shown in Table 4-1. Overall, almost one half of the interviewees use the crossing five or more days a week and this corresponds with the fact that the majority of the people using the crossing worked or lived in the area, and therefore would be familiar with the junction operation and timing.

Table 4-1: How often would you say you use this particular crossing? (all sites)

Number of Times	Before	After
5 or more days a week	44%	45%
At least 2-4 times a week	21%	24%
At least once a week	9%	8%
At least once a fortnight	4%	4%
At least once a month	4%	5%
Less often	10%	9%
This is the first time	8%	6%
Total number	629	660

4.2.2 Satisfaction and compliance with signals

In order to assess whether waiting times were perceived to be shorter, the interviewees were asked:

On this occasion, did you wait for the green man to show before you crossed?

The responses consisted of those who did wait for the green man to show: 'Yes'; those who did not wait for the green man to show: 'No'; and those for whom the green man was showing on arrival at the crossing: 'Already green'. Overall 55% waited for the green man before and 60% after, 27% did not wait before and 23% did wait in the after period. All remaining respondents did not have to wait for the green man.

The responses of those who arrived at the crossing whilst there was no green man showing are shown in Table 4-2. In all but Site 00/025, a higher proportion of people waited for the green man than did not wait and at all but three sites a higher proportion of people waited after the pedestrian timings had been changed than before. A chi squared test on the overall results showed that significantly more people who were interviewed waited for the green man before crossing in the after period than in the before period. For the men who were interviewed there was no significant change in the proportion that waited for the green man in the after period compared to before. A small change in responses was observed in women who were interviewed, with proportionately more waiting for the green man in the after period than before. For the men who were interviewed there was no significant change in the proportion that waited for the green man in the after period compared to before. A small change in responses was observed in women who were interviewed, with proportionately more waiting for the green man in the after period than before.

Table 4-2: On this occasion, did you wait for the green man to show before you crossed?

Site	Yes		No	
	Before	After	Before	After
00/022	67%	38%	33%	62%
00/025	33%	50%	67%	50%
00/052	69%	86%	31%	14%
05/066	67%	97%	33%	3%
08/028	59%	72%	41%	28%
09/021	95%	70%	5%	30%
10/007	80%	93%	20%	7%
10/013	79%	70%	21%	30%
10/123	52%	72%	48%	28%
Males [^]	62%	66%	38%	34%
Females [#]	73%	78%	27%	22%
All sites [*]	67%	72%	33%	28%

[^]Chi-squared test (males) $p > 0.10$

[#]Chi-squared test (females) $p < 0.10$

^{*}Chi-squared test $p < 0.05$

The interviewees were asked:

How did you feel about the length of time you had to wait for the green man to show before you crossed?

Table 4-3 combines those who answered very satisfied with satisfied and those who answered dissatisfied with very dissatisfied. Few people responded with the extremes of the scale (very (dis)satisfied). The majority of people were satisfied (or very satisfied) with the length of time they had to wait for the invitation to cross. Overall, and for males and females separately, no significant changes in satisfaction of people were observed before and after the re-timing.

The interviewees were asked;

How satisfied were you with the amount of time you had to cross the road?

The responses were mixed, (as shown in Table 4-4) but a large majority were satisfied. In most cases (all but two sites) the proportion of people satisfied reduced in the after period, and significantly fewer people overall (shown in Figure 4-5) were satisfied with the time they had to cross. A corresponding increase was observed in the overall proportion of those who were neither satisfied nor dissatisfied. A much larger, statistically significant, drop in satisfaction was observed in those with impairments or accompanied by a person with impairments. No changes were observed within the male and female subgroups.

Table 4-3: How did you feel about the length of time you had to wait until there was a green man?

Site	Satisfied		Neither		Dissatisfied	
	Before	After	Before	After	Before	After
00/022	76%	78%	8%	11%	16%	11%
00/025	75%	81%	13%	6%	13%	14%
00/052	55%	74%	14%	17%	31%	10%
05/066	72%	66%	6%	29%	22%	6%
08/028	91%	79%	0%	6%	9%	15%
09/021	98%	89%	2%	2%	0%	9%
10/007	74%	89%	14%	2%	12%	9%
10/013	65%	62%	25%	24%	11%	14%
10/123	87%	80%	6%	6%	6%	14%
Males [^]	75%	81%	12%	9%	13%	10%
Females [#]	78%	77%	9%	11%	13%	12%
All sites [*]	77%	79%	10%	10%	13%	11%

[^]Chi-squared test (males) p>0.10

[#]Chi-squared test (females) p>0.10

^{*}Chi squared p>0.10

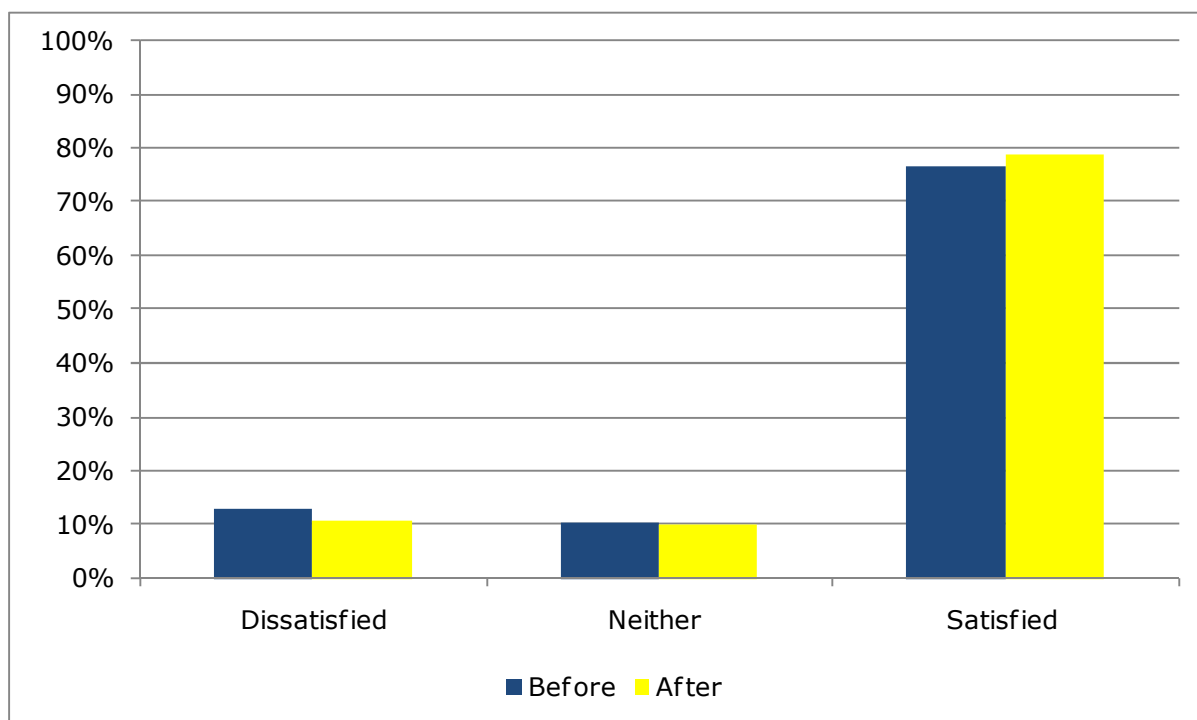


Figure 4-4: How did you feel about the length of time you had to wait until there was a green man? (all sites combined)

Table 4-4: How satisfied were you with the amount of time you had to cross the road?

Site	Satisfied		Neither		Dissatisfied	
	Before	After	Before	After	Before	After
00/022	87%	71%	10%	26%	3%	3%
00/025	87%	74%	8%	10%	5%	16%
00/052	79%	73%	7%	17%	13%	10%
05/066	71%	83%	10%	11%	19%	7%
08/028	93%	84%	1%	5%	6%	11%
09/021	96%	90%	3%	4%	1%	6%
10/007	91%	85%	6%	7%	3%	8%
10/013	63%	73%	18%	17%	18%	10%
10/123	86%	80%	13%	13%	1%	8%
Males [^]	85%	81%	9%	11%	6%	8%
Females [#]	81%	78%	9%	13%	10%	10%
Impaired [†]	82%	68%	6%	12%	13%	20%
All sites [*]	83%	79%	9%	12%	8%	9%

*Chi squared p<0.05

[†] Chi squared (impaired) p<0.05

[^]Chi-squared test (males) p>0.10

[#]Chi-squared test (females) p>0.10

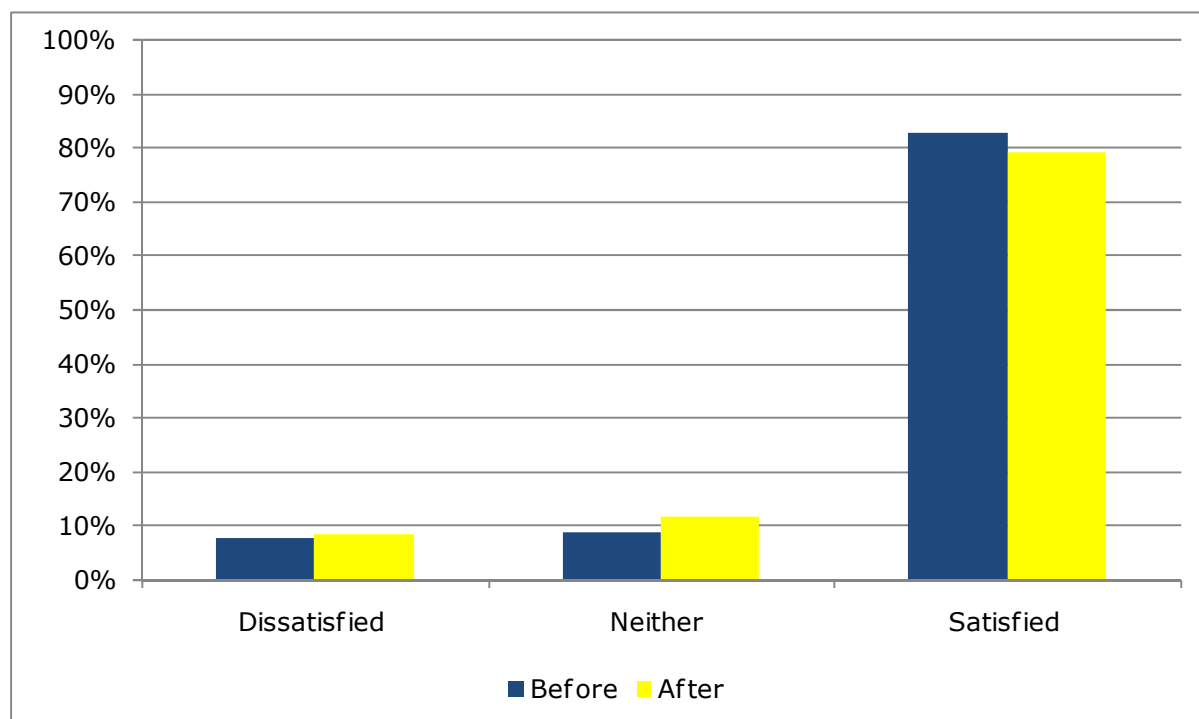


Figure 4-5: How satisfied were you with the amount of time you had to cross the road? (all sites combined)

Table 4-5: Did you feel at all rushed when crossing the road?

Site	Yes, felt rushed		Yes, little rushed		No	
	Before	After	Before	After	Before	After
00/022	6%	16%	27%	37%	67%	47%
00/025	13%	17%	10%	23%	78%	60%
00/052	12%	12%	31%	48%	57%	40%
05/066	25%	9%	32%	46%	42%	46%
08/028	4%	5%	21%	30%	75%	65%
09/021	3%	9%	25%	10%	72%	81%
10/007	8%	5%	22%	22%	71%	73%
10/013	11%	16%	32%	23%	58%	61%
10/123	14%	8%	26%	27%	60%	66%
Males [^]	13%	12%	22%	25%	66%	63%
Females [#]	8%	9%	29%	31%	63%	60%
Impaired [†]	7%	22%	30%	38%	63%	40%
All sites [*]	10%	10%	25%	28%	64%	61%

*Chi squared p>0.10

[†] Chi squared (impaired) p<0.01

[^]Chi-squared test (males) p>0.10

[#]Chi-squared test (females) p>0.10

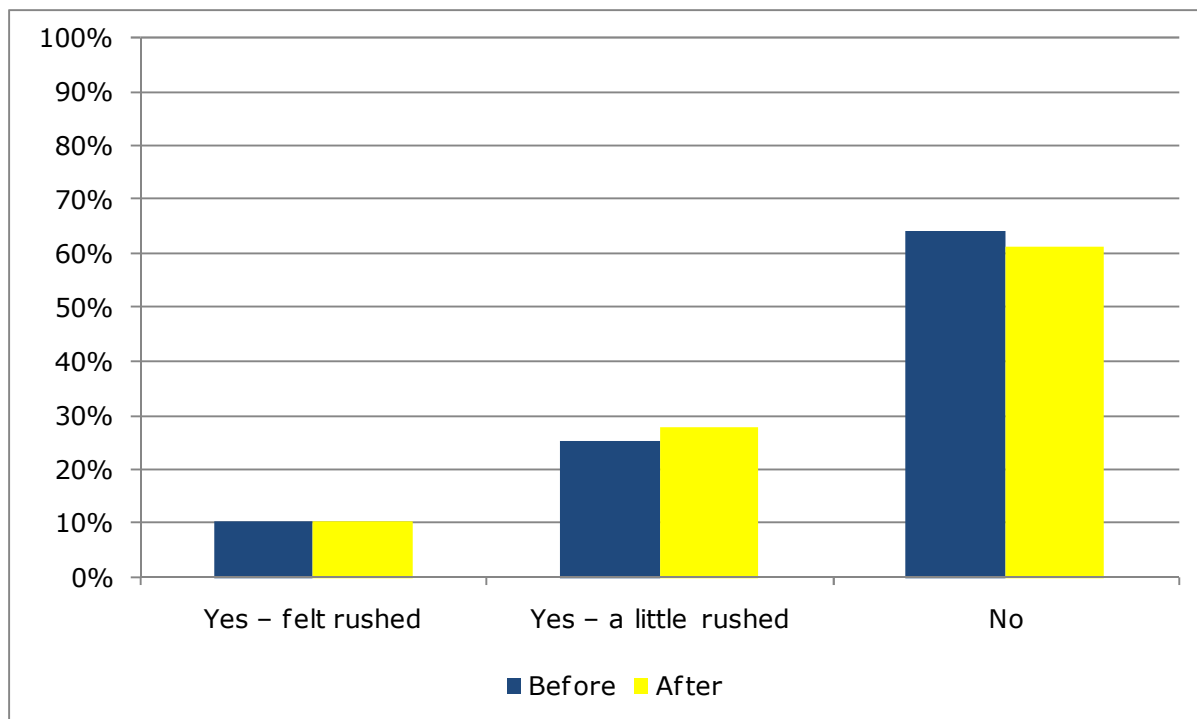


Figure 4-6: Did you feel at all rushed when crossing the road? (all sites combined)

Did you feel at all rushed when crossing the road?

The responses to this question (in Table 4-5) suggest that most people did not feel rushed, but that proportion decreased at four of the sites and overall, although this was not a statistically significant reduction. No significant change in the distribution of the responses was observed within the male and female subgroups. There were some large changes in responses at some sites for example Site 00/022, however overall the proportion of people who felt they were rushed rose only a little from 35% before to 38% after the pedestrian timing was changed. The proportion of people classified as impaired or accompanied by an impaired person who felt rushed increased significantly in the after period by about a third. There was an equivalent increase in those who felt rushed whilst crossing the road in the after period compared to before the changes in pedestrian timings.

How satisfied were you that it was clear when it was safe to cross the road (either by seeing the green man or hearing the signal)?

Table 4-6 and Figure 4-7 show that most people were satisfied, although the proportion of people satisfied was lower (around three quarters) at Sites 00/022 (before and after), 05/066 (before) and 10/013 (before). Once the pedestrian timing had been changed, overall significantly more people (mostly women) were satisfied that it was clear when to cross the road. However, of the impaired group, fewer were clear when it was safe to cross after the re-timing.

Table 4-6: How satisfied were you that it was clear when it was safe to cross the road?

Site	Satisfied		Neither		Dissatisfied	
	Before	After	Before	After	Before	After
00/022	77%	69%	21%	21%	3%	10%
00/025	86%	87%	5%	6%	10%	6%
00/052	94%	90%	4%	5%	1%	5%
05/066	75%	91%	8%	4%	17%	4%
08/028	87%	87%	6%	8%	7%	5%
09/021	94%	97%	4%	1%	1%	1%
10/007	86%	95%	9%	2%	5%	3%
10/013	74%	85%	17%	10%	9%	5%
10/123	89%	85%	10%	10%	1%	5%
Males [^]	85%	86%	8%	10%	6%	4%
Females [#]	83%	89%	12%	5%	5%	6%
Impaired [†]	83%	78%	11%	8%	6%	14%
All sites [*]	84%	88%	10%	7%	6%	5%

*Chi squared $p < 0.05$

[^]Chi-squared test (males) $p > 0.10$

[†] Chi squared (impaired) $p < 0.05$

[#]Chi-squared test (females) $p < 0.01$

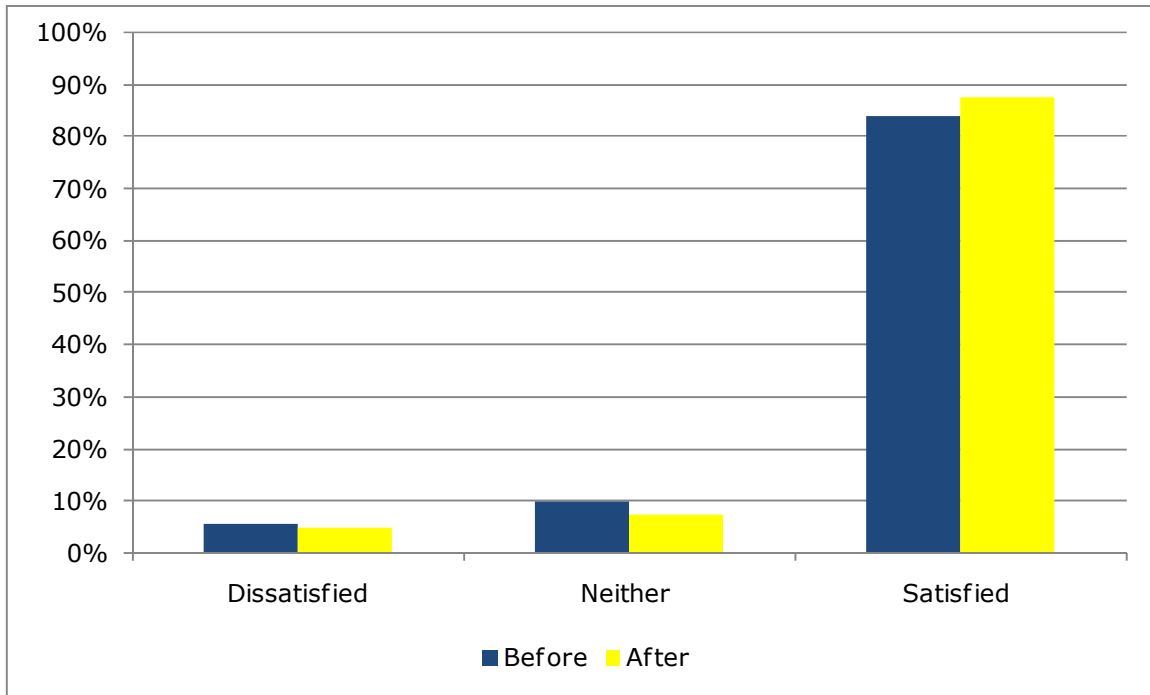


Figure 4-7: How satisfied were you that it was clear when it was safe to cross the road? (all sites combined)

How satisfied were you with the ease of getting on and off the kerb to use this crossing?

For all sites few of those interviewed found it difficult or unsatisfactory to get on and off the kerb to use the crossing. Details for each site can be found in Table 4-7 and Figure 4-8 below. Responses at each site varied in their difference between the before and after period, however a significant difference in the distribution was observed with a higher proportion of people overall, and in the female group being satisfied and fewer dissatisfied or indifferent in the after period.

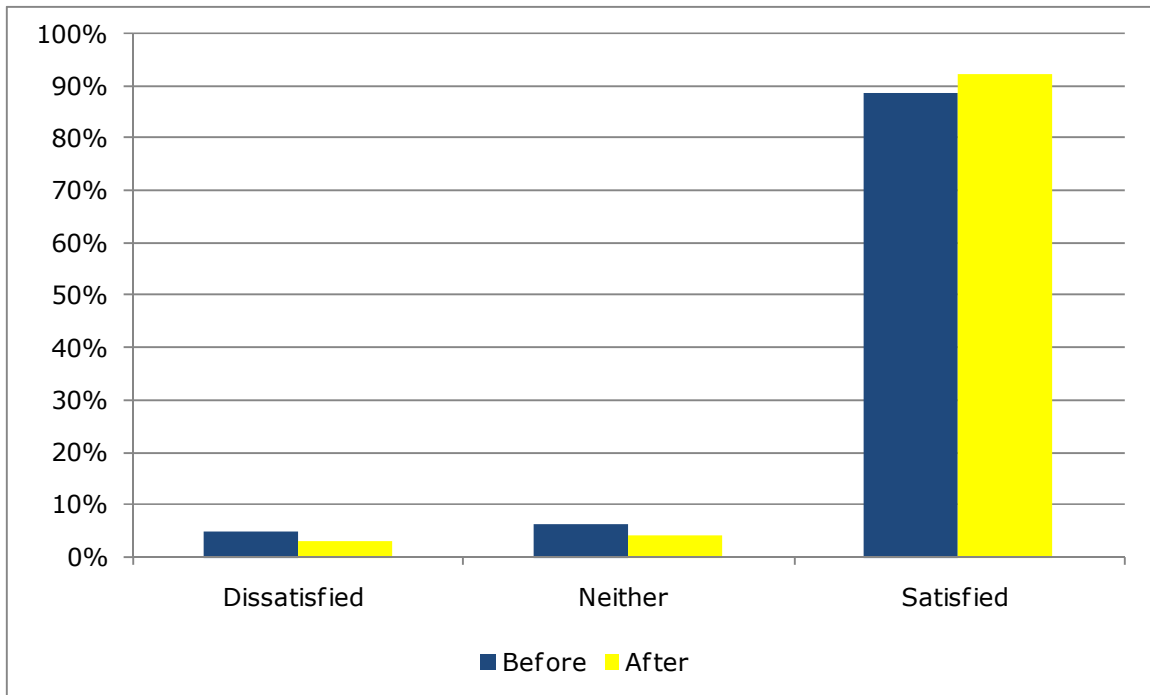


Figure 4-8: How satisfied were you with the ease of getting on and off the kerb to use this crossing? (all sites combined)

Table 4-7: How satisfied were you with the ease of getting on and off the kerb to use this crossing?

Site	Satisfied		Neither		Dissatisfied	
	Before	After	Before	After	Before	After
00/022	92%	84%	8%	12%	0%	4%
00/025	87%	96%	11%	1%	2%	3%
00/052	85%	97%	7%	3%	7%	0%
05/066	92%	89%	0%	7%	8%	4%
08/028	96%	94%	1%	5%	3%	1%
09/021	93%	96%	6%	1%	1%	3%
10/007	85%	96%	8%	2%	8%	2%
10/013	83%	90%	8%	4%	10%	6%
10/123	89%	89%	7%	6%	4%	5%
Males [^]	90%	93%	6%	5%	4%	3%
Females [#]	88%	92%	7%	4%	5%	4%
All sites [*]	89%	92%	6%	4%	5%	3%

*Chi squared $p < 0.05$ [^]Chi-squared test (males) $p > 0.10$ [#]Chi-squared test (females) $p < 0.05$

The satisfaction of crossing time, clarity of signal to cross and ease of crossing at a particular site can be combined by assessing how safe a person feels in using that crossing. Table 4-8 and Figure 4-9 show the responses to the question.

How safe or unsafe would you say you felt using this particular crossing?

High proportions of people felt safe using the crossing, although some attention should be drawn to Sites 10/013 and 05/066 where the feeling of safety is comparatively low. Some sites were perceived to get safer in the after period, and some less safe. Overall no significant change in the responses was detectable, however in the impaired group, a significant change in the distribution of responses was observed with fewer people feeling safe whilst crossing in the after period.

Table 4-8: How safe or unsafe would you say you felt using this particular crossing?

Site	Safe		Neither		Unsafe	
	Before	After	Before	After	Before	After
00/022	81%	72%	12%	10%	8%	18%
00/025	79%	81%	14%	9%	6%	10%
00/052	78%	73%	16%	18%	6%	8%
05/066	75%	67%	8%	17%	17%	15%
08/028	88%	77%	4%	13%	7%	10%
09/021	87%	90%	7%	3%	6%	7%
10/007	83%	91%	6%	3%	11%	6%
10/013	55%	66%	21%	18%	24%	16%
10/123	70%	78%	24%	13%	6%	9%
Males [^]	79%	79%	12%	10%	9%	10%
Females [#]	74%	77%	14%	12%	12%	11%
Impaired [†]	70%	58%	19%	12%	11%	30%
All sites [*]	76%	78%	13%	11%	10%	11%

*Chi squared p>0.10

† Chi squared (impaired) p<0.01

[^]Chi-squared test (males) p>0.10

[#]Chi-squared test (females) p>0.10

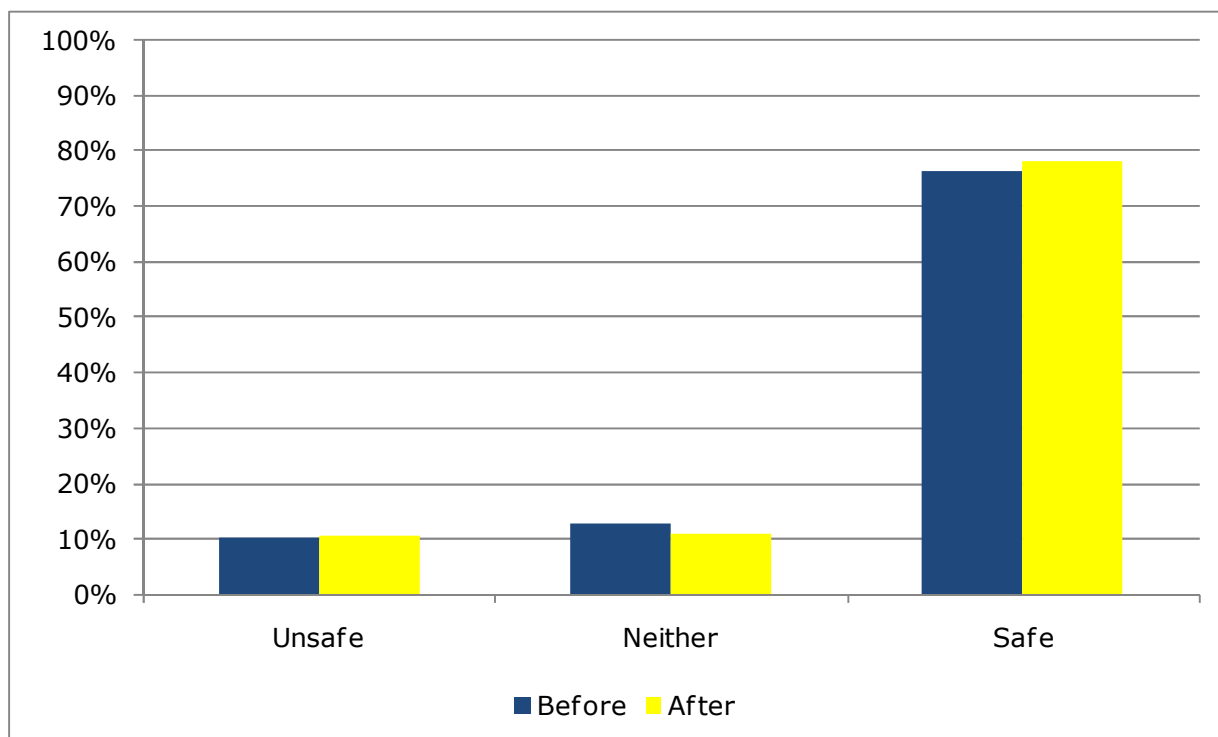


Figure 4-9: How safe or unsafe would you say you felt using this particular crossing? (all sites combined)

4.2.3 Changes noticed

The interviewees were asked:

Did you notice that when the green man disappears, there is a blackout period (i.e. the pedestrian signal is blank) before the red man appears?

Similar proportions of people noticed the blackout period before and after the changes in pedestrian phasing; however when the sample is split by males and females then changes in distribution are observed: more males and fewer females observed the blackout in the after period compared to before (Table 4-9).

Table 4-9: Proportion of interviewees who noticed that when the green man disappears, there is a 'blackout' period before the red man appears.

Site	Before	After
00/022	49%	32%
00/025	29%	31%
00/052	22%	25%
05/066	54%	35%
08/028	34%	51%
09/021	27%	46%
10/007	37%	37%
10/013	43%	30%
10/123	26%	34%
Males [^]	36%	40%
Females [#]	36%	32%
Impaired [†]	34%	30%
All sites [*]	36%	36%

*Chi squared $p > 0.10$

[†] Chi squared (impaired) $p > 0.10$

[^]Chi-squared test (males) $p < 0.10$

[#]Chi-squared test (females) $p > 0.10$

All interviewees were then asked 'What do you think this blackout period means?'. Figure 4-10 shows the proportion of pedestrians' and the proportion of impaired pedestrians' responses that were correct, incorrect and those who did not know. Around 60% of all pedestrians did not know or gave a wrong answer, and 40% gave a correct interpretation. Of those who had an impairment, a higher majority (67%) did not know what the blackout period meant. Some responses that were made included 'If I have not yet started to cross I should not start to do so', 'There is still time for me to cross safely', 'the green light is about to be shown to the traffic at the crossing', 'broken circuitry', 'run or hurry up', 'change to red man' and 'amber'.

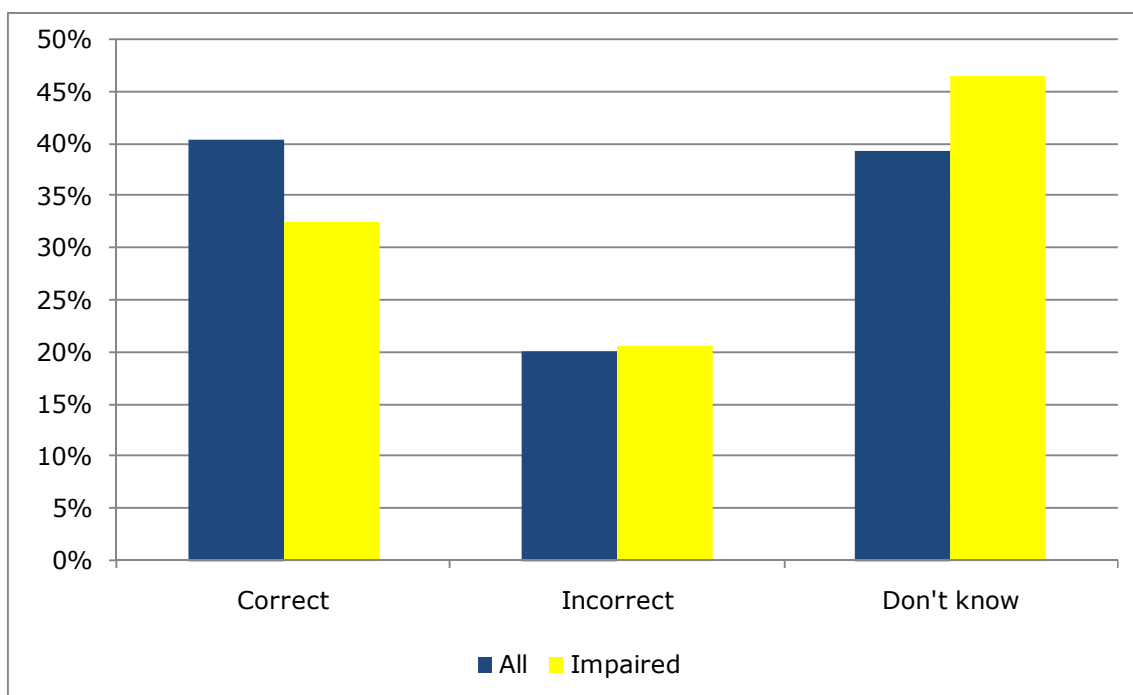


Figure 4-10: What do you think this blackout period means? (all sites combined)

Finally, the respondents were asked if they had noticed any changes to the crossing and what they thought those changes might be. Table 4-10 shows that few people had noticed any changes, and overall more people said they had noticed changes in the before period than afterwards.

Table 4-10: Proportion who noticed any changes to the way this crossing operates?

Site	Before	After
00/022	3%	6%
00/025	6%	1%
00/052	4%	3%
05/066	12%	4%
08/028	6%	3%
09/021	1%	3%
10/007	2%	0%
10/013	5%	12%
10/123	3%	0%
Males [^]	7%	4%
Females [#]	2%	3%
Impaired [†]	3%	6%
All sites [*]	5%	3%

*Chi-squared $p > 0.10$

[^]Chi-squared test (males) $p < 0.01$

[†]Numbers too small to draw robust conclusions

[#]Chi-squared test (females) $p < 0.10$

Only two impaired people reported that they noticed a change before the re-phasing, and three in the after period. So it is not possible to draw robust conclusions from this sample.

Comments made by respondents were generally based on the timing of before and after the green man changed (some noticed longer periods and some noticed shorted periods in both surveys). Other comments included: 'the signals appearance was clearer', 'sequencing was different on the filter light which cause problems in certain days' and one interviewee thought 'phasing is worse for pedestrians; blind spot for traffic'. These comments were equally distributed across the before and after period.

4.3 Summary

Overall, there seems to be little effect on pedestrians' satisfaction after the changes had been made to the pedestrian timings. However, pedestrians with impairments or those accompanied by impaired people were strongly affected. Significantly fewer pedestrians in this category were satisfied with the amount of time they had to cross, fewer felt safe whilst using the crossing and a higher proportion felt rushed when crossing the road in the after period. A significantly higher proportion of impaired pedestrians noticed the change in the after period compared to before.

5 Results - Accompanied Walks

5.1 Findings

Digital recordings of all the sessions were listened to by the researchers for this qualitative task and case studies for each of the participants written up (see Appendix E). The case studies were then summarised and analysed using a variant of Thematic Content Analysis. Key themes, findings and exceptional results are outlined below.

5.1.1 Observations by researcher

As observed in the pedestrian behaviour section of this study 52% of all pedestrians crossed the experimental crossings during the red man phase. However, most of the participants on the Accompanied Walks waited until the green man before crossing.

As can be seen in the sections below, more of the participants were only halfway across the road when the blackout period occurred on the two experimental crossings (test 1 and test 2) compared to when crossing the control sites (control 1 and control 2). The mean waiting time for participants to receive the green man also seemed longer at the experimental crossings compared to the control sites. The time participants took to cross the road did not vary greatly between experimental or control sites.

5.1.1.1 Crossing: Test 1

- Time to wait for the green man ranged from 26 to 74 seconds (mean of 53).
- Time taken by participants to cross ranged from 8 to 20 seconds (mean of 13).
- The **majority of participants were only halfway across the road** when the blackout period occurred and all but one of these participants stopped in the central refuge for the next phase of green man. One participant only reached quarter of the way across before the blackout period, one only a third of the way, and only one over halfway.

5.1.1.2 Crossing: Test 2

- Time to wait for the green man ranged from 30 to 69 seconds (mean of 48).
- Time taken by participants to cross ranged from 10 to 24 seconds (mean of 15).
- The **majority of participants were only halfway across the road** when the blackout period occurred but three of them carried on to the other side without stopping in the central refuge. Two participants had not progressed as far as the middle when the blackout period occurred, both of whom stopped in the middle for the next phase.

5.1.1.3 Crossing: Control 1

- Time to wait for the green man ranged from 0 to 60 seconds (mean of 24).
- Time taken by participants to cross ranged from 7 to 14 seconds (mean of 11).
- **All but one participant crossed all the way across the road** without stopping at the central refuge for the next phase. This participant only got halfway across before the blackout phase whereas the others were three quarters or all of the way across.

5.1.1.4 Crossing: Control 2

- Time to wait for the green man ranged from 0 to 69 seconds (mean of 48).

- Time taken by participants to cross ranged from 11 to 22 seconds (mean of 17). Streetworks were present on a quarter of the crossing for seven of the Accompanied Walks and appeared to impede the ease and speed of crossing.
- **Five of the participants were almost all the way across** before the blackout phase commenced compared to four who had only made it to the middle of the crossing (for two of these the streetworks were present). Three of these four participants stopped in the middle for the next phase whereas one carried on during the blackout phase.

5.1.2 (Immediate) Observations by participants

Participants tended to strongly express their opinion that they had to wait a long time for the green man and that the green man phase was very fast for the two experimental crossings (test 1 and test 2). This is in contrast to their immediate impressions of the control crossings (control 1 and control 2) where these opinions were not explicitly expressed.

"It was quite fast and I only got halfway across before the green man went off and I knew I had to stop then... it seemed to take a long time before they changed [to green man]" (crossing test 1, participant number 7).

"It's annoying because you don't expect to have to stop in the middle." (crossing test 2, Participant 4)

Participants also felt that the experimental crossings were very busy and therefore dangerous, although the control crossings were busy with pedestrians as well. They also expressed that the experimental crossings would be improved with tactile paving on the central refuge.

There was an assumption at the two control crossings that the intention was for pedestrians to cross all the way in one attempt (perhaps due to the width). Participants did generally feel that if the intention was for them to wait in the central refuge rather than crossing all the way – and there was some confusion over whether this was the case or not - that there should be another traffic light for pedestrians to indicate when it was safe to cross rather than just the one at each side of the junction and that there should be sufficient space for them to wait, particularly for wheelchairs and pushchairs.

Other thoughts on all four of the crossings – such as the presence of audible signals, tactile paving, rotating cones, or angle of the junction - varied by participant but there was no pattern for experimental versus control crossings. These other comments included the following:

- Crossings test 1, control 1 and control 2 would ideally have audible signals;
- Crossing test 1 would be improved with pedestrians traffic light in the central refuge;
- There should be rotating cones at Crossing test 2 and those at Crossing control 2 were not working;
- There was only a push box on the right-hand side of Crossing test 1 (west to east);
- There was confusion over whether the two halves of the crossing were independent of each other at Crossing test 2;
- The angle of the crossing was considered steep at Crossing control 1;
- The road works across part of Crossing control 2 were of concern to some participant, particularly those with vision impairment;

- Road surface at Crossing test 2 needs smoothing and flattening (especially as there was a large puddle on one side which was troublesome to manoeuvre around/over). Step in central refuge not ideal; and
- Push button control box on west side of Crossing test 2 angled towards back of pavement rather than to side so awkward position to stand at 90 degrees to the road (vision impaired participant who used rotating cones to know when safe to cross).

5.1.3 Participant reflections on all four crossings

5.1.3.1 Time to wait for green man phase

There was a tendency for participants to feel that they **had to wait too long at the two experimental crossings** (test 1 and test 2), particularly test 1. This was thought to be made worse by those who felt they had to wait in the central refuge for another phase of the lights. It was rare for participants to feel that they had to wait too long at the two control crossings.

"The first one [test 1] I had to wait a little while and I was a bit peed off with that and the second one [test 2] I waited a long time. I didn't like those two crossings to be honest. The third one [control 2] was a bit better. The fourth one [control 1] I had to wait a little while. That was the busier junction and I think there was more people crossing there but it was ok." (Participant 5).

Generally, it was accepted that the larger the junction, the longer the wait would be for the pedestrian until the green man phase.

5.1.3.2 Blackout period

It was more common for participants **not to have consciously noticed the blackout phase**. One participant did notice it on the two experimental crossings (test 1 and test 2).

There was a split between those who thought the blackout period meant that they had a couple of seconds leeway and that they could carry on if they had already started crossing or the **same as the 'green flashing man'**; and those who thought that the green man disappearing **meant red man and so not safe** to be on the crossing. The latter felt that it may make pedestrians hurry or worried. There were also some who would interpret the blackout phase as an **electrical fault** with the traffic signals. The following quotes from participants illustrates these points:

"That's annoying because you don't know how long it's going to be. For someone like me it's a gamble as to whether you can make it all the way across. You don't know if it's two seconds or twenty seconds." (Participant 4).

"It made me move a bit quicker" (Participant 1).

"I think it makes people hurry across the road. People might think to themselves that traffic is going to start revving their engines. I think it could be a bit frightening for some people" (Participant 5).

5.1.3.3 Length of time to cross the road

It was commonly perceived that the green man disappeared quickly on the two experimental crossings and because **many participants had only reached halfway across they were inclined to wait in the central refuge** rather than cross the second half of the crossing. As one participant explained:

"The green man went out and I was only halfway [so stopped at the central refuge]... if it had gone out when I only had a third of a way to go then I would have carried on." (Participant 5).

The following quotes show how most participants felt about the length of time they had to cross the road on the experimental crossings:

"Sometimes you wish it would stay [green] just that little bit longer because it's hard to mobilise yourself again for the second bit when you just want to go." (Participant 2).

"I thought that those crossings [test 1 and test 2] were different from other crossings in general around London in terms of significantly less time to cross and longer to wait, even compared to relatively busier places like Oxford Street." (Participant 4).

For the vision impaired participant who **relied on either the rotating cones or audible signals** to let them know when it was safe to cross, crossing test 2 seemed like it had the least time to cross because *"the audible beeps didn't last long enough and when they stopped I didn't know whether it was safe to cross"* (Participant 6). The other crossings did not have audible signals and so this was not so evident to this participant.

It was pointed out that **if the participants had known the crossings then it could affect whether they would cross all the way** as they would become familiar with how much time was available to cross before the traffic started moving again.

There was some **uncertainty amongst participants about whether or not it was intended that they cross all the way or treat the two halves of the crossing independently**. Some felt that because there was a push button control box in the middle that they would have to wait there whilst the fact that there was only a 'green/red man' display box at either side suggested that it was all one crossing. Some admitted that after the first crossing they expected to have to wait in the middle (particularly if the order of crossings involved the experimental crossings first). There were **mixed feelings about having to wait in the middle**, with some of the opinion that at busy junctions it was to be expected and that if there was sufficient space it was acceptable whereas others, especially if they considered that they progressed at a 'normal' speed, that it was an annoyance.

Whilst other pedestrians not involved in this study crossed whilst the red man was displayed to them, there was a tendency for participants to be **extra cautious** and wait for the green man rather than give in to a *"false sense of security"* by trusting when other pedestrians crossed.

5.1.3.4 Feelings about crossings

Words used to describe how participants felt **about the length of time they had to cross** the road (particularly at the experimental crossings as described above) included: **rushed, uneasy, hurried, and annoyed**.

However, there was also a tendency for participants in the sample to feel **confident generally due to their familiarity with crossings** in London. Busier junctions were considered difficult or concerning especially those which involve heavier traffic or require them to look in different directions when crossing.

Some felt **intimidated if the central refuge was insufficiently wide** whilst there was also **confusion** about whether they were expected to cross only to this point or the whole crossing.

Particular circumstances where participants reported feeling **unsafe** include where there were **road works** on part of the crossing, when there was **no audible/tactile information** (for the vision impaired participant), and in particular when **traffic continued to move during the pedestrian phase**. The latter occurred several times during the study, including a taxi, bus, a couple of cyclists, and several cars.

5.1.3.5 *Suggested improvements to crossings*

In addition to those improvement suggested above in section 5.1.2 for specific crossings, the following general features were considered desirable for any crossing by the participants of the Accompanied Walks, as expressed during the course of the study:

- Filter lanes for traffic so that pedestrians can predict where the traffic is going to go (direction);
- Ensuring that traffic does not continue to proceed during the pedestrian phase;
- (Louder) audible beeps to indicate when safe to cross for vision impaired and others;
- Avoiding ambiguity by not having a blackout phase but rather distinct green man or red man phases;
- Reassurance of central refuge in case unable to cross all the way – with a push button in case get 'stranded' there and wide enough to accommodate a wheelchair;
- Having a light display signal box in the central refuge if there is one to aid vision impaired pedestrians and/or have little 'green/red man' above the WAIT signal box;
- Replace the blackout phase with an 'amber man' phase as should be clearer to pedestrians especially those who are also drivers;
- Carry out maintenance work across crossings at less busy times, i.e. weekends;
- Tactile paving of contrasting colour to indicate edge of pavement and central refuge (though others found it annoying);
- More posts or objects to rest on near crossings;
- Push button control box on both left and right hand sides of each side of crossing;
- Allow pedestrians to see what signal is shown to traffic so can interpret blackout;
- Working rotating cones on the signal control box;
- Lower kerbs and level smooth surfaces on crossing; and
- Count down in seconds until the red man phase; and
- Longer period of green man for pedestrians particular during busier pedestrian periods.

6 Discussion

This project comprised a before and after study to consider possible pedestrian behaviour and safety implications which might be associated with the re-timing of traffic signals such that the pedestrian 'invitation to cross', or green man, time would be reduced. Consideration was also given to vehicular throughput and the views of pedestrians. The views of pedestrians with a range of mobility or visual impairments were also sought.

Compliance

Pedestrian compliance with the signals deteriorated following the re-timing. There was an increase of 13.8% in the number of pedestrians who began their crossing whilst a red man was displayed.

Similarly, the number of pedestrians who began their crossing during the blackout period increased by 6.9%.

The number of pedestrians who began to cross whilst a green man was displayed decreased by 11.6%.

Use of Refuge

About 95% of pedestrians who stopped on a central refuge had begun their crossing whilst a red man was displayed. There was an increase of 15.8% in the number of pedestrians who stopped in the central refuge. This increase was too large to be attributed to an increase in overall pedestrian traffic.

The increase in pedestrians who crossed on the red man and who stopped in the refuge was broadly proportionate to the increase in the incidence of pedestrians crossing on the red man. A similar pattern is observed for pedestrians who start to cross during the blackout period.

The numbers of pedestrians who began crossing whilst a green man was displayed and who then stopped in the central refuge was a very small proportion of the total central refuge usage. However, the numbers of pedestrians crossing on the green man who stopped in the refuge increased following the re-timing (from 1.8% of the total to 3.7% of the total) and this was despite a decrease in the incidence of pedestrians crossing on the green man.

As such, the reduction in the available green man time was associated with an increase in the number of people who did not cross the complete crossing width in one go. Although this increase involved pedestrians crossing during all signal conditions, the percentage increase in pedestrians seeking refuge, who had begun their crossing whilst a green man was displayed, was particularly notable.

Observations of the participants on the Accompanied Walks identified a tendency for pedestrians to only get halfway across the road when the blackout period occurred on the two experimental crossings compared to the two control crossings where it was more common for participants to reach the other side in one attempt. The use of the central refuge by participants on the experimental crossings was therefore greater than at the control crossings. Participants tended to assume that the intention was for them to wait in the central refuge rather than treat it as one continuous crossing. There were mixed feelings about having to wait in the middle however, particularly with concern over the limited space and perceived increased waiting time for the green man (which was matched by the researcher observations).

Crossing Times

Actual crossing times were considered and it was found that they varied considerably from site to site and that they were little changed between the before and after periods.

Some pedestrians were observed crossing at speeds which were slower than the assumed speed of 1.2m/s (used for calculating the blackout period). However, the vast majority of pedestrians exceeded this speed and the data indicated that the crossing speeds of slower pedestrians or pedestrians with mobility impairments approximates to the assumed crossing speed of 1.2m/s.

Conflicts

The total numbers of conflicts observed was similar during the before and after study periods and, as would be expected, most conflicts were minor. Approximately 90% of conflicts involved a pedestrian who had begun to cross when a red man was displayed. The more serious conflicts reduced in number but the numbers involved were too small a figure to draw reliable inferences from.

The number of grade 2 conflicts increased from 51 in the before period to 78 in the after period and there was a corresponding reduction from 739 to 714 grade 1 conflicts. There was therefore an increase in the severity of the more minor grades of conflicts recorded during the study periods.

Although the total number and rate of conflicts was little changed between the before and after periods, there was an increase in the number which involved pedestrians who had begun crossing whilst a red man was displayed. (There was a corresponding decrease in the number of conflicts associated with pedestrians who had begun to cross on a green man or during a blackout period).

There was a notable increase in the severity of some of the more minor (grade 2) conflicts. This increase was large in percentage terms (from 51 to 78) although the numbers involved comprised just 129 out of a total of 1,623 observed conflicts.

About 90% of grade 2 conflicts involved a pedestrian crossing whilst a red man was displayed and this was consistent with the rate for other conflict severities. The increase in grade 2 conflicts involved pedestrians who were crossing well into the red man period and, as such, the change did not appear to be associated with the re-timing.

There was also an increase in the numbers of children involved in conflicts although it should also be noted that this was attributable to the situation at just two sites and that, overall, children were involved in less than 2% of conflicts.

Conflict rates per pedestrian, per motor vehicle and per pedal cyclist were largely unchanged although there was an increase in the incidence of conflicts involving good vehicles at one site.

Network Operation

There was a small increase in the number of vehicles passing through most sites but variations were found between sites. Overall, there was a statistically significant increase of 6.5% in the number of vehicles passing through the junctions after the re-timing (excluding site 00/052).

Pedestrian Perceptions

The results of the pedestrian interviews showed few changes overall in people's satisfaction. It appears that the majority of people did not even notice any changes. More extreme changes were observed by impaired people or those accompanied by people with impairments.

The results of the interviews suggest that more people waited for the green man to cross after the changes were implemented than before which is contradictory to the conclusion drawn from the road user observations. Fewer people were satisfied with the time they had to cross and there was a large drop in the proportion of impaired people who were satisfied in the after period compared to before re-timing. Overall, those who were interviewed did not feel more rushed after the re-timing, nor did they perceive the crossing to be any less or more safe. However, people with impairments were significantly more likely to feel they were rushed in the after period compared to the before period, and a larger proportion did not feel safe when using the crossing in the after period.

Even though the majority of people worked or lived in the area and used the crossings at least twice a week, few noticed any changes, and more noticed changes in the before period.

The pedestrians with mobility impairments, who were accompanied at the crossing sites and subsequently interviewed about the experience, generally complied with the pedestrian signals. The majority of participants had not completed crossing the road when the blackout period began.

Participants in the Accompanied Walks study tended to express strongly and unprompted that they had to wait a long time for the green man to appear and that the green man phase was very fast at the two experimental crossings in contrast to their expressed opinions of the control crossings. This made them feel uneasy, rushed or hurried. The blackout phase itself was not consciously noticed by participants. Interpretations of its meaning were mixed with some thinking it must have been due to an electrical fault.

Other observations made by participants on the Accompanied Walks included improvements that could be made to specific crossings in the study - such as having audible signals or smoothing the road surface - and improvements to crossings in general - such as replacing any blackout phase with an 'amber man' phase similar to traffic signals, having a count-down, and having a longer phase of green man for pedestrians during busier pedestrian periods.

7 Conclusions

The objective of this trial was to investigate the possible pedestrian safety implications of a proposed re-timing of certain traffic signals in London. This was to be assessed by consideration of conflict study data. Pedestrians using the crossing and pedestrians with a range of impairments were to be interviewed to investigate their perceptions of the re-timing and vehicle throughput was also to be considered.

The re-timing involved a reduction in the 'green man invitation to cross' time available to pedestrians and it was found that this was associated with an increase in the numbers of pedestrians who failed to comply with the signals and began to cross either during the blackout period or when a red man was displayed.

About 95% of pedestrians who stopped in the central refuge had begun to cross whilst a red man was displayed. The increase in the number of pedestrians crossing on a red man following the signal re-timing was associated with a similar increase in pedestrians stopping in the central refuge.

About 90% of conflicts involved a pedestrian crossing whilst a red man was displayed and the total number of conflicts was very similar in the before and after periods. There was an increase in the numbers of conflicts involving a pedestrian who had begun to cross whilst a red man was displayed and, overall, this was offset by the reduction in conflicts involving pedestrians who had begun to cross during the blackout period or whilst a green man was displayed.

There was a notable increase in the severity of the more minor conflicts. However, although the increase was large in percentage terms (an increase from 51 to 78), the numbers involved comprised just 129 out of a total of 1,623 observed conflicts.

About 90% of grade 2 conflicts involved a pedestrian crossing whilst a red man was displayed and this was consistent with the rate for other conflict severities. The increase in grade 2 conflicts involved pedestrians who were crossing well into the red man period and, as such, the change did not appear to be associated with the re-timing.

There was no conclusive change noted in the rate of involvement of any particular type of vehicle or age or mobility of pedestrians in the observed conflicts.

Pedestrians crossing speeds were found to vary considerably between sites and between pedestrians. However, they were little changed between the before and after periods. The vast majority of pedestrians exceeded this speed and the data indicated that the crossing speeds of slower pedestrians or pedestrians with mobility impairments approximates to the assumed crossing speed of 1.2m/s.

The re-timing was not associated with any observed increases in crowding of footways or central pedestrian refuge areas although such crowding was only observed at three of the nine study sites.

There was a small increase in the number of vehicles passing through most sites but variations were found between sites. Overall, there was a statistically significant increase of 6.5% in the number of vehicles passing through the junctions after the re-timing (excluding site 00/052).

Most pedestrians did not notice the change to the re-timing and their levels of satisfaction with the waiting time for the crossings was unchanged. Nevertheless, there was a reduction in the numbers who were satisfied with the time provided for crossing.

There was also an increase in the numbers of pedestrians with mobility impairments who felt rushed or unsafe at the sites where the signals had been re-timed.

Appendix A Pedestrian Observations Survey Form

Effect of retimed traffic signal controlled junctions on road users in London

Pedestrian Data

Site number	
Date	
Start time	End time

IGNORE all red boxes

Cumulative total for 15 min sample in each hour of the 4 hour survey

Hour	Hour 1	Hour 2	Hour 3	Hour 4	TOTAL (sample)	TOTAL (hours)
No. of times ped stage runs					0	0
No. of peds starting to cross	Red Man				0	0
	Green Man				0	0
	Blackout				0	0
No. of peds who stop in refuge, who started in...	Red Man				0	0
	Green Man				0	0
	Blackout				0	0
No. of times footway gets congested with peds					0	0
No. of times refuge gets congested with peds					0	0
Total number of peds crossing the road within crossing area					0	0
Total number of vehicles through crossing					0	0
Total number of cycles through crossing					0	0

One crossing sample every hour (up to maximum of 5 peds)

Hour 1					
	Arival time at crossing	Time green man shown	Time started to cross	Time finished crossing	Time to cross
Ped 1					00:00:00
Ped 2					00:00:00
Ped 3					00:00:00
Ped 4					00:00:00
Ped 5					00:00:00
Hour 2					
	Arival time at crossing	Time green man shown	Time started to cross	Time finished crossing	Time to cross
Ped 1					00:00:00
Ped 2					00:00:00
Ped 3					00:00:00
Ped 4					00:00:00
Ped 5					00:00:00
Hour 3					
	Arival time at crossing	Time green man shown	Time started to cross	Time finished crossing	Time to cross
Ped 1					00:00:00
Ped 2					00:00:00
Ped 3					00:00:00
Ped 4					00:00:00
Ped 5					00:00:00
Hour 4					
	Arival time at crossing	Time green man shown	Time started to cross	Time finished crossing	Time to cross
Ped 1					00:00:00
Ped 2					00:00:00
Ped 3					00:00:00
Ped 4					00:00:00
Ped 5					00:00:00

Appendix C Accompanied Walks Topic Guide

[Read out the following when meet before commence research]

TRL has been asked by Transport for London to carry out some research into traffic signal controlled junctions in London. Thank you for agreeing to participate in the research. We will be visiting four different traffic signal controlled junctions during this research and you will be asked to cross the road as you normally would. I will ask questions about your experiences throughout the session, which will take no longer than 2 hours. Do you have any objections to the discussions being recorded? This will make it easier for me to concentrate on what you say and not have to take notes. All records will be destroyed at the end of the project and only **anonymised** findings will be reported. Do you have any questions before we start?

[Ask following questions before begin accompanied walks]

1. Background information

Do you consider that you have an impairment which affects day to day life?

How much does this affect you in your daily life (on a scale of 1-10 where 1 is 'only go out when the journey is essential' and 10 is 'make all the journeys I want and am not restricted by mode of transport used' where would you rate yourself)?

What challenges do you face when travelling independently in the street environment?

How do you overcome or address these challenges?

Use of mobility or other aids/ which one(s)

Listen for audible warning signals

Restrict travel to off-peak times

Please could you tell me a little bit about your experiences of moving about the street environment and in particular your use of pedestrian crossings where a button has to be pushed to stop the traffic.

How often do you use these types of (signal controlled) crossings?

Do you ever travel in the street environment with buggies, shopping trolleys, children, older or less mobile people?

[Now proceed to crossings. Order should be alternated between ABCD and DCBA. Reading following instructions.]

We have now arrived at the first crossing. Please cross the road using the signal controlled junction when you are ready. Then please stand away from the edge of the road and wait for me to join you on the other side.

[Researcher observations to be recorded verbally using DVR:

- *Time to cross road – timing on DVR will record*
- *Progress across when blackout occurs*
- *Any hesitancy*
- *Difficulties with the kerb*
- *How many other pedestrians at crossing and any interaction participant has.]*

2. After each crossing

What are your thoughts on your experience crossing here?

Was any aspect particularly challenging?

Have you ever used this particular crossing before?

How often?

When was the last time you used it?

How did your experience compare this time to previously?

[Now go to a place away from the crossings. Use the show cards with pictures of each crossing and remind the participant of the order that they approached them]

3. After all four crossings

How did you feel about the time you had to wait until there was a green man at each crossing?

Did you notice a 'blackout' period?

What did you think it meant?

How did you feel about the length of time you had to cross the road?

Any concerns regarding whether sufficient time?

How did you feel when using each crossing?

Safe or unsafe

Hurried or relaxed

Worried or confident

From your experiences, possibly in other countries, are there any ways that you would improve the crossings?

Second count down visual display

Audible warnings which change depending on time left

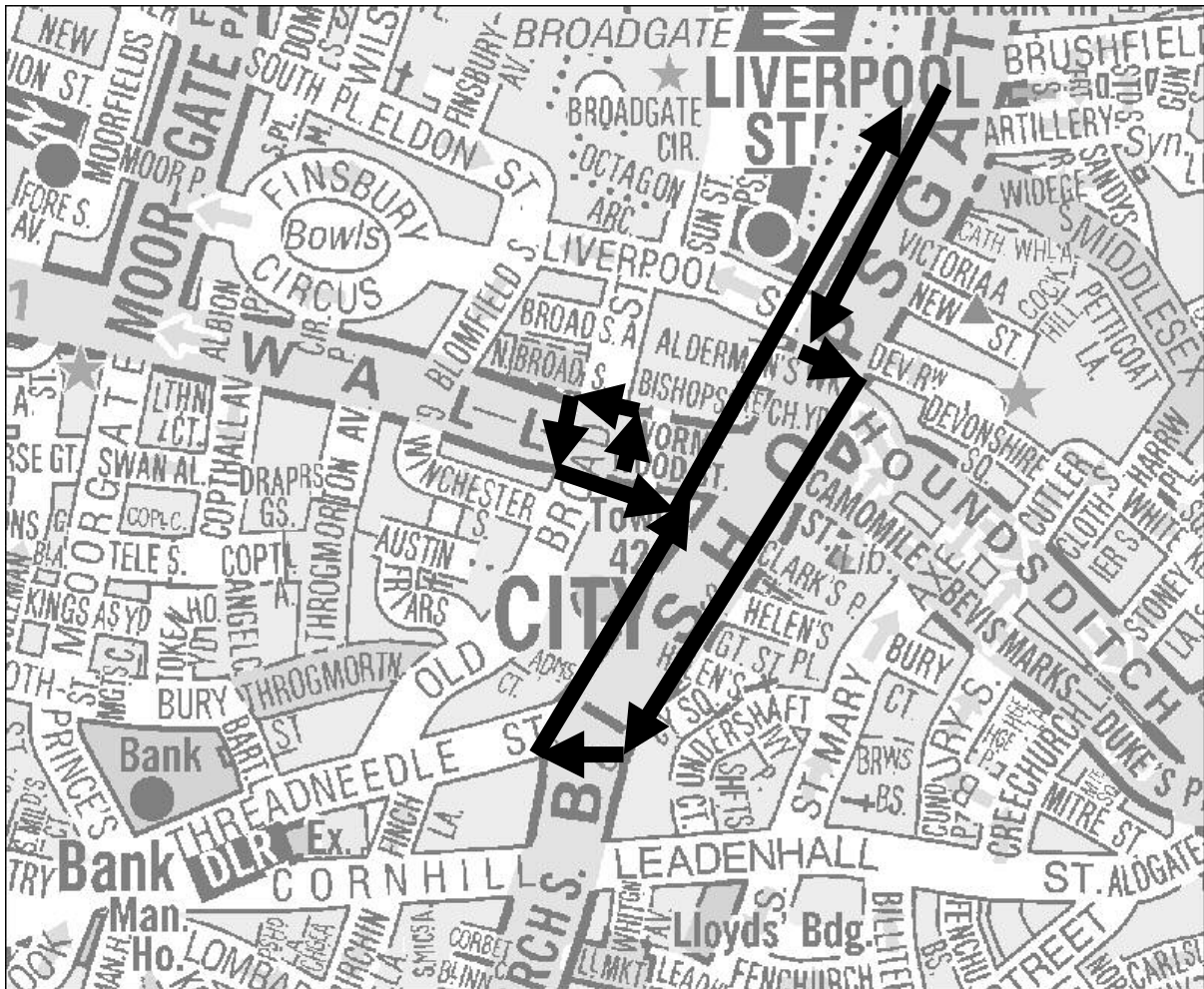
Rotating cones, Handrails, Tactile paving, lowered kerbs

[Now read out the following]

Thank you for your time today. Please now take the participant claim form and freepost envelope to complete and return to TRL with relevant receipts. You will be reimbursed with a few weeks of receipt of the form. You are now free to go.

Appendix D Route taken by Accompanied Walk participants

D.1 Clockwise Route



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Appendix E Accompanied Walks Case Studies

E.1 Case Study 1:

Participant information:

Age – Over 60

Gender – Female

Disability/condition – Vision impairment

Challenges faced –

- Have difficulty focusing with both eyes together.
- Get double vision sometimes so difficult to judge distance of traffic.
- Near signs are fine but underground signs are difficult for example.
- Scale of 1-10 where 1 is only go out when essential and 10 is no restrictions = 10.

How overcome – I know where I'm going (find out beforehand). Usually have to shut one eye to get a correct perspective.

Use of signal controlled crossings – Happy to cross on own. Used to them and walking around this area.

Study information:

Day and time of participation – Monday 9th February 2009 10.00am-12noon

Order of crossings – Clockwise route

Weather – Raining

Experiences at crossings:

Test 1 (Bishopgate, Camomile Street, Wormwood Street):

Researcher Observations:

Participant crossed on red man to middle of road where no traffic and then waited in middle. Started to edge forward but still red man. Green after 40 seconds of being there. 6 seconds before blackout period and participant got to other side just as it went black (only crossed half the crossing). Other pedestrians crossing on red man too.

Participant Observations:

Didn't find it too challenging. Thought there should have been a green man in the middle because people hop to the central refuge. Crossed to the middle based on the traffic lights to traffic being red so knew safe. Not crossed that one before.

Test 2 (Bishopgate, Threadneedle Street):

Researcher Observations:

The button had been pressed when participant arrived at crossing. Waited 51 seconds for green man. Audible signals. Participant took 7 seconds to get to the middle of crossing just as blackout period starts and participant continues to cross whole crossing taking a total of 16 seconds to cross still during blackout period.

Participant Observations:

Waited for green man due to all of the traffic. No challenges except large puddle just on kerb. *"It did cut out before I got to the end... it was a bit short."* Because it wasn't red participant explained that thought it was safe for another couple of seconds.

Control 1 (Old Broad Street, London Wall, Wormwood Street):

Researcher Observations:

On arrival at the crossing just at the end of the phase (so traffic just about to move off). Some people crossed on red man. Waited for 43 seconds for green man. Participant got to centre after 5 seconds and to other side after 12 seconds, which was 3 seconds after blackout period started (blackout period after 10/11 seconds of green man phase).

Participant Observations:

n/a

Control 2 (Old Broad Street, London Wall, Wormwood Street)²:

Researcher Observations:

Some people crossing on red man. Participant crossed as it went green. Got to the middle after 8 seconds (held up a bit by pedestrians in the centre refuge). Blackout period after 14 seconds and participant just made it to the other side of the crossing.

Participant Observations:

Not find challenging. Felt it was a bit of a long time to wait for green man. Tempted to cross earlier and could see traffic was stopped so could make it to the central refuge (whilst still red man).

Other observations:

Time had to wait until safe to cross – Found a couple a bit slow and think they should have a filter road (A and B). As a pedestrian can cross on the red man phase though if realise it is safe because traffic is on red (is a driver) and *"it saves time"*.

Blackout period – Noticed this on two crossings before got to the other side (couldn't remember which ones)... *"it made me move on a bit quicker"*. Not make feel uneasy because knew that would be red to traffic for a little while even after green man disappears. Don't cross if red man comes up and can see traffic start to move.

Length of time had to cross the road – All felt similar.

Feel when using crossings –

Normal. Used to living in a built-up area so similar crossings to what used to. Felt quite confident and not worried on any of them.

² This crossing had streetworks on this arm of the junction which covered a quarter of the pedestrian crossing on the south side.

Improvements to crossings – Filter lanes for the traffic so pedestrian can predict where traffic is going to go and to regulate the traffic more. Feel safer in areas where there is a lot of traffic because speed is reduced. Cars not going through the red phase for them, i.e. thought taxi and bus did that today.

E.2 Case Study 2:

Participant information:

Age – Over 60

Gender – Female

Disability/condition – Vision impairment.

Challenges faced –

- Can't read anymore even though have very strong prescription glasses
- Don't cook and buy microwaveable meals and go food shopping with daughter
- Can't go on tube anymore on own unless ask someone what platform need and go on buses instead and can't read signs
- On scale 1-10 (where 1 is only go out when essential and 10 is make all journeys I want' = 8
- Happy walking in familiar area and not very happy in unfamiliar areas due to sight

How overcome –

- OK walking around the street environment but carry a white cane to inform people that partially sighted.
- Always wait for green man to cross the road which can see unless very foggy day
- Rely on audible signals to know when green to cross to reassure her.

Use of signal controlled crossings – Very used to pedestrian crossings and use them a few times a week

Study information:

Day and time of participation – Monday 9th Feb 10am-12noon

Order of crossings – Clockwise

Weather – Raining

Other – Had been to area before but not remember any of four particular crossings.

Experiences at crossings:

Test 1 (Bishopgate, Camomile Street, Wormwood Street):

Researcher observations:

- Participant pressed button to cross, on own at crossing to start with then others crossed on red in both directions rather than waiting until green man, took 45 seconds from time of button press to green, took 4 seconds for participant to cross to central refuge just as the blackout period occurs, participant stopped and pressed button looked quite anxious waiting in the middle and potentially not room for many people to wait in the central refuge, other pedestrians continue to cross rush across on red, took 1.10mins from when pressed button to turn to green when waiting on the central refuge, only 7 seconds until blackout period this time but participant made it across second arm 1 second after blackout period.

Participant impressions:

- It's an extremely busy crossing and so you need to take care when crossing and make sure you wait.
- Found it difficult to see the green man from one side of the crossing to the other.
- Didn't hear beeps to say safe to cross.
- *"When I got to the middle it had been green but it turned red so I knew I couldn't continue over until I'd pressed the button again"* (not notice 'blackout' unprompted).
- Had not used this crossing before.

Test 2 (Bishopgate, Threadneedle Street):

Researcher observations:

- Participant pressed button to cross, on own at crossing, took 36 seconds to turn green, there are audible beeps, took participant 5 seconds to get to central refuge at blackout period just as she got there, pressed button at central refuge, participant stepped from middle of central refuge where flat with road surface up to the pavement at the side, couple of other pedestrians crossed on red participant whilst waiting in the middle, took 52 seconds from when pressed button to turn green, blackout after 5 seconds and participant just got to the other side of the road.

Participant impressions:

- Participant heard the audible beeps
- Thought pressed the wrong button when in the central refuge to get across the second half – thought one controlled one direction and the other the other direction.
- Found it a lot easier and not particularly challenging than crossing A because there are less roads leading into it so less traffic.
- *"I got stuck in the middle because the green light had gone out on this side and I realised that you have to re-press it again to cross this side. I don't want to cross when it's not green"*

Control 1 (Old Broad Street, London Wall, Wormwood Street):

Researcher observations:

- Participant pressed button to cross, a couple of pedestrians crossed straight away as turned green after 6 seconds, took 5 seconds to get to the middle and still green, blackout period after 10 seconds and participant was a metre short of the other side of the pavement.

Participant impressions:

- Doesn't mind or feel threatened by having to wait in the middle of a crossing so long as there is an central refuge.
- Heard audible beeps on this crossing.

Control 2 (Old Broad Street, London Wall, Wormwood Street)³:

Researcher observations:

- Participant pressed button and pressed again after 36 seconds of red (possibly not sure if it has registered), other pedestrian crossed ahead of participant on red, took 1 minute 9 seconds from when pressed button to green man, took 7 seconds to get to the middle when still green, blackout period after 13 seconds just as participant arrives at edge of road works on crossing, took 20 seconds to cross in total, continually looking left and right while crossing.

Participant impressions:

- Didn't think the first press had worked as took so long to change. Although someone beeped her to tell her she could go she didn't cross until confident that green. Felt alright when it turned green.
- Thought she crossed all on green and felt alright because it was on green.
- Made sure nothing was coming from the other direction before crossing second part.
- Didn't hear audible beeps.

Other observations:

Time had to wait until safe to cross –

- Don't mind waiting so long as the green man eventually appears, thought that the larger the junction the longer pedestrians need to wait and that traffic has priority.
- *"You have to wait for the lights, that's it"*
- *"At crossings where you have to wait in the middle you have to wait longer because you have to wait for the green man again so that will take you twice as long"*

Blackout period –

- Didn't notice this, thought referring to the blackout period after the red man (i.e. green man, red man, blackout, green man cycle). Thought there might have been a fault especially because at crossing **Control 2** she pressed the button again because she thought it hadn't worked because it blacked out after red man after pressed button.
- *"Stopped in the middle because the green light on the far side had disappeared so it had gone to red"*
- Interpreted the blackout period before red man as red man and not safe to cross.

Length of time had to cross the road –

- Will always wait in the middle of the road if there is a central refuge and it's not green but it *"made me feel like I was taking too long"*
- *"Sometimes you wish it would stay [green] just that little bit longer because it's hard to mobilise yourself again for the second bit when you just want to go" – did*

³ This crossing had road works on this arm of the junction which covered a quarter of the pedestrian crossing on the south side.

not comment on any in particular but thought this in general and thought someone must have worked out how long you need at each crossing

- Would be difficult with a pram as *"you'd be lucky to get halfway and there isn't that much room in the middle"*

Feel when using crossings –

- Felt alright crossing at A because it wasn't too wide to get to the middle.
- Confused at crossing B because thought pressed wrong button when got to middle.
- Felt most difficult crossing was D(E) and D(W) due to traffic coming from different directions and *"it was a big junction"* (because perceived each half of crossings A and B each as separate crossings so they seemed less distance from one side to the other and only had to look one for traffic way)

Improvements to crossings –

- Helps if have an audible beeper because it gives you confidence you can go and they need to be loud enough to hear them over traffic and with hearing of elderly person
- Better if red man all the time not green rather than blackout periods so knew for definite not safe to cross rather than wondering if faulty signal and avoid ambiguity
- Makes you feel safer if you know there is a central refuge to get you halfway
- Put green/red man sign in middle of the crossing or make them much larger so you can see it from the start of the crossing otherwise it is a long distance to see it when across four lanes of traffic especially in poor weather (rain, fog)
- Good to have a push button in middle if there is a central refuge so you don't get stuck there

E.3 Case Study 3:

Participant information:

Age – 40 to 59

Gender – Male

Disability/condition – Mobility impairment

Challenges faced –

- People, especially in rush hour, *those with the big rucksacks just knock you flying*
- Escalators are a bit of a drama for me, because of balance. *People tend to be a bit ignorant and leg it up the left hand side, with their rucksacks, and they bang you, and I've been knocked down... on Piccadilly Line.*
- unnecessary obstructions
- Tend to meet family and nieces in town.

How overcome –

- Avoids rush hour, so arranges meetings for between rush hours.
- Is very mobile.

Use of signal controlled crossings – Uses a car to get into office, and then mostly uses public transport to get around London for meetings.

Study information:

Day and time of participation – Monday 9th Feb 1.30-3.30pm

Order of crossings – Anti-clockwise

Weather – cold and raining

Other – Participant knows the area quite well as works close by. Although he drives into work he often walks around this area, especially as his bank is near one of the crossings. But uses a zebra crossing because it's closer to the bank.

Experiences at crossings:

Control 1 (Old Broad Street, London Wall, Wormwood Street):

Researcher observations:

- Participant pressed button to cross, on own at crossing (4:18) traffic about to move off. When clear of traffic, participant asked if he should go or wait. Asked to cross as would normally cross. While still on red phase, participant crossed the road, taking 7 seconds to complete the cross (4:34 to 4:41). Lights were still on red phase when participant reached the other side. Participant moved very quickly and had no difficulty with crossing.
- 12 seconds of green phase while researcher crossed.

Participant impressions:

- Chose to cross on red because he wanted to get to the middle before they started moving (taking advantage of stationary traffic to cross half the crossing).
- There was a vehicle blocking the second half of the crossing that the participant had to walk around. Participant pointed out that visually impaired people would have difficulty with that situation.
- Based decision to cross the second half of the road on the traffic lights (for traffic)

Control 2 (Old Broad Street, London Wall, Wormwood Street)⁴:

Researcher observations:

- Red when arrived and pressed the call button.
- There were other people crossing the road, and Participant became aware of green phase at 9:19 and started to cross. It was a little difficult to see the green light as a vehicle had blocked the view as it finally cleared the crossing. Participant reached the middle at 9:28, as the blackout period came on, and he stopped in the centre. He pressed the call button in the centre and at 9:50, while it was still showing red phase, he crossed and reached the other side at 9:57.
- Participant took 9 seconds to cross first half and 7 seconds to cross the second half.
- Researcher crossed at green 10:35, middle at 10:44, 10:48 black, 10:51 other side. So researcher took 16 seconds to cross. Blackout period came on at 13 seconds. Red phase had been around 1 minute.

Participant impressions:

- Bit dubious about the roadworks in case of cyclists. Stopped halfway, reason given because "green light went off". Pushed the button at the centre.
- Crossed while still on red because as a driver he recognised that as the traffic was flowing on another arm of the junction he knew traffic ahead of him was not going to move. Also other people were crossing.

⁴ This crossing had road works on this arm of the junction which covered a quarter of the pedestrian crossing on the south side.

Test 2 (Bishopgate, Threadneedle Street):

Researcher observations:

- Red when arrived and pressed the call button (11:56)
- Asked participant to wait until green phase. Taxi driver beeped for Participant to cross in front. Had to indicate we were waiting for green phase, but that was an example of possible external pressure on participant to cross.
- Green phase at 13:00, participant crossing with other pedestrians.
- Blackout period at 13:07 as participant reached centre. Participant continued to cross and reached other side at 13:14
- Participant took 14 seconds to cross the whole crossing, blackout period came on after 7 seconds.

Participant impressions:

- Much more cautious crossing that crossing because in the middle of a junction where cars are coming at speed. Also got the right turn from Threadneedle Street into Bishopsgate so it is more of a two-step thing – walk to middle and evaluate
- When taxi driver beeped, would possible normally have walked to middle on red phase, but would have looked behind the taxi driver to make sure nothing was speeding along.
- At middle, saw that green man had changed to red, remembered people walking next to him so he went with the crowd.

Test 1 (Bishopgate, Camomile Street, Wormwood Street):

Researcher observations:

- Was on red phase when arrived 15:25. Other pedestrians were crossing on red, but participant waited. However he did check what the traffic lights were doing while he was waiting.
- Green phase started at 16:46, Participant reached middle at 16:52 as the phase went black. He continued to cross with other pedestrians and reached the other side at 16:59.
- Participant took 13 seconds to cross the crossing. Blackout period appeared after 6 seconds.
- Took 1min 14 seconds to change to green for researcher to cross. Pedestrians were ignoring the phases and crossing as they wanted.

Participant impressions:

- Waited for the green man because it was a main junction.
- Additional danger zone from not being able to see traffic from behind.
- Quite long to wait for the green man.

Other observations:

Time had to wait until safe to cross –

- *There was quite a long distance between waiting and crossing. On one occasion [Control 2] the green light came but by the time I got to the middle it turned. You said to black, I noticed to red, so I hesitated.*
- Camomile – it was quite a long time to cross.

Blackout period –

- [Control 2] didn't notice blackout period: *probably in my brain I looked at it as a green man going off and thought "red" and concentrated on my walking.*
- What does it mean when the green man goes off? *It means do not cross the road.*
- If you saw the green man disappear and a blackout period before the red man came on, what would you understand by that? *An electrical fault. I just thought there was a delay in the electrics or the timing.*

Length of time had to cross the road –

- *On Camomile ... I was hesitant because of the traffic coming from my right, turning left, so that could be quite dangerous I think (so because of that participant waited for green phase to cross). I think I crossed that in one go. It was accessible, quite a wide road. The first part I was nervous because of the traffic, so that's why I waited. I think the lights stayed on most of the way.*
- *You have a false sense of security, when other people move, it's natural human reaction to move with them, [but I thought I'd] hold back because it only takes one car flying round the corner, or couriers....*

Feel when using crossings –

- *When normally crossing: I tend to be quite mobile ... if I can negotiate I'm going to make that middle, then I do it ... I judge the traffic.*
- *Participant was asked if felt unsafe at any crossing: just the one with the roadworks, digger, at London Wall. They'd fenced it all around but from where I was standing I couldn't tell [if the digger was inside or outside the fence.]*
- *I know London so I wasn't too nervous.*
- *In London people are quite impatient*

Improvements to crossings –

- *Any maintenance [that] needs to be done right on a corner maybe push that off to a weekend.*
- *Why don't they replace the black with an amber? Then you are repeating traffic light signals with pedestrian ones, they say the same thing. Everyone knows that red is stop, amber is go with caution, or wait, and green's go. Probably 60-70% of walkers are drivers. People's minds are quite fickle. If you introduce a new concept then they've got to translate that to wherever they are, what mode of transport they are doing.*

E.4 Case Study 4:

Participant information:

Age – Over 60

Gender – Male

Disability/condition – Mobility impairment

Challenges faced – can be quite slow and get cars honking horns, difficult to cross if not at a pedestrian crossing

How overcome –

- Try to cross at designated crossings
- Walk with a stick for two or three weeks a year
- Have regular coffee breaks to sit down when walking around
- Never walk across on red man as *"I am always conscious that I'm quite slow and something could come that I might not be able to get out the way of"*

Use of signal controlled crossings –

Been using them for 60 years, very familiar now as don't drive anymore

Study information:

Day and time of participation – Monday 9th Feb 1.30-3.30pm

Order of crossings – Anti-clockwise

Weather – Raining

Other – Participant has walked around the area before but not familiar with crossings or remembers them particularly.

Experiences at crossings:

Control 1 (Old Broad Street, London Wall, Wormwood Street):

Researcher observations:

- Green as soon as got to crossing, participant arrived at middle when still green so carried out, blacked out after 10 seconds but a metre from the edge and participant didn't look at green/red man.

Participant impressions:

- Must have used crossing before because been to area before perhaps a year ago but can't remember this crossing specifically
- Fairly normal crossing with a bit in the middle

Control 2 (Old Broad Street, London Wall, Wormwood Street)⁵:

Researcher observations:

⁵ This crossing had road works on this arm of the junction which covered a quarter of the pedestrian crossing on the south side.

- Pressed the button and walked to the edge of the road works, waited until it turned green which took 43 seconds, started to cross straight away, participant took 6 seconds to get to the central refuge when still green, got to other side just as it turned black-out period after 11 seconds. [when I crossed it took 2 minutes to turn green and blacked out after 12 seconds]

Participant impressions:

- *"With that amount of leeway there is certainly plenty of time to get across the two [sections of the crossing] but the bit in the middle is obviously helpful in case you have to wait there".*
- Participant commented that there would be days when his condition was worse and he wouldn't make it all the way across but if wheelchair bound not go out at all.

Test 2 (Bishopgate, Threadneedle Street):

Researcher observations:

- Red light but button was already pressed when participant got there so didn't need to press it, couple of people at crossing who crossed just before it turned green, audible beeps, and green after 50 seconds, went black after 5 seconds and participant was just about to step out from central refuge, but stopped and looked up at blackout and then pressed button in middle, other pedestrians walking across when blackout/red even 26 seconds after blackout period, this time took 1min8sec to turn green, blackout after 5 seconds when participant just got to the other side.

Participant impressions:

- *"It seemed very quick. I'd got to the middle and the lights had gone out."*
- Can work out how quick or slow a crossing is when you get to know an area.
- Annoying amount of water at one side of the crossing so you have to step around or over it.
- Participant said if known the road or knew what the traffic was doing he might have carried on rather than stopping in the middle but didn't know whether traffic going to come round corner.
- Would have used this crossing before a few years ago but couldn't remember the experience of crossing it last time.
- *"It's annoying because you don't expect it [to have to stop in the middle] and you're more likely to have people take a gamble" because green for so short a time.*
- Also seemed a long time that had to wait for green man to show after button pressed – *"it seemed like a long wait but it might have seemed longer because it's wet"*

Test 1 (Bishopgate, Camomile Street, Wormwood Street):

Researcher observations:

- Button had already been pressed when arrived but didn't seem to register as blacked out rather than going green (even though WAIT was illuminated), but other pedestrians crossed so participant also did, stopped in the middle because it went to red man, so he pressed the button in the middle, couple of pedestrians crossed on red man, participant hesitating but looks ready to go, cyclist just went through when green for pedestrians but behind participant, less than 7 seconds until blackout.

Participant impressions:

- Confused about why cars had come through just before crossing first section of crossing as thought it was green for pedestrians because WAIT sign had gone off
- It seemed like a very long wait once button had been pressed when got to middle so *"certainly not good for pedestrians"*
- Very similar to last crossing where *"it [the period of green man] was very fast with a very long wait"*

Other observations:

Time had to wait until safe to cross –

- *"The first two [control sites] were more or less ok but the last two [test sites] seemed quite long"*

Blackout period –

- *"That's annoying because you don't know how long it's going to be. For someone like me it's a gamble as to whether you can make it all the way across. You don't know if it's 2 seconds or 20 seconds"* Thought this would be different if knew the crossing and how much time was available.
- Participant would not start crossing - from kerb at side of crossing or central refuge - if on the blackout period but thought that you should be able to finish crossing if already started and not a good design for anyone (pedestrians or traffic) if have to wait in the middle.
- Interpreted it the same as green flashing man and presume still red for traffic. But having thought about it, because the blackout period seemed to last a long time thought that it must be red and then amber for traffic during that time.
- Also not sure whether it is because the signal has stopped working.

Length of time had to cross the road –

- *"Again, the last two [test sites] I had to stop in the middle because it was so quick. You shouldn't have to and I wasn't walking slowly but more or less normal speed. If I'd had my stick with me I might expect to have to wait in the middle but I thought they were far too quick. "*
- Thought short length of time to cross the road might not be so bad if the wait whilst in the central refuge hadn't been so long but that *"seemed an awfully long time...it felt like three hours in the pouring rain"*.

- Thought that crossings test 1 and test 2 were different from other crossings in general around London in terms of significantly less time to cross and longer to wait, even compared to relatively busier places like Oxford Street. Not uncommon to have a central refuge though.

Feel when using crossings –

- If had been having a worse day, i.e. using stick or even wheelchair participant would have got more “worried” at the speed with which they change.
- The only crossing where felt unsafe was crossing A because the cars went through when thought it was green for pedestrians – thought the signals had stopped working properly.
- *“Having got to the middle it was annoying that it [the green man] then went off [at crossings test 1 and test 2]”*

Improvements to crossings –

- Irritated by things designed for blind people such as tactile surfaces especially annoying with a walking stick
- Like posts and things which can rest on near crossings
- Need audible signals as well as visual ones for vision impaired and non-vision impaired as you might be distracted and especially if there is only a short period when on green man (didn’t think any of the four crossings had them).
- Not a lot of space for a wheelchair in the central refuges if have to wait in the middle especially if there are lots of people around.
- Could improve the situation if know what signal is shown to the traffic so as a pedestrian you can judge whether you can risk crossing all the way.

E.5 Case Study 5

Participant information:

Age – 40 - 59

Gender – Female

Disability/condition – Mobility impairment

Challenges faced –

- Sometimes the stairs, coming up the stairs
- Sometimes bus drivers breaking too hard. *Because I've had a heart operation it seems to me that my chest is weakened... if the driver step on his brake ...sometimes I feel my ribcage is going to split open again*
- *Sometimes the bus cuts out the estate I live on. I can't carry heavy loads so that's difficult for me. So have to walk further.*
- *Don't travel on trains unless I absolutely have to*

How overcome –

- Avoid or restrict journeys.
- Worst part of travelling is to avoid extra walking; I have to plan a journey the long way round to plan a journey with the least amount of walking.
- Has son that sometimes gives lifts.

Use of signal controlled crossings –

- Doesn't live near any crossings, but there is one outside the train station. Maybe uses 4/5 times a week.
- Sometimes travel with elderly people
- Participant said she is quite slow when crossing and would rather wait until she knows it's safe.

Study information:

Day and time of participation – Tuesday 9th Feb 10.00-12.00pm

Order of crossings – Clockwise

Weather – Light rain

Other – N/A

Experiences at crossings:

Test 1 (Bishopgate, Camomile Street, Wormwood Street):

Researcher observations:

- When crossing the previous crossing in preparation for this trial, we got to middle and it wasn't clear we would make the other side in time so we stopped and pressed the button for the second half. Not sure if this will have an effect on how Participant crosses

- Button pressed. Traffic has stopped on this side. 01:10 Participant crossing, she is the only person crossing. 01:16 green man has gone out, participant is in the centre and she has stopped and pressed the button for the next half of the crossing.
- Pedestrians are crossing during the red phase and passing participant on the central refuge.
- 2:35 green phase. Blackout period at 2:41. Participant has reached the other side 2:45
- Participant crossed 1st half in 6 seconds, 2nd half in 10 seconds. Blackout period in 6 seconds.

Participant impressions:

- *It took a long time to cross the road.*
- *I think the traffic was ok but I was a bit frightened by that bus [which overtook a van while Participant was on the central refuge]*
- *I don't like standing in the central reservation at all. I think they could let the green man stay on for a bit longer there.*
- *Hadn't crossed this crossing before.*

Test 2 (Bishopgate, Threadneedle Street):

Researcher observations:

- Pressed button (4:22). Pedestrians crossing on red man. No traffic flowing through on red phase. All traffic has stopped. Traffic moving off again still red phase, participant still waiting to cross. Green phase (5:31), participant crossing. She stumbled slightly on uneven tarmac in middle of first half. At the central refuge (5:37) gone to blackout period. Decided to wait at central refuge and pressed button. There wasn't any traffic but now a taxi has pulled up (5:53). Participant is not taking advantage of the stopped taxi. Traffic has started moving off (6:16). On previous crossing Participant mentioned she was concerned about buses being very close to her when she was on the central reservation. This is a wider central refuge. Pedestrians crossing on red. Green phase (6:55). Researcher crossing first arm while participant crosses second arm. Blackout period (7:02). Participant reached other side (7:07)
- Participant timings: 1st half in 6 seconds, 2nd half in 12 seconds

Participant impressions:

- *It took a really long time [to cross] and I don't think the green man stays on long enough. By the time you get here [to the centre] it's off.*
- *What were you thinking as you crossed? The bit in the middle is not as narrow as the other one. I thought that the road needs fixing [referring to the stumble as she crossed]*
- *When in the middle how did you feel about the traffic around you? It was ok because this bit was a bit wider. When it's narrow you can still feel the traffic that's passing on the other side. So it was ok, ... although it was a bit of a long wait.*
- *Did you feel any pressure to cross when the taxi stopped? I thought "he expects me to cross the road" because any other person would cross the road.*

- *Normally if I was with my children I would wait [has 12 year old twins] and the reason I would wait is one of them has special needs. But if it was me on my own and the traffic had stopped up there... and there was no traffic turning in here, I would have chanced it.*

Control 2 (Old Broad Street, London Wall, Wormwood Street)⁶:

Researcher observations:

- Crossing from this side Participant will need to negotiate the roadworks on the opposite side.
- Button pressed (10:38) currently red phase and traffic is moving. Pedestrians crossing on red phase
- Traffic has stopped on this side. Green light (11:07) Participant now crossing, she is the only person crossing. Passed the middle and green phase is still on. Green man has gone out (11:19), participant has reached roadworks and is going round. Made to other side at 11:26.
- Participant crossed in 19 seconds. Green man went out after 12 seconds.

Participant impressions:

- *It was ok. I never expected the green man to stay on for so long, so I was hovering for a couple of seconds [in the middle] but then I realised it was going to stay on ... I think it's probably because they've put the roadworks here.*

Control 1 (Old Broad Street, London Wall, Wormwood Street):

Researcher observations:

- Button pressed (14:02) currently red phase and traffic is queued. Pedestrians were about to take a chance on the red phase but one car was edging forward and revving his engine and they changed their minds!
- Traffic has stopped on this side. Green light (14:49) Participant now crossing, taxi parked in centre of junction so all pedestrians are having to walk around the vehicle. Passed the middle and green phase is still on. Green man has gone out (15:03), participant has reached roadworks and is going round. Made to other side at 15:09.
- Participant crossed in 20 seconds. Green man went out after 14 seconds.

Participant impressions:

- *It was ok ... there was a lot of people there.*
- Didn't notice the vehicle across the junction
- Referring to man who was revving his engine: *this is the sort of thing I warn my kids about... people trying to intimidate you on the crossings. ...I say it might take ages to cross the road but at least you are going to be safe. But at the same time*

⁶ This crossing had road works on this arm of the junction which covered a quarter of the pedestrian crossing on the south side.

I don't like to wait either. I think "I wish they'd hurry up" but I know there is a reason for it.

- *Especially [for] children with special needs, like my son, he has no awareness of danger.*

Other observations:

Time had to wait until safe to cross –

- *Test 1: The first one I had to wait a little while and I was a bit peed off with that, especially ... if you are crossing the road to get a bus... I know you have to wait but I think that was a bit too long.*
- *Test 2: Waited a long time, the central refuge was wider.*
- *I didn't like those two crossings, to be honest.*
- *Control 2: that was a bit better. There was a central refuge there, but the green man was on for a long period of time so I was able to get across both roads, so that one was good.*
- *Control 1: had to wait a little while. That was the busier junction and I think there was more people crossing there. It was ok.*

Blackout period –

- *Noticed the blackout period. Thought that it was "letting you know ... hurry up and cross the road, the lights are going to change."*
- *Had seen it before, but thought it used to be a green flashing man.*
- *I think it makes people hurry across the road. People might think to themselves that traffic is going to start revving their engines. I think it could be a bit frightening for some people.*

Length of time had to cross the road –

- *When asked about stopping at the central refuge on crossing A and B: the green man went out and I was only halfway.... If it had gone out when I only had a third of a way to go ... yes I would have carried on.*

Feel when using crossings –

- Test 1: *The central refuge in the road ... it was too narrow ... so you feel a bit intimidated by the traffic that's passing ... that is quite frightening.*
- Felt safest on the third crossing. Traffic was coming towards the participant so she could see it.
- *The first one had a lot of buses and taxis, I didn't like that crossing.*

Improvements to crossings –

- *I think if they just left the green man on longer [on first two crossings] it would have been better.*
- Asked about having a countdown in seconds until the red man? *You'd have kids rushing across the road. You'd find kids saying 'I can do it in 5'... 'I can do it in 4'. ...Just leave the green man on a bit longer.*

E.6 Case Study 6:

Participant information:

Age – 20-39

Gender - Female

Disability/condition – Vision impairment

Challenges faced – high number of pedestrians, can't see green/red man at crossings, get lost if don't know area

How overcome –

- Don't usually walking in an unfamiliar area
- Usually with someone not on own
- Ask someone if on own and unsure about things
- Got white cane to bring attention to vision impairment - if still crossing when green for traffic then rely on them to wait for me but don't like to do that
- May have to use cane for feeling objects on the ground as eye sights worsens
- Relies on backup of rotating cone at crossing to know when safe to cross and therefore need to be stood next to push button so may have to wait until others moved out the way
- When WAIT sign goes off on signal-controlled box indicates safe to cross
- Listens for audible signal
- *"I don't rely on when other people cross and cross when they do as they might not be crossing at the right time"*

Use of signal controlled crossings – use one everyday to get to work, not used to walking around study area though visited theatre a couple of months ago but thought not crossed any of crossings there before

Study information:

Day and time of participation - Thursday 12th February 10am-12noon

Order of crossings – Anti-clockwise

Weather – Cold bright and sunny

Other – I accompanied participant across each crossing by walking next to her but slightly behind her for safety reasons so she still walked independently, not many other pedestrians

Experiences at crossings:

Control 1 (Old Broad Street, London Wall, Wormwood Street):

- Rotating cone wasn't working and was *"completely uncertain [about when it was safe to cross]"*
- Waited one round to be sure that traffic wasn't going to move when the WAIT sign was off and also noticed how long traffic was stationary for.

- Would have delayed journey
- No audible warning signal to say when safe to cross
- Assumption (but not certain) that even though there was a central refuge in the middle of the junction that it would be safe to cross all the way and noticed that the traffic wasn't moving
- Similar to the one that use for work as that stops for you to cross the whole junction even though it has central refuge in the middle

Control 2 (Old Broad Street, London Wall, Wormwood Street)⁷:

- *"It was quite unusual that it had push button in the middle of it and lucky that I spotted it otherwise I might have walked all the way across"* (participant presumed from this information that the two halves of the crossing independent of each other).
- Thought it seemed narrower than crossing Control 1 but because there was a push button was there thought it was safer to press this to let her know whether safe to continue. Noticed traffic stopped for ages so would have time to cross both arms of crossing.
- Rotating cones were working on this crossing.
- If crossing from north to south on this crossing with road works at end of crossing *"I would just walk straight into them"* because wouldn't know they were there and also not know which way to go round them.

Test 2 (Bishopgate, Threadneedle Street):

- *"It's a very odd set up"...*The control box was angled backwards so had to stand behind (to see when the WAIT sign stopped being illuminated) it rather than beside it so inconvenient for crossing road.
- *"It had the [audible] beeps but they didn't last very long so I thought it wasn't safe to continue so I stopped in the middle. They did seem particularly short as I had only got to the middle."* Observed that participant just got to middle at blackout period.
- Even though there didn't seem to be any traffic coming she couldn't be certain that one wouldn't come round the corner so stopped on central refuge.
- Not helpful to have a step up to get to the push button in the central refuge (also a metre away from the edge of the kerb) – those with less vision wouldn't be able to spot the push button or the kerb. And no tactile paving in the central refuge and *"I do like that reassurance that I'm on the edge of the kerb"*.

⁷ This crossing had road works on this arm of the junction which covered a quarter of the pedestrian crossing on the south side.

- Pressing the button didn't have any effect on the crossing (thought again that because push button in the middle that the parts of the crossing must be independent)... *"so that added to the time I had to hang around... I seemed to be waiting in the middle for ages"*.
- Seeing the push button in the middle of the crossing (central refuge) suggested that it was a separate crossing and would think that means there isn't time to get all the way over. Participant doesn't usually see them.
- No rotating cones on either push button at this junction. On the first one there was a hole where one may have broken off.
- There were audible beeps so *"good replacement for the rotating cones"* and did think they were loud enough.

Test 1 (Bishopgate, Camomile Street, Wormwood Street):

- *"It's quite wide and there was only a push button on one side of the crossing"* (i.e. when standing on the pavement ready to cross the control box was on the right hand side only). Could be difficult if more people trying to cross at once, as participant likes to be next to the control box so can see WAIT sign and feel rotating cone.
- Rotating cone seemed to start turning too early, whilst there was still traffic coming round the corner so hesitated but could have been dangerous... usually the rotating cones have a couple of seconds delay after other people start to cross but this one seemed early or had timing issues.
- Noticed push button control boxes in the central refuge *"but because at the last few crossings they didn't seem to make any difference I just carried on"* but there was some uncertainty about whether to cross all the way at once.

Other observations:

Time had to wait until safe to cross – *"Too long, certainly at the first one (**Control 1**) because there was no audio or tactile information I waited a full circle before certain it was safe to cross, and the second (**Control 2**) and third (**Test 2**) I stopped in the middle because there was a push button there and I didn't realise there was no need to stop in the middle. The fourth one I didn't seem to have to wait too long as it seemed to change as soon as I pressed the button."*

Blackout period – Not heavily reliant on green and red man anyway. This could have corresponded with audible beeps but there were none on control crossings or **Test 1** but participant found helpful to have these on study crossing Test 2.

Length of time had to cross the road –

- Crossing B stands out more because audible beeps didn't last long enough and when stopped didn't know whether safe to cross.
- Difficult to judge the others because push button in the middle so thought probably wasn't long enough to cross all the way but learnt for last one (**Test 1**) that there was.
- Participant thought that for all there was probably enough time to cross but it was not clear whether this was the case or not from the outset without the benefit of hindsight.

Feel when using crossings –

- Felt more *unsafe* at **Control 2** because no audible or tactile information so relying on the WAIT sign going out and making an assumption that safe to cross.
- Felt quite unsafe at **Test 1** because the rotating cones started turning too soon.
- Generally felt safe at all crossings because all straight across rather than staggered but there was *uncertainty* about whether to wait in the middle.
- *"Because it is straight across you assume that you are just going to walk straight across and then you suddenly see a push button and that is conflicting information."*

Improvements to crossings –

- Helpful if had little red and green person above the WAIT sign on the signal box (seen them in Eltham)
- Make sure rotating cones are working
- Have a rotating cone or audible beeps
- Make sure audible beeps are going the whole time it is safe to cross *"so when it stops you know it is no longer safe... generally you keep walking because there is an assumption that you have got a few more seconds"*
- Tactile paving of a contrasting colour and next to the crossing and push button
- Push button near the kerb and facing pedestrians rather than behind the crossing
- Helpful to have tactile paving in the central refuge to indicate it – those with less vision may not be aware that there is central refuge and that they may be expected to wait on it
- Push button on left and right of pedestrians as they cross the road
- Noted that the tactile paving should have been red for signal controlled pedestrian crossings and buff coloured for non-signal controlled crossings and all four crossings were buff.

E.7 Case Study 7:

Participant information:

Age – Over 60

Gender – Female

Disability/condition – Vision and hearing impairment

Challenges faced – too many people who can get in the way, less likely to notice and pay attention if using scooter rather than walking frame, rough surfaces can be problematic, “some crossings are short of time” so only cross if at beginning of green cycle

How overcome – use walking frame which has wheels and seat so can sit on that if need a break, also have a motorised scooter which use if in local area which familiar with

Use of signal controlled crossings – Generally only travel as a pedestrian around Ealing (home), otherwise once a fortnight go further afield to have lunch with friends for example, used to using signal controlled crossings

Study information:

Day and time of participation – Tuesday 24th February 2009 10am-12noon

Order of crossings – Clockwise

Weather – Light drizzle, overcast

Experiences at crossings:

Test 1 (Bishopgate, Camomile Street, Wormwood Street):

Researcher Observations:

Button had already been pressed when got to crossing.

Took 50 seconds to turn green

Less than 7 seconds until blackout and participant had got halfway to the middle of road

Participant waited in the middle and pressed the button in the middle, took

No audible signals

Two or three other pedestrians around and usually crossed on red or regardless of phase

Took about 50 seconds to turn green again

Participant prompt to leave pavement when turns green

About 5 seconds before blackout, participant only halfway across second part of crossing

Participant sat down on walking frame seat when got to other side to wait for researcher

Participant Observations:

“Quite fast and I only got halfway across before the green man goes off and I knew I had to stop then. If I knew the crossing I could probably get across but it would be a bit risky”

“Seemed to take a long time before they changed [to green man]”

Good flat kerbs

"Apart from the phasing of the lights I would say it was fine"

Not crossed here before that can remember.

Test 2 (Bishopgate, Threadneedle Street):

Researcher Observations:

Button had already been pressed – participant had to wait 30 seconds for green man

Other pedestrians going across on red

About 5 seconds until blackout and about 1.5 metres short of the middle of the road, got to the middle after 10-12 seconds and turned red just after got to middle, participant waiting.

Waited about 40 seconds until turned green again

About 6 seconds until blackout and participant about 1.5 metres away from kerb

Took participant about 12 seconds to cross from middle to edge which is about the same time it took until it turned onto red man

There are audible signals at crossing

Few other pedestrians crossing with participant and nobody else who waited in the middle

Participant Observations:

I thought the way down was quite steep – not as smooth as the other crossing (A).

"The light phasing is really not very good. If I used it every day I would probably go [all the way across]."

Might be better if they were separate crossings rather than all the same one as could have crossed first half before green man actually came on.

Control 1 (Old Broad Street, London Wall, Wormwood Street):

Researcher Observations:

A few other pedestrians.

Turned green after 10 seconds of getting there.

Blackout after 11 seconds just as participant was about half a metre away from middle.

Stopped in middle and pressed button but other pedestrians carry on even though red after 20 seconds

No audible signals on crossing

Almost a minute until it turned green

Participant got to the other side when it was still green man, blackout after 11 seconds

Participant Observations:

(Cyclist went through on red light)

The pavement was quite steep at the other side, although brakes on walking frame "it runs away with her"

"I got halfway that time!"

Thought the lights changed quicker with shorter cycle so she didn't have to wait as long for green man

Control 2 (Old Broad Street, London Wall, Wormwood Street)⁸:

Researcher Observations:

Button already pressed, taxi stopped halfway across the crossing but moved off as lights change so before participant had to cross

Other pedestrian crossed on red

Turned green after 50 seconds, blackout after 12 seconds just as participant got to middle, turned red man 20-22 seconds from start of green

Participant pressed button as soon as got to middle

Turned green after 58 seconds

Another pedestrian crossing the other way looked to have got in participant's path

Participant took 10 seconds to cross the second half of the crossing just as it blacked out

No audible signals

Participant Observations:

"Quite narrow in the middle but fortunately I was the only person who was waiting but a trolley or scooter or wheelchair would struggle. I would have to be quite careful [if using electric scooter]"

⁸ The road works which were previously across part of the pedestrian crossing were now no longer there.

Other observations:

Time had to wait until safe to cross –

Thought the first crossing had to wait a long time and that last two were quicker

Compared to other crossings in London thought had to wait longer at Test 1, about the same at Test 2, and Control 1 and Control 2 were quicker

Blackout period –

Not consciously noticed them but when explained it then participant did notice that green man disappeared before red man appeared at those crossings.

Thought it meant same as flashing green man used to mean, i.e. that *"if you're already crossing keep going otherwise stop"*

Hadn't noticed blackout period at other crossings either.

Unless participant sees the green man she won't start crossing.

Treated the two parts of the crossing as two separate crossings but when thought about it and if became familiar with crossing would think of them as one crossing as would know how long she had to cross.

Length of time had to cross the road –

"I would say it was too short – at all of them actually – after the first crossing I expected to have to wait in the middle of the other crossings."

Doesn't mind having to wait in the middle if whole phasing is quicker so not too long until green again and if sufficient space in the central refuge

Feel when using crossings –

Felt more hurried at the last two crossings because a bit less steady on feet and the middle of the crossing (where had to wait) was narrower

Improvements to crossings –

More time to cross at all crossings

Of the four crossings participant didn't hear audible signals at any but deaf in one ear – would find reassuring but not essential to have this

Finds tactile paving a nuisance because difficult underfoot when using walking frame

Lower kerbs beneficial

Would be clever if timing of phase adjusted to time of day so in heavier traffic conditions participant wouldn't mind waiting longer to cross

E.8 Case Study 8:

Participant information:

Age – 40-59

Gender – Male

Disability/condition – Mobility impairment

Challenges faced – Danger from traffic especially cyclists going through red lights.

How overcome – Be aware of traffic, listen for audible signals.

Use of signal controlled crossings – Everyday. Works in central London.

Study information:

Day and time of participation – Tuesday 24th February 2009 1.30-3.30pm

Order of crossings – Clockwise

Weather – Light drizzle, overcast

Experiences at crossings:

Test 1 (Bishopgate, Camomile Street, Wormwood Street):

Researcher Observations:

Participant pressed button and started crossing while still red man then stopped at central refuge. Only three other pedestrians. Green man after 26 seconds so participant started crossing and blackout period after 6 seconds and participant reached the kerb after 8 seconds (from the middle).

Participant Observations:

"I found the first part of the crossing more difficult and had to be more aware, basically because there was no green man. I was waiting for the further one to tell me but then I realised that traffic had stopped so it was ok to stop. I was just wary of the first part."

Would be helpful to have tactile paving in the central refuge to show that you are in the middle and it is safe there.

Not used crossing before.

Test 2 (Bishopgate, Threadneedle Street):

Researcher Observations:

Participant pressed button. No other pedestrians at crossing initially. Green man after 35 seconds and then blackout after another 4 seconds when participant not reached middle yet. He stopped in the middle and pressed the button. Uneven road surface. Participant crossed over when on red man but no traffic on that side of crossing, took 10 seconds to cross second half.

Participant Observations:

Comfortable, nothing to worry about. Thought the signals took longer to turn green on the second part of the crossing. Used this crossing before, last time about 6 months ago, not noticed anything different, experience the same as last time.

Control 1 (Old Broad Street, London Wall, Wormwood Street):

Researcher Observations:

Participant crossed to halfway during blackout period and then carried on to other side (not on green). Three other pedestrians crossing in other direction at the same time.

Participant Observations:

Very easy. No challenges. Used crossing before two weeks ago – used early morning so traffic busier then.

Control 2 (Old Broad Street, London Wall, Wormwood Street)⁹:

Researcher Observations:

A lot of people crossing on red, button had already been crossed, some people waiting in the middle. Had to wait 50 seconds for green man. Participant hesitated before crossed as motorcyclist looked like may move off, participant reached centre of road after 10 seconds and 20 seconds total to cross road. There are audible signals at crossing. Went to blackout period after 16 seconds so participant just got further than the middle of the road so carried on.

Participant Observations:

Pedestrian coming directly towards participant difficult but no other concerns. Used crossing two weeks ago – similar experience.

Other observations:

Time had to wait until safe to cross –

Some of them were very slow – in particular the last one (Control 2).

Blackout period –

Noticed it but didn't know what it means.

Length of time had to cross the road –

No problems, quite easy.

⁹ The road works which were previously across part of the pedestrian crossing were now no longer there.

Feel when using crossings –

“It was 50:50 on some of them [whether felt unsafe or not]... the first two [Test 1 and Test 2]... that was just a bit uneasy”. Felt that the crossings should have had lights in the middle of the road as well as either side.

Not worried generally and confident throughout.

“I was a bit worried about crossing the road [at Test 2] because of the traffic.” – from the perspective of there being more traffic.

Improvements to crossings –

- Shared surfaces are concerning – would not like as an impaired pedestrian.
- Like tactile paving in the middle of the road – in the central refuge – to feel more comfortable and discourage cyclists from using crossing.
- Crossing in America is a “*nightmare*” for disabled pedestrians (high kerbs).
- Could have a voice or something else audible saying it’s safe to cross for vision impaired.
- Lower kerbs should be used at crossings.

E.9 Case Study 9:

Participant information:

Age – 40-59

Gender – Male

Disability/condition – Hearing impairment and learning disability

Challenges faced – None (doesn't find that he needs to hear audible signals at crossings)

How overcome – N/A

Use of signal controlled crossings – walk every day, walked round Liverpool street station area before but not recently (last time a couple of weeks ago)

Study information:

Day and time of participation – Tuesday 24th February 2009 1.30-3.30pm

Order of crossings –Anti-clockwise

Weather – Light drizzle, overcast

Experiences at crossings:

Control 1 (Old Broad Street, London Wall, Wormwood Street):

Researcher Observations:

Participant crossed on red to begin with (the button had already been pressed). Fairly quick walker, got to the central refuge and it turned green so carried on. Lots of other pedestrians around.

Participant Observations:

Found it ok, seemed a busy street with traffic and pedestrians. Only crossed on red because other people were also doing so and thought it was safe to cross then.

Control 2 (Old Broad Street, London Wall, Wormwood Street)¹⁰:

Researcher Observations:

Asked participant to wait for the green man before crossing from now on.

Button already pressed on arrival, some people crossed on red, turned green after 45 seconds and participant started to cross straight away, 15 other pedestrians also crossing at same time, 12 seconds before blackout period and participant just got to the other side.

Participant got all the way across before the blackout period began.

Participant Observations:

Got lots of traffic coming from different directions so could be confusing.

¹⁰ The road works which were previously across part of the pedestrian crossing were now no longer there.

Test 2 (Bishopgate, Threadneedle Street):

Researcher Observations:

Button already pressed on arrival, 32 seconds to turn green, participant took 7 seconds to get to the middle and it just blacked out then but he carried on walking to other side, took 14 second to walk whole crossing, turned red couple of seconds after participant arrived at other side (i.e. 15/16 seconds green/blackout period).

Audible signals at this crossing.

Participant got halfway across (i.e. to the central refuge) before the blackout period began

Participant Observations:

The van parked to the left of the crossing made it difficult as can't see whether traffic is going to come as some drivers still go through when green for pedestrians (he likes to look left and right whilst crossing). Thought length of time to cross was ok and fairly standard.

Test 1 (Bishopgate, Camomile Street, Wormwood Street):

Researcher Observations:

Participant pressed button to cross, six people went across on red, participant waiting for about 57 seconds before turned green, took 5 seconds to get to the central refuge and blackout period after 7 seconds but participant carried on crossing, another 7 seconds of blackout period before turns red. Participant got $\frac{3}{4}$ of the way across before the blackout period began but all the way across before red period.

Only push button on right hand side of crossing from this direction (lamp post couple of metres on left but no button).

Participant Observations:

"It doesn't give you much time to cross the road..." . The green man doesn't stay on for long. Noticed the blackout period and thought it meant that *"the traffic might move again"*.

Other observations:

Time had to wait until safe to cross –

Thought all four crossings were similar and thought comparable with other crossings. Felt satisfied with this.

Blackout period –

If already started crossing and the green man disappeared would carry on crossing if not got far to go but could mean that traffic may start moving again. Would wait in the middle if the traffic had started moving again though.

Length of time had to cross the road –

Wished all crossings would stay on the green man for longer *"the green man didn't stay on for very long"*– thought that third (Test 2) and fourth (Test 1) crossing were particularly bad. *"I was only halfway across and the green man disappeared (at crossing Test 2)... but got three quarters of the way across (at crossing Test 1)"*

Feel when using crossings –

Participant said that he felt rushed and that he had to walk faster when he didn't make it all the way across the road before the blackout period. Felt safe enough (when pressed).

Improvements to crossings –

Make audible sounds louder (applicable to all four crossings in study)

Make green man stay on longer (applicable to all four but especially the Test 1 and Test 2)

Appendix F Pedestrian questionnaire



Interviewer no:

Interviewer name:

Location:

Date:

Time interview started:

Time Interview completed:

Introduction

Good morning/afternoon/evening. My name is from Accent and I am carrying out research for TRL and the Transport for London into people's views of pedestrian crossings. Can you spare a few minutes to take part in our survey? It will last no longer than 5 minutes and any answer you give will be treated in confidence in accordance with the Code of Conduct of the Market Research Society. You do not have to answer questions you do not wish to and you can terminate the interview at any point.

Main Questionnaire

Q1. What is your **MAIN** reason for being in this area today?

Shopping

Work here

Attend education here

Live locally

Entertainment (eg cinema, theatre)

Drinking/dining/eating out

Tourism/sight-seeing

Meeting friends/relatives

Passing through

Other

Q2. Are you doing any other activities while you are here today? **MULTI**

No, none

Shopping

Work here

Attend education here

Live locally

Entertainment (eg cinema, theatre)

Drinking/dining/eating out

Tourism/sight-seeing

Meeting friends/relatives

Passing through

Other

Q3. How often would you say you use this particular crossing?

5 or more days a week

At least 2 -4 times a week

At least once a week

At least once a fortnight

At least once a month

Less often

This is the first time

Q4. **IF Q3 = >3 GO TO Q5:** On average, how many times a day do you use this crossing?
Once
Twice
Three times
Four times
More than four

Q5. On this occasion, did you wait for the green man to show before you crossed?
Yes
No, because it was already green
No, it was not green when I crossed

Q6. How did you feel about the length of time you had to wait until there was a green man?
Very dissatisfied
Dissatisfied
Neither
Satisfied
Very satisfied

Q7. How satisfied were you with the amount of time you had to cross the road?
Very dissatisfied
Dissatisfied
Neither
Satisfied
Very satisfied

Q8. Did you feel at all rushed when crossing the road?
Yes – felt rushed
Yes – a little rushed
No

Q9. How satisfied were you that it was clear when it was safe to cross the road (either by seeing the green man or hearing the signal)?
Very dissatisfied
Dissatisfied
Neither
Satisfied
Very satisfied

Q10. How satisfied were you with the ease of getting on and off the kerb to use this crossing?
Very dissatisfied
Dissatisfied
Neither
Satisfied
Very satisfied

Q11. How safe or unsafe would you say you felt using this particular crossing?
Very unsafe
Unsafe
Neither
Safe
Very safe

Q12. Did you notice that when the green man disappears, there is a 'blackout' period (ie the pedestrian signal is blank) before the red man appears?
Yes
No

Q13. What do you think this 'blackout' period means? **DO NOT PROMPT; TICK ALL MENTIONED**
There is still time for me to cross safely
If I have started crossing I have enough time to cross safely
I should turn back or stay on the central refuge
If I have not yet started to cross I should not start to do so
The green light is about to be shown to the traffic at the crossing
Other **PLEASE SPECIFY**
Don't know

Classification Questions

I am now going to ask you some questions about yourself. These are for analysis purposes only and, as I said, any information you give me will be completely confidential.

Q14. Record gender
Male
Female

Q15. Which of these age groups do you fall into?
16 – 24
25 – 34
35 – 59
60 +

Q16. Record if:
Pushing pram or buggy
Carrying one or more large bags
Wheeling a shopping trolley/luggage
Pushing a cycle
Not encumbered

Q17. Do you have any problems that affect your mobility or ability to go about your daily business, including problems caused by age?
None
Mobility impairment
Hearing impairment
Visual impairment
Learning difficulties
Other

Q18. Record if travelling alone or not
Solo
Accompanied by child(ren) aged 10 or under
Accompanied by child(ren) aged 10-15 years
Accompanied by adult(s) aged 16+

Q19. **IF Q18 = 1 GO TO Q20:** Does the person/any of the people accompanying you have any problems that affect their mobility or ability to go about their daily business, including problems caused by age?
None
Mobility impairment
Hearing impairment
Visual impairment
Learning difficulties
Other

Q20. How often do you typically wait for the green man to come on before starting to cross the road at this crossing?
Always
Mostly
Sometimes
Rarely
Never

Q21. How often do you drive in London?
At least 5-6 days a week
At least 2 -4 times a week
At least once a fortnight
At least once a month
Less often
Never

Q22. Have you noticed any recent changes to the way that this crossing operates?
Yes
No
If yes, then please specify.....

Thank you for your help in this research

This research was conducted under the terms of the MRS code of conduct and is completely confidential. If you would like to confirm my credentials or those of Accent please call the MRS free on 0500 396999. **HAND OVER THE THANK YOU SLIP.**

Please can I take a note of your name and where we can contact you for quality control purposes?

Respondent name:

Telephone: home:work:

Thank you

I confirm that this interview was conducted under the terms of the MRS code of conduct and is completely confidential

Interviewer's signature:

Appendix G Pedestrian questionnaire tables

Table G.1: Number and proportion of interviews at each site

Site	Before	After	Proportion before
00/022	78	68	53%
00/025	63	77	45%
00/052	68	60	53%
05/066	59	46	56%
08/028	67	79	46%
09/021	67	70	49%
10/007	65	99	40%
10/013	92	82	53%
10/123	70	79	47%
All sites	629	660	49%

Table G.2: Proportion of males interviewed at each site

Site	Before	After
00/022	38%	56%
00/025	54%	57%
00/052	50%	53%
05/066	51%	46%
08/028	57%	57%
09/021	51%	43%
10/007	45%	42%
10/013	50%	51%
10/123	56%	51%
All sites	50%	51%

Table G.3: Purpose of visit by interviewees

Site	Shop		Work		Study		Live		Cinema	
	Before	After	Before	After	Before	After	Before	After	Before	After
00/022	12%	16%	58%	57%	3%	1%	4%	1%	1%	1%
00/025	11%	34%	60%	51%	6%	6%	0%	8%	2%	1%
00/052	13%	33%	51%	60%	3%	3%	1%	3%	3%	2%
05/066	25%	11%	34%	28%	2%	15%	27%	41%	5%	0%
08/028	37%	23%	34%	47%	15%	15%	16%	9%	15%	1%
09/021	15%	10%	24%	20%	4%	10%	51%	57%	0%	0%
10/007	42%	9%	18%	11%	3%	3%	62%	71%	0%	2%
10/013	35%	23%	29%	13%	2%	4%	57%	39%	0%	7%
10/123	17%	25%	51%	51%	4%	5%	11%	24%	1%	1%

Site	Dining		Tourism		Meet friends		Passing through		Other	
	Before	After	Before	After	Before	After	Before	After	Before	After
00/022	9%	12%	1%	1%	14%	21%	24%	18%	6%	10%
00/025	19%	12%	8%	5%	5%	4%	5%	8%	21%	16%
00/052	13%	5%	9%	3%	10%	8%	21%	17%	9%	3%
05/066	5%	11%	3%	2%	10%	11%	17%	13%	25%	11%
08/028	7%	10%	9%	0%	15%	14%	1%	19%	7%	5%
09/021	3%	0%	1%	1%	13%	9%	22%	37%	1%	7%
10/007	5%	8%	0%	1%	5%	11%	23%	20%	6%	0%
10/013	8%	20%	2%	6%	13%	13%	12%	20%	18%	26%
10/123	3%	6%	0%	6%	4%	13%	16%	19%	10%	1%

NB. Table continues from above

Appendix H Map showing locations of study sites



Figure H - 1 Map showing locations of study sites

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Walker R, Winnett M, Martin A and J Kennedy(2005) *Puffin Crossing Operation and Behaviour Study*. TRL Report PPR239. Crowthorne: Transport Research Laboratory.

The effect of re-timed invitation to cross periods on road users at signalised junctions in London



An experimental trial was undertaken which involved reducing the invitation to cross (green man) period at a sample of nine signal controlled junctions in London and assessing the effects on accessibility, safety and behaviour of pedestrians and other road users.

The study was undertaken using video footage which was obtained during before and after periods. Conflict studies were undertaken which involved observing, evaluating and recording 'near misses'. A sample of pedestrians was interviewed including pedestrians with special mobility needs who were accompanied whilst crossing junctions.

Approximately 90% of conflicts involved a pedestrian crossing whilst a red man was displayed. The total number of conflicts was very similar in the before and after periods.

There was an increase in the number of one of the more minor classifications of conflict although this did not appear to be associated with the re-timing.

The number of pedestrians who failed to comply with the signals increased.

Pedestrian speeds were unaffected. Most pedestrians exceeded the assumed speed used in national guidance and the speeds of slower pedestrians approximated to this.

There was a small increase in the number of vehicles passing through most of the sites. The increase was statistically significant.

Most pedestrians did not notice the change to the timing and their levels of satisfaction with the waiting time were unchanged. Nevertheless, there was a reduction in the numbers who were satisfied with the crossing time and an increase in the numbers of pedestrians with mobility impairments who felt rushed or unsafe at the sites where the signals had been re-timed.

Other titles from this subject area

PPR239 Puffin Crossing Operation and Behaviour Study by Walker R, Winnett M, Martin A and J Kennedy 2005

PPR242 Reporting of road traffic accidents in London: Matching Police STATS19 with hospital accident and emergency data. Supplementary report for St. Thomas' Hospital Central London. H Ward, S Robertson, K Townley and A Pedler. 2007

PPR247 Review of Road Safety Good Practice in English Local Authorities. J A Castle and G E Kanya-Lukoda. 2007

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