

Transport Research Laboratory



Pedestrian Countdown at Traffic Signal Junctions (PCaTS) - Road Trial

TECHNICAL APPENDICES

TfL 2481

TECHNICAL APPENDICES

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1 Introduction to Technical Appendices

1.1 Purpose of Technical Appendices

These technical appendices provide supplementary information and further detail to that provided in the main report. These appendices provide a detailed description of the methodology and data obtained from the surveys, including more detailed reporting and analysis at the level of individual sites, and including data on both sets of follow-up surveys: After 1 and After 2. Summarised information and conclusions at the level of the trial are set out in the main project report.

1.2 Report formatting

To ensure consistency across the technical appendices, the following formatting convention was introduced for each chart:

Chart fill background		All Video (Behaviour) Survey Charts
		All Perception Survey Charts
		Mobility Survey Charts
		Child Survey Charts
		Child and Mobility Survey Charts
		External Data Source
Series fill		'Before' (Standard signal) data is a solid colour
		'After 1' (PCaTS) data is diagonally striped
		'After 2' (PCaTS) data is hatched
		Comparison of 'Before' and 'After 1' is vertical

Site description Site number, followed by name, e.g. "01/212 (Oxford St.)"

2 Methodology

2.1 Dates of Surveys

The Countdown timers were installed at the eight sites during the summer months of 2010 and became fully 'live' after a few weeks of testing. Surveys were used to assess the PCaTS trial. These were planned for three points in time, with the timing at each site designed to ensure that data would be comparable and would not be affected by seasonal factors, even though the date on which PCaTS went live was different at each site:

- 'Before' Survey: Shortly before PCaTS introduction
- 'After 1' Survey: Shortly after the site was fully commissioned
- 'After 2' Survey: Following a settling in period approximately 3 months after introduction

The specific dates of each video survey are included in Appendix A. Details of any roadworks, incidents or other events which may have affected the surveys are included in Appendix A.

Three types of survey were carried out:

- Video surveys to examine the behaviour of pedestrians and drivers, interactions between road users, pedestrian flows and vehicle flows
- Face-to-face questionnaire surveys of pedestrians' perceptions and understanding of PCaTS
- Accompanied walks with children and people with mobility impairments, who were asked questions during the walks to obtain qualitative information about the crossing experiences at PCaTS and Standard crossings. Questionnaire surveys of these groups were also carried out, asking about perceptions and understanding as in the main survey ("After 1' survey only).

Figure 1 below shows how the data collected from the three survey types was used in the investigation, and where in this document the findings are reported.

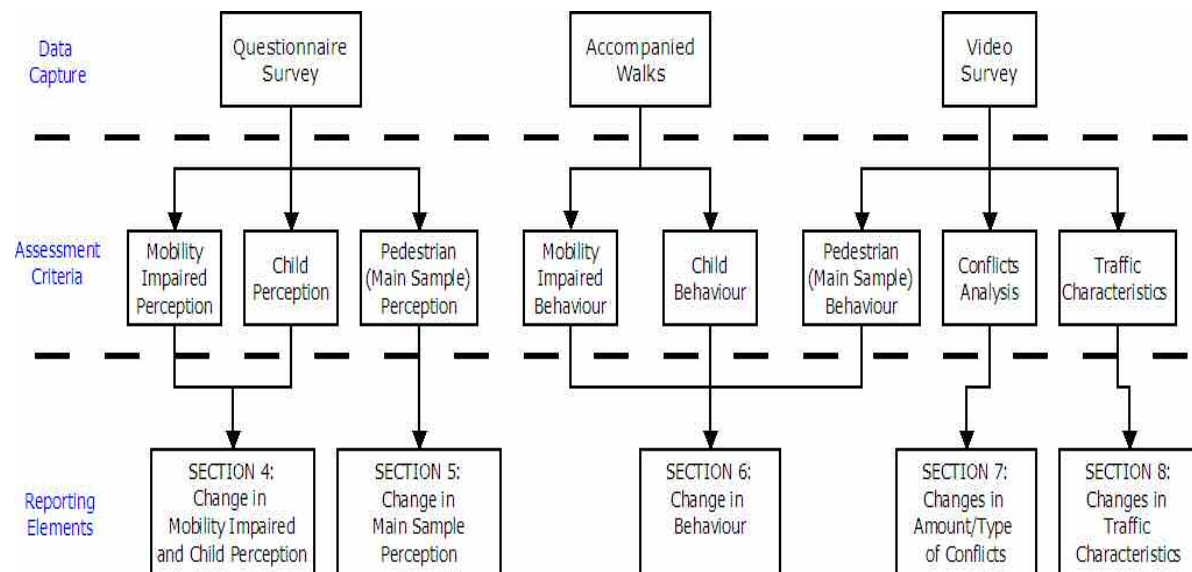


Figure 1 Links Between Data Capture and Reporting Measures

Table 1 shows the types of survey which were conducted at each stage.

Survey type	'Before' PCaTS	'After 1'	'After 2'
Video Survey	✓	✓	✓
Questionnaire	✓	✓	✓
Accompanied Walk		✓	

Table 1 Surveys at each stage in the study

Further details of each type of survey are provided in the remainder of this section.

2.2 Traffic Signals and Signal Timings

2.2.1 Traffic Signal Terminology

The eight sites in the survey were all located at signalised junctions. As such the vehicle traffic signals did not have the Amber flashing phase used at Pelican crossings, nor did the far-side pedestrian traffic signal have a flashing Green Man phase. All arms of the junction were equipped with PCaTS; however, the surveys were only conducted on one arm.

The terminology "Standard Crossing" is used in this report to describe the pedestrian crossings in the 'Before' survey, without PCaTS. The pedestrian signal phases on the Standard Crossings were Green Man, then Blackout, then Red Man.

The terminology "PCaTS Crossing" is used in this report to describe the pedestrian crossings in the 'After 1' and 'After 2' surveys, with PCaTS. The pedestrian signal phases on the PCaTS Crossings were Green Man, then Countdown, then Red Man.

"Red Man" period is used to describe the period of time from the start of the Red Man until the next Green Man

"All Red" period is used to describe the time when both a Red Man is shown to the pedestrians and a Red Light is shown to traffic.

Specific definitions in the context of the Highway Code of each pedestrian signal phase are provided in Appendix D.

2.2.2 Modification to Signal Timings

In addition to the installation of the Countdown equipment there were also several modifications to the signal timings at the pilot sites. In interpreting the results of this study it should be borne in mind that any observed changes are a result of a package of changes implemented by TfL: the planned package included shorter Green Man times, longer Countdown compared to Blackout period, shorter All Red period, a Countdown timer, and increased Green time to traffic. Thus the results are generally relevant to other planned schemes that introduce the same package of measures, but from a statistical viewpoint it is not always possible to isolate the effect of individual elements within the package (i.e. the results are confounded). Specifically:

- For all eight sites, the Green Man time was reduced in the 'After' surveys compared to the 'Before' survey.
- For all eight sites, the Blackout time was increased in the 'After' surveys compared to the 'Before' survey.

- The “available crossing time” is defined here as the sum of the Green Man time and the Blackout time (or Countdown time). The difference in available crossing time between the ‘Before’ and ‘After’ surveys is investigated in Section 6.1.3. In summary the difference was:
 - 0 seconds on Blackfriars and Tower Bridge
 - 1 second extra on Kingsway and Roehampton
 - 4 seconds less on Finsbury, representing a 19% decrease
 - 4 seconds more on Oxford St. and Balham, representing a 19% and 25% increase, respectively
 - 5 seconds more on Old Kent, representing a 42% increase
- The average cycle times calculated from the pedestrian phases were the same (to within 1 second) in both the ‘Before’ and ‘After’ surveys for each site, with the exception of Tower Bridge and Blackfriars in the ‘After 2’ survey. See Appendix C for further information
- The “All Red phase” (after the end of the Blackout phase when both the pedestrian and vehicle signals are red) was reduced on all sites. It ranged over all sites from 5 to 9 seconds in the ‘Before’ survey. This was reduced to 3 seconds on all sites in the ‘After’ surveys (See Appendix C).

The changes to the pedestrian signal timings are discussed in detail in Section 6.1.3, and the changes to the traffic signal timings are discussed in Section 8.1.2.

2.3 Questionnaire surveys of pedestrians’ perceptions

2.3.1 Perception Data Sampling

Pedestrians were interviewed about their experiences and understanding of the type of crossing that they had just finished crossing. A minimum target sample size of 60 completed questionnaires was set for each site during each survey and interviewers approached people at random, in order to provide sufficient data for statistically robust analysis to be carried out. The sample was generally achieved in one day. Interviews were carried out between 07:00 and 19:00 on weekdays.

2.3.2 Perception Data Collected

The questionnaire surveys among pedestrians using the crossings at the trial sites were carried out without providing any information to respondents about the changes to the signals. They were carried out just after people had used the crossing and were designed to obtain the following information:

- Perceptions of the conventional setup
- Perceptions of PCaTS (‘after’) in a live environment - what it means, is it liked, how people react and how they feel
- Perceptions of the time they have available to cross the road and actions taken
- Comparison of perceptions and understanding of PCaTS solution options with those prevailing under the conventional setup of traffic signals at ‘all-red’ junctions
- Comparison of perceptions of PCaTS between different pedestrian groups, based on age, sex and mobility or sensory impairment
- Perceptions of what the PCaTS units indicate, and the reasons behind these perceptions

- Perceptions of what the Blackout units indicate and the reasons behind these perceptions
- Perceptions of what the safe crossing period is
- Perceptions of the length of time taken to cross the road
- Perceptions of the duration of the invitation to cross period
- Perceptions of whether or not to cross the road (given the display) when the Countdown numbers are displayed on at arrival at the junction, and whether Countdown numbers appear during a crossing
- Comparison and preference between PCaTS and the conventional setup
- Perceptions of safety while crossing the road and whether these change in the 'after' periods

The questionnaires used are included in Appendix B.

2.3.3 Perception Data – Alternative Sites

Data collected on four sites failed quality standards in the 'Before' survey, which meant that a high proportion of the data from each site could not be used. In order to obtain valid results it was necessary to deviate from the intended methodology. Alternative sites were located that closely conformed with the original sites, see section 5.1 for more detail.

2.3.4 Perception Data Site Categories

The data from pedestrian perception surveys was classified into four categories based on site characteristics and pedestrian flow.

The sites in each category are listed in Table 2. For further information on the characteristics of each category see section 5.2.

Category 1	10/008 (Balham)
Category 2	03/029 (Finsbury); 08/003 (Tower Br); 10/160 (Roehampton); 08/211 (Old Kent)
Category 3	08/028 (Blackfriars); 02/045 (Kingsway)
Category 4	01/212 (Oxford St)

Table 2 Pedestrian perception site categories

2.4 Video surveys of road user behaviour and interactions

2.4.1 Video Survey Layout

The video surveys were used to record the movements and interactions between the drivers and pedestrians at one arm of each of the junctions in the trial in the area within 50m of the crossing. On each junction arm at least four cameras were set up, one covering each side of the pedestrian crossing, and one on the approach to the junction. Where there were difficulties with the field of view (e.g. due to street furniture), up to two further cameras were positioned to ensure that all required data could be collected. Details of individual video survey locations and layouts can be seen in Appendix A.

2.4.2 Video data sampling

To cover both peak and off-peak traffic, video data were collected throughout the duration of a 12 hour survey day, between 07:00 and 19:00 on weekdays. Data were

collected for two days in the 'before' phase in case one day did not provide sufficient data for all of the planned analysis to be carried out; data were collected on one day in the 'after' surveys. The video recordings were made on days when no interviews were being carried out with pedestrians.

A sample of one quarter of the data collected was analysed; this consisted of the data for a quarter hour period in each hour and was designed to provide sufficient data for statistically significant conclusions to be drawn. Thus over each 12 hour period, data covering a total of 12 periods of 15 minutes were analysed.

2.4.3 Video data collection

The video surveys were designed to obtain the following information:

- Changes in junction capacity and vehicle throughput resulting from PCaTS and changes in the signal timing
- Changes in driver behaviour such as creeping forward in anticipation of the end of the pedestrian crossing period
- Changes in pedestrian flow across the crossings resulting from PCaTS and changes in the signal timing
- Changes in pedestrian delay and vehicle delay
- The effects of central islands and use of central islands on pedestrian behaviour
- Changes in other aspects of pedestrian behaviour including:
 - completing a crossing when deciding to cross at the different periods
 - starting to cross under the different conditions and then turning back or waiting at an island
 - crossing speeds
- Pedestrian compliance: the number of pedestrians deciding to cross during different periods of a pedestrian phase and the general junction stage and the differences between the 'before' and 'after' scenarios
- The types of interactions and conflicts occurring at junctions 'before' and 'after', their frequency, and any changes in driver behaviour and in pedestrian behaviour and compliance

2.4.4 Video Data Limitations

It should be noted that the general rule of performing the 'After 1' video survey within a few days of the PCaTS site "going live" was not applied to site 01/212 (Oxford St.) The 'After 1' study for this site was conducted three weeks later than originally scheduled owing to technical reasons; with respect to the installation of PCaTS.

2.4.5 Video Data Site Categories

The pedestrian behaviour data from the videos was analysed site by site, but for reporting purposes is depicted in two groups for some charts and tables. The groups are depicted in Table 3.

Display Group 1	01/212 (Oxford St.)
	02/045 (Kingsway)
	03/029 (Finsbury)
	08/028 (Blackfriars)
Display Group 2	10/008 (Balham)
	08/003 (Tower Br)
	08/211 (Old Kent)
	10/160 (Roehampton)

Table 3 Display groups for pedestrian behaviour data

2.4.6 Video data – sample sizes

A video survey was used to assess how pedestrians crossed the road, including when and if they used the crossing. Detailed information was collected both on how overall groups of pedestrians crossed, and how individuals crossed. It was not feasible to record information for all pedestrians owing to the numbers using the crossing. Consequently, the data was sampled so as to account for variations in pedestrian profiles throughout the day. Therefore, data was collected from the first 15 minutes of each hour: starting at 07:00 and ending at 19:00, i.e. 07:00-07:15, 08:00-08:15, ..., 18:00-18:15. Specifically three different samples of pedestrian data were extracted from the videos:

1. “Full Sample” – overall flow information on all pedestrians using the crossing in the 12 sessions of 15 minutes throughout the day
2. “Detailed Sample” – more detailed information on pedestrians using the crossing (e.g. crossing time, gender etc), with up to 20 observations randomly picked in each of the 36 5-minute periods, i.e. 07:00-07:05, 07:05-07:10, 07:10-07:15,...08:00-08:05,...18:10-18:15
3. “Vehicle Sample” – information from the camera, which looked predominantly at the vehicles, but also had data on any pedestrians Crossing elsewhere (i.e. crossing the road by not using the crossing)

Consequently, the Full Sample contained a total of 3 hours of data on all pedestrians that used the crossing, according to the pedestrian phase displayed. The Detailed Sample contained a subset of the pedestrians in Full Sample, with a maximum of 720 observations, but with detailed individual timing information. The pedestrians who crossed elsewhere (Vehicle Sample) were not included in the other two samples. Where appropriate, square brackets are used on the vertical axis of graphs to show which sample was used.

The number of observations in the Full Sample and the Detailed Sample are shown in Figure 2 and Figure 3. Pedestrians who crossed elsewhere are discussed in Section 6.2.5.

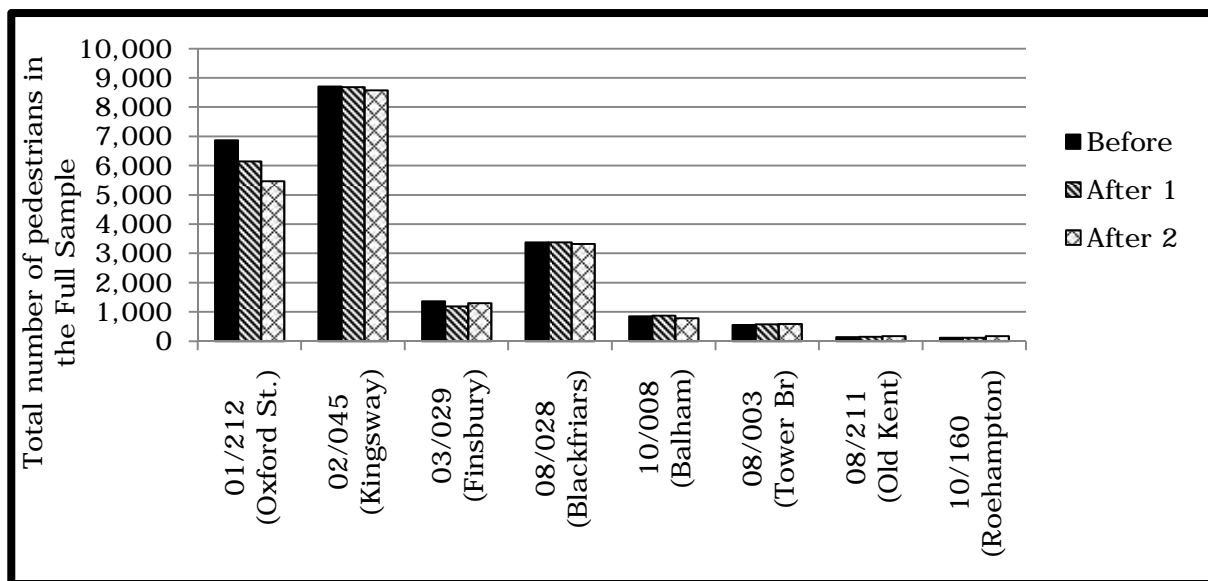


Figure 2 Total number of pedestrians in the Full Sample

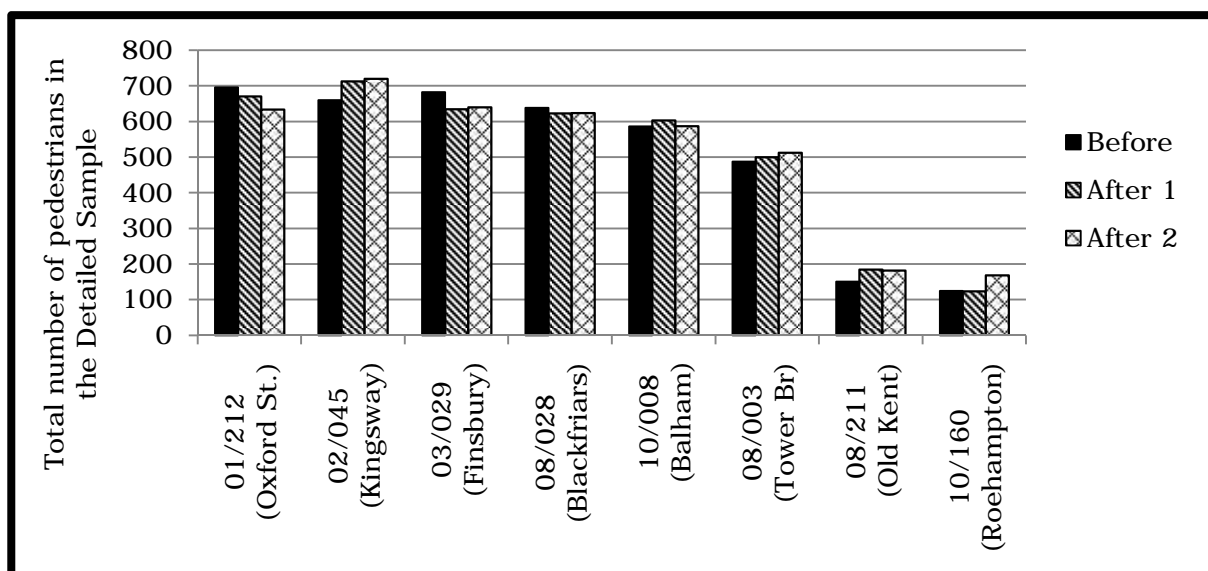


Figure 3 Total number of pedestrians in the Detailed Sample

2.4.7 Video data – focussing on the traffic green

The video surveys and analysis permitted detailed analysis of how and when pedestrians used the pedestrian crossings on the eight sites. However, it was decided that a further investigation was to focus on the critical time and examine how many pedestrians were present on the crossing just before the change in priority back to traffic; as these pedestrians could potentially conflict with traffic as it starts to move. The analysis consequently examined the number of pedestrians on the crossing at 6, 4, 2 and 0 seconds before the traffic signals change to green and provided a series of snapshots on the crossing use.

This analysis was restricted to two sites: Finsbury and Tower Bridge. These were selected as their stage sequence resulted in the monitored junction arm receiving

priority directly after the pedestrian phase. As a consequence the pedestrians on these crossings, particularly those on the side of the crossing directly in front of waiting traffic, referred to as Side A (see Figure 4) had the minimum time available before being in potential conflict with traffic. The video analysis counted the number of pedestrians in five zones at each of these times:

- The number of pedestrians in defined zone on Footway A who were either waiting to cross or about to cross.
- The number of pedestrians on Side A of the crossing
- The number of pedestrians in defined zone on the pedestrian island
- The number of pedestrians on Side B of the crossing
- The number of pedestrians in defined zone on Footway B who were either waiting to cross or about to cross.

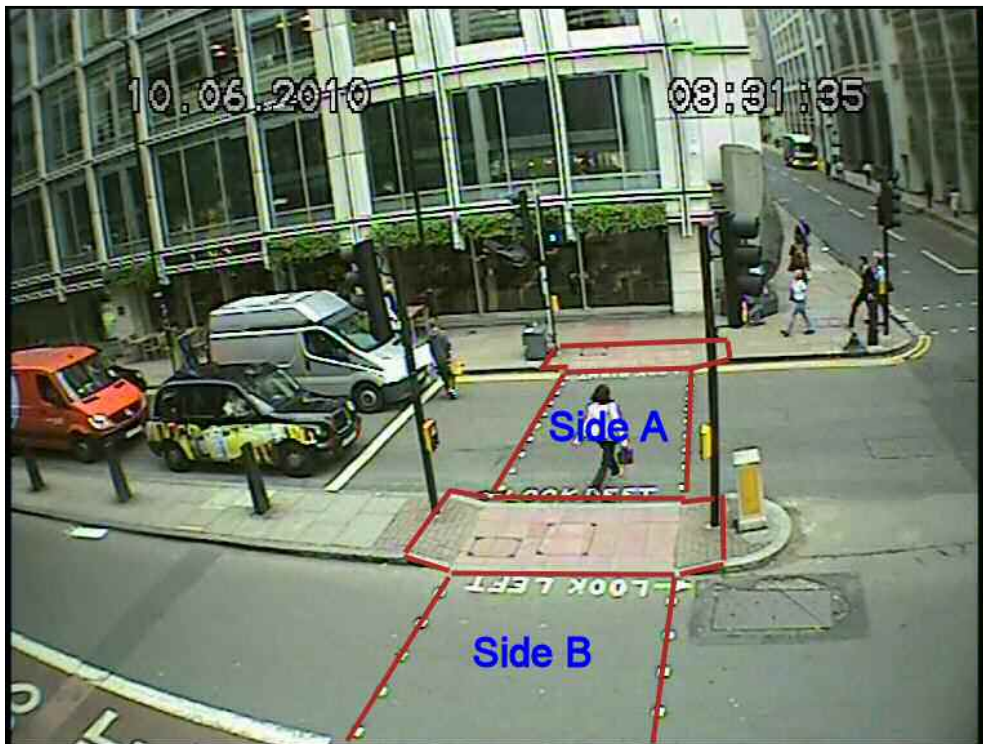


Figure 4 Zonal layout for Finsbury (03/029)

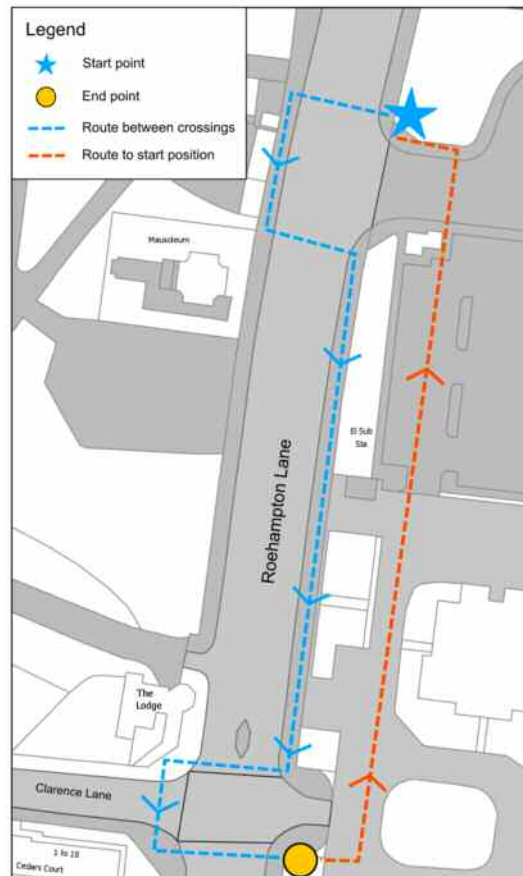
2.5 Accompanied walks with children and people with mobility impairments

2.5.1 Sites and routes

The accompanied walks were carried out with impaired and vulnerable road users to capture their perceptions and experiences of using the crossings and identify any mobility issues which occurred. The walks took place at one of the trial sites, 10/160 (Roehampton), which was on a two-way street, with a central pedestrian island. There were two lanes of traffic in one direction, and one lane of traffic in the other direction. The site was selected because it had suitable signal timings and was located within easy walking distance of a conventional crossing with a similar layout (in terms of number of

lanes, central island and signal timings), which could be used for the purpose of making comparisons with the PCaTS trial crossing.

Participants were divided into groups and allocated different starting points on the route between the two crossings so that participants were not influenced by observing the behaviour of others in the trial. An example of one of the routes is shown in Figure 5.



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Figure 5 Example of a route followed by one group

2.5.2 Sampling

The mobility-impaired participants were identified through Wandsworth Community Transport's Shopmobility Group. A total of 18 mobility-impaired adults took part in the study, walking in pairs; all were sufficiently mobile to be able to make their own way to the site and walk the required distances between the crossings (see route in Figure 5).

A class of 27 school children aged 11 were recruited from a London primary school. The children took part in the trial in groups of 9.

2.5.3 Information collected during accompanied walks

The researcher accompanying the participants made observations to capture immediate impressions on key points and actions performed after each individual crossing. On each crossing, observers noted which participants crossed all of the way, those who stopped at the island and those who chose not to cross. They also asked participants whether they felt rushed, and whether they felt safe to cross.

The experiment varied the time within the signal phase when participants were asked to look at the signal and respond to it. They were therefore asked to make decisions when

they were given different amounts of time in which to cross the road before the end of the Green Man phase. Thus comparable information was collected with a range of different amounts of time available to cross. Different groups of the mobility impaired participants and child participants experienced the crossings and “decision” times in different order to reduce any learning effects.

After finishing their accompanied walk, participants provided further information by completing a questionnaire. This was a slightly modified version of the questionnaires used for interviewing pedestrians in the main survey at the eight trial sites, and used different approaches to presenting the questions for the adults and school children. Some of the questions were designed to be comparable with the data collected in the ‘before’ or ‘control’ interviews.

The information collected in the main survey and in the two special target surveys is summarised in Table 4.

Question topic	Main survey ‘before’	Main survey ‘after’	Mobility impaired survey	Child survey
Meaning of Green Man & Red Man on arrival	✓	✓	✓	✓
Meaning of Red Man appearing half way across	✓	✓	✓	
Awareness of the Blackout period				✓
Meaning of the Blackout period				✓
Meaning of the Blackout period on arrival & while crossing	✓		✓	
Stated behaviour on arrival during Blackout	✓		✓	✓
Stated behaviour if Blackout appears while crossing				✓
Actual behaviour – signal showing when started crossing	✓	✓	✓	
Perception of which signal indicates the last time when should start crossing	✓	✓	✓	✓
Meaning of Countdown on arrival & while crossing		✓	✓	
Stated behaviour if Countdown appears while crossing				✓
Stated behaviour if ‘15’ appears while crossing				✓
Stated behaviour if ‘10’ appears while crossing		✓	✓	✓
Stated behaviour if ‘5’ appears while crossing		✓	✓	✓
Use of pedestrian island for waiting	✓	✓	✓	

Question topic	Main survey 'before'	Main survey 'after'	Mobility impaired survey	Child survey
Estimate of time available for crossing	✓	✓	✓	
Perception of time taken to cross	✓	✓	✓	✓
Perceived safety when using the crossing	✓	✓	✓	✓
Perception of being rushed while crossing			✓	
Frequency of using crossing	✓	✓	✓	
Views on Countdown			✓	✓
Comparison of Countdown vs. standard crossing: enough crossing time, safety, rush			✓	
Past experience of using standard crossing				✓
Preference for Countdown/ standard crossing		✓	✓	✓
Helpfulness of Countdown				✓
Age group and gender	✓	✓		
Encumbered (luggage, bicycle, pram, buggy)	✓	✓		
Mobility problems	✓	✓	✓	
Travelling alone or with others	✓	✓		

Table 4 Information collected in main survey and special target surveys

2.6 Statistical Significance

Statistical tests have been performed throughout the analysis contained in this report. These test hypotheses as to whether a change has occurred or not, and provide a level of confidence in the results. An approximate guide as to interpreting the levels of confidence is shown below:

- 99% = Very high level of confidence
- 95% = High level of confidence (usually considered a significant change)
- 90% = Reasonable level of confidence (indicative of a change)

3 Sites Selected

3.1 PCaTS Implementation Sites

The sites selected for the trial were chosen by TfL with the aim of including a range of crossings representing the different situations expected. These included crossings with varying widths (i.e. number of traffic lanes) and crossings with and without a central pedestrian island.

The eight sites were located in five inner London Boroughs: Camden, Islington, Southwark, Wandsworth and Westminster. The details of the sites are shown in Table 5 below, while an overview of the location of the sites is shown in Figure 6 overleaf.

Latitude and Longitude	TfL Site Number	Map Reference	Roads	Borough
51.515234/ -0.14203	01/000212	1	Oxford Street - Regent Street - Oxford Circus	Westminster
51.517529/ -0.120356	02/000045	2	A4200 Kingsway - A40 High Holborn - A4200 Southampton Row	Camden
51.520472/ -0.087301	03/000029	3	Finsbury Square - Finsbury Pavement - Chiswell Street	Islington
51.50362/ -0.104692	08/000028	4	A201 Blackfriars Road - B300 The Cut - B300 Union Street	Southwark
51.443396/ -0.152843	10/000008	5	A24 Balham High Road - Chestnut Grove - Balham Station Road	Wandsworth
51.502285/ -0.077484	08/000003	6	A100 Tower Bridge Road - A200 Tooley Street	Southwark
51.489947/ -0.079933	08/000211	7	Old Kent Road - Surrey Square - Penry Street	Southwark
51.455115/ -0.243295	10/000160	8	A306 Roehampton Lane - Queen Marys Hospital Main Entrance	Wandsworth

Table 5 Location of the PCaTS Implementation Sites

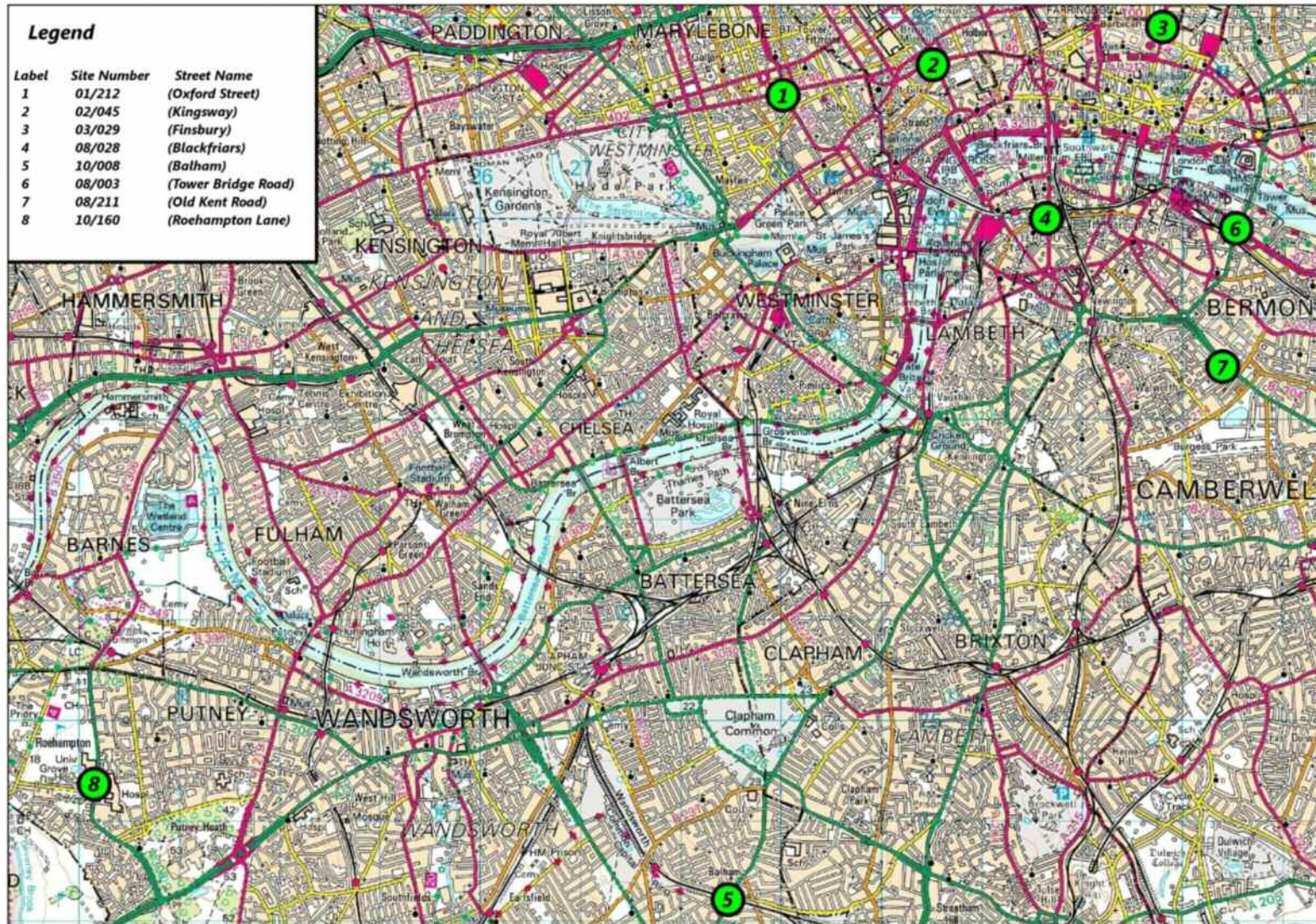


Figure 6 Locations of PCaTS Implementation Sites

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3.2 Junction Arm Characteristics Surveyed

At each site, one arm of the junction was selected for the survey. Selection of the junction arms to be studied at each site took into account the following criteria:

- the number of lanes (as a proxy for the width of the crossing)
- the presence of a pedestrian island
- the volume of pedestrian and vehicle traffic through each arm

Junction arms with low flows of pedestrians or vehicles were excluded from consideration because they would not provide enough data on conflicts between vehicles and pedestrians; this left two junction arms to be considered further at each site, and to assist in the final selection, counts were made of pedestrian and vehicle flows at these junction arms¹. Using the count data to identify the arms with the highest flows at each site, the final selection of junction arms was made, ensuring that the surveys included a range of crossings with different combinations of numbers of lanes and pedestrian islands. The final sites selected are shown in Appendix A.

The results from the various data sources are now presented in Sections 4 to 8 as described in Figure 1. The terminology “significant” or “statistically significant” has been used inter-changeably in the results sections when statistical tests have been undertaken.

¹ Counts over four 5-minute periods were used to estimate hourly flows. The counts took place at different times at each site. All were carried out between 9 am to 5 pm.

4 Results: Mobility Impaired Participants and Child Perception (Questionnaire Data)

All mobility impaired participants and children experienced both a Standard crossing and a PCaTS crossing. The mobility impaired participants used each crossing twice and the children used each crossing four times. All crossing decisions were made in the Green Man, but at different times before the end of the Green Man phase.

Afterwards, participants were asked to complete a questionnaire on their experiences and preferences. The questionnaires were based upon those used in the main on-street perception surveys. In the case of the mobility impaired participants they were modified to account for the fact that they had experienced both crossings as opposed to having just used one crossing. The children's questionnaire was then further simplified and re-phrased to ensure it was of a suitable level for them.

It should be noted that not all participants answered all questions. Percentages given are out of the number of participants who answered the question.

4.1 Mobility Sample Composition

Participants were asked for their age, gender, information on their mobility impairment and the extent to which they use pedestrian crossings. This personal information provides a context to the answers given and indicates any potential biases within the sample. The gender composition is shown in Figure 7.

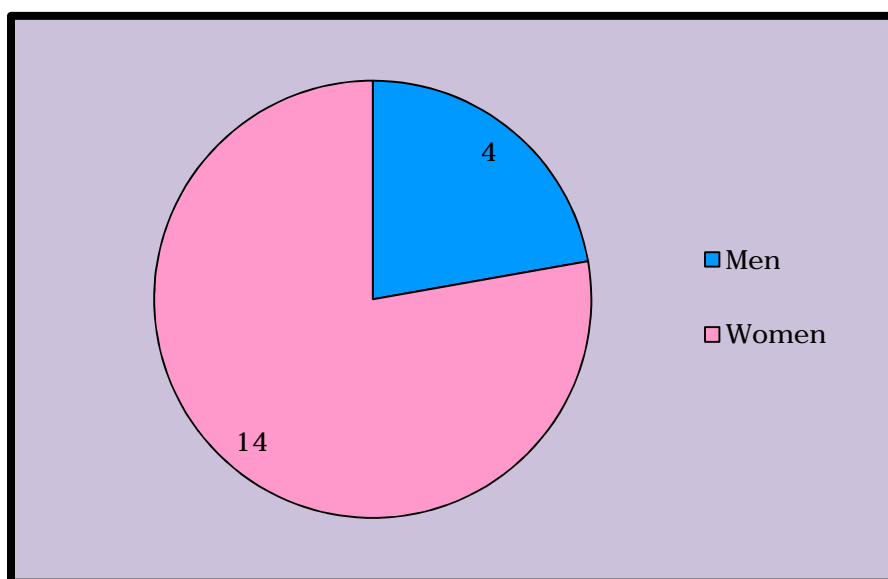


Figure 7 Gender of the mobility impaired participants

The sample participants were:

- 78% women
- All over 60 years old, and most were substantially older.

The age of the participants was as expected, given the stipulation of mobility impaired requirements and the nature of the organisations approached to take part in the survey. The gender distribution initially appears biased towards women, with greater than the national average (see Figure 8) of 61% 65 years old or more, and even 68% of 80 years old or more, however:

- The percentage of women in the sample was not statistically different (at the 95% confidence level) from the national average for people aged 65 and over.

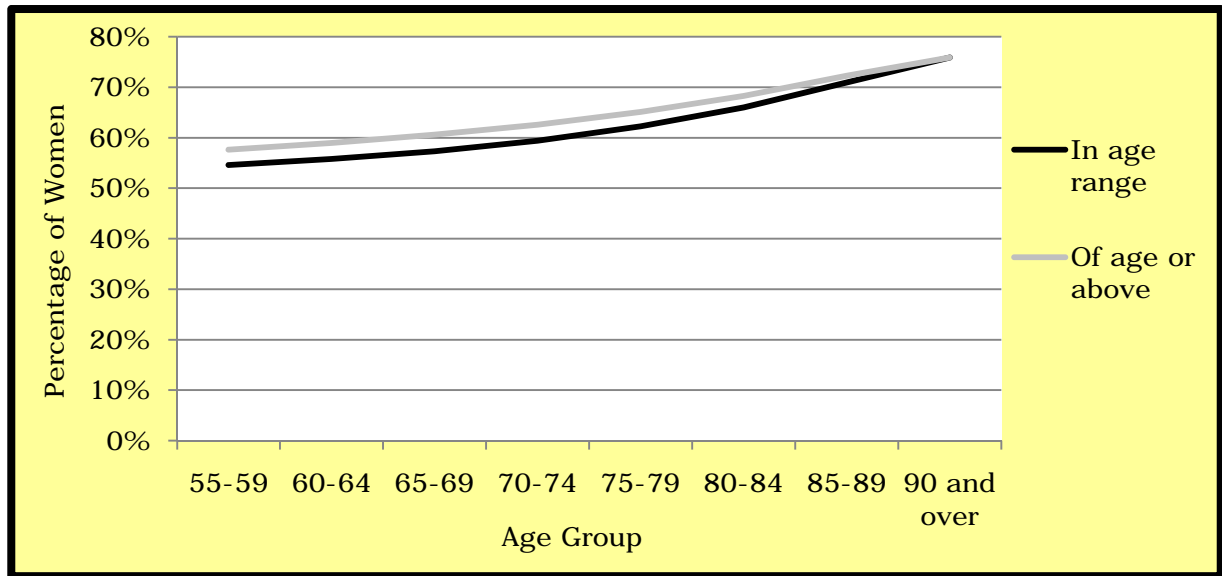


Figure 8 Percentage of Women in Population (2001 Census)

All participants had one or more impairments, as this was a requirement to take part in this element of the study:

- 100% (18) were mobility impaired
- 17% (3) had a visual impairment, although they could read the pedestrian signals
- 6% (1) had a hearing impairment

To establish the extent of people’s mobility impairment participants were asked for further information on what they found difficult:

- Many required assistance with basic tasks around the home: 44% (8) with getting up and down stairs; 33% (6) with getting in and out of chairs (Participants were asked to tick all answers that applied)
- 39% (7) did not need assistance in their home
- Most, 66% (12), used one or more walking sticks at least occasionally to assist with walking, and 22% (4) used other aids
- During the trial most participants used a walking aid to assist them: 72% (13)

4.2 Children Sample Composition

Children participating in the trial were in the same school class, so no control was available for their gender distribution. However, the obtained distribution, see Figure 9 was not significantly different from the 49%/51% girl/boy composition in the population (Population Census, 2001).

Twenty-seven children took part and 13 boys and 13 girls answered this question. One child did not answer the question but information provided by the school tells us that this child was a girl.

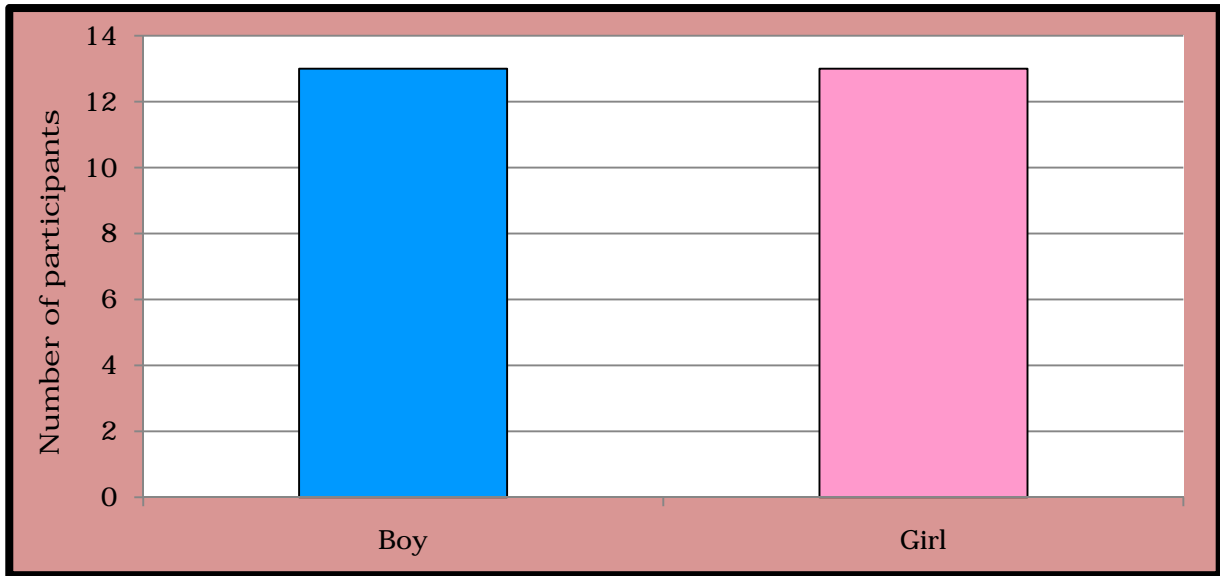


Figure 9 Gender of the participants in the child study

4.3 Experience in using crossings

All the mobility impaired and child participants were asked whether they use standard pedestrian crossings. Furthermore, the mobility impaired participants were asked how often they usually use them. The answers for both groups are shown in Figure 10 and Figure 11.

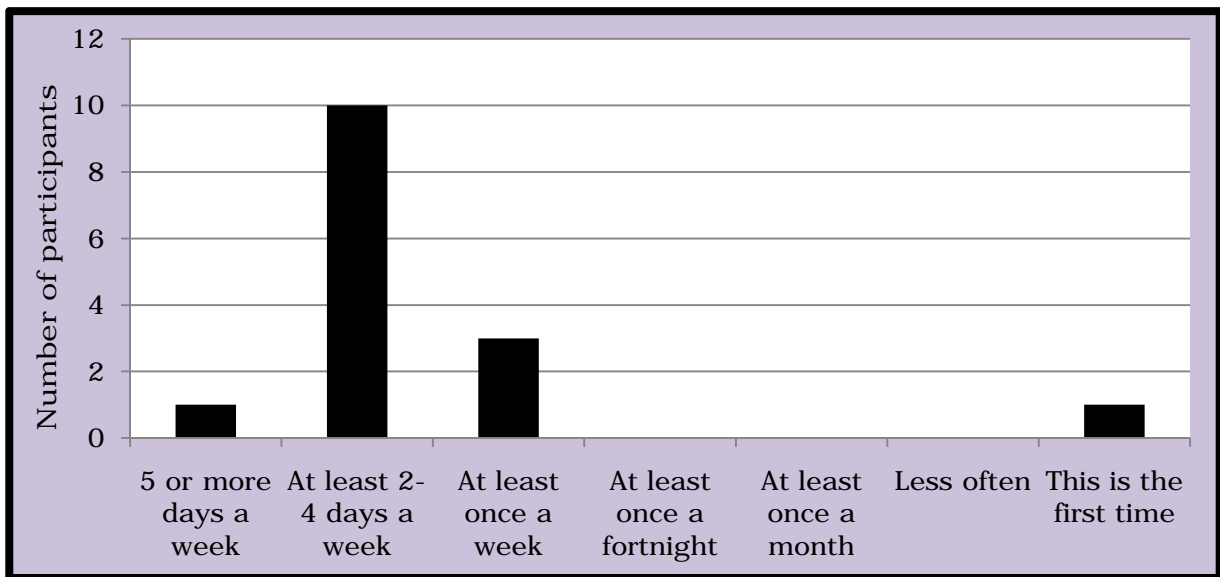


Figure 10 Frequency of pedestrian crossing usage for mobility impaired participants

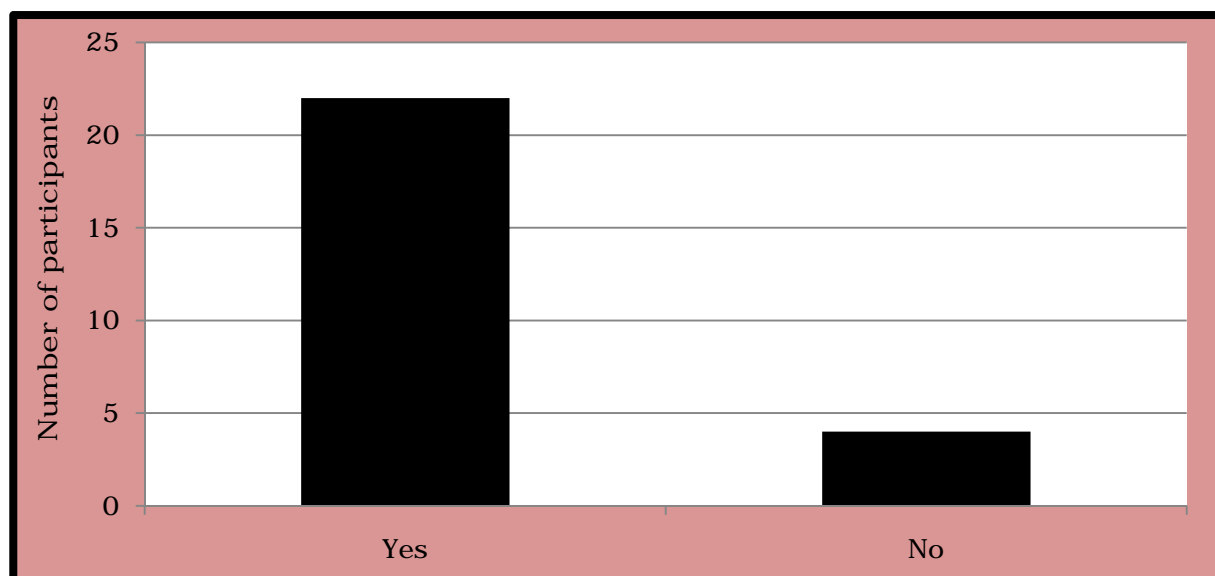


Figure 11 Children who have used a pedestrian crossing

- All but one of the mobility impaired participants used a standard pedestrian crossing regularly: at least once a week. The other participant's answer, though possible, it is thought they misunderstood the question
- Most 85% (22 of 26 answering the question) of the children had previously used a standard pedestrian crossing.

4.4 Understanding of Signals

Standard pedestrian signals at junctions use a Green Man to indicate an invitation to cross, an interim Blackout which permits pedestrians who have already started to complete crossing, and a Red Man to indicate that pedestrians should not start to cross. PCaTS replaces the Blackout with a Countdown in seconds to improve the information available on the time remaining to reach the other side of the crossing.

Although these are the official interpretations of the pedestrian signals, it has been previously found (Stirling et al, 2009 – PPR411) that many pedestrians do not fully understand them. The first part of the questionnaires given to both the mobility impaired participants and the children explored the extent to which they understood this information.

4.4.1 Green Man

The mobility impaired participants' and children's understanding of the Green Man is shown in Figure 12.

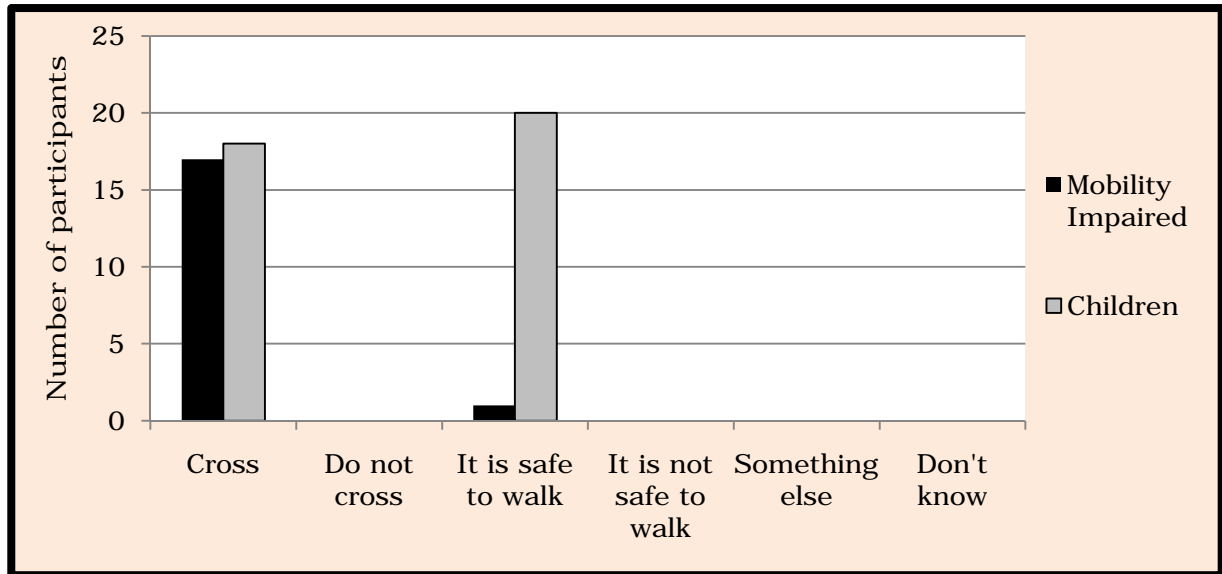


Figure 12 Response to the question 'What does the Green Man mean to you?'

All of the participants, in both the mobility impaired and child studies, said that the Green Man meant either Cross, or it is Safe to walk. This implies they all understood the basic meaning of the Green Man. However,

- The children were more likely to appreciate the associated safety of the Green Man than the Mobility Impaired participants

Although only asked to give one answer to this question, several of the children gave more than one answer. This is why there are more answers than children in Figure 12.

4.4.2 Red Man

Both mobility impaired and child participants were also asked to state their understanding of the Red Man. Their answers are summarised in Figure 13.

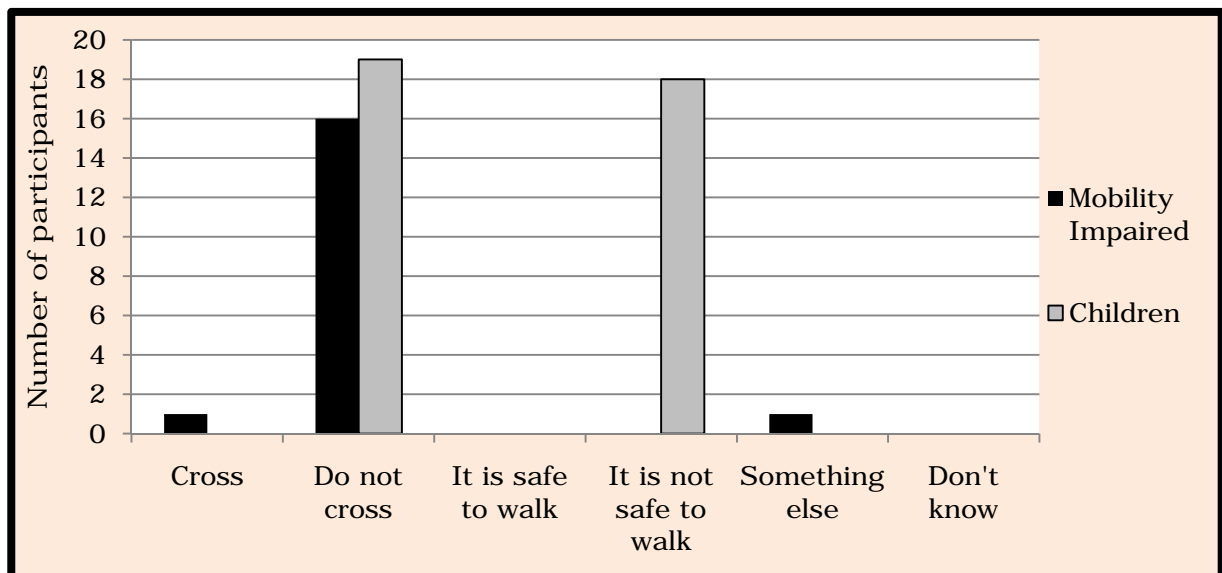


Figure 13 Response to the question 'What does the Red Man mean to you when you arrive at a crossing?'

- Most of the participants: 16 (89%) of the mobility impaired participants and all of the children understood not to start crossing the road

- The question requested one answer, however, 10 children answered both that they should not cross and that it was not safe to walk
- The only difference was that, as with the Green Man, the children stated that the decision not cross was also associated with safety

Mobility impaired participants were also asked what the Red Man means if it appeared whilst on the crossing, Figure 14.

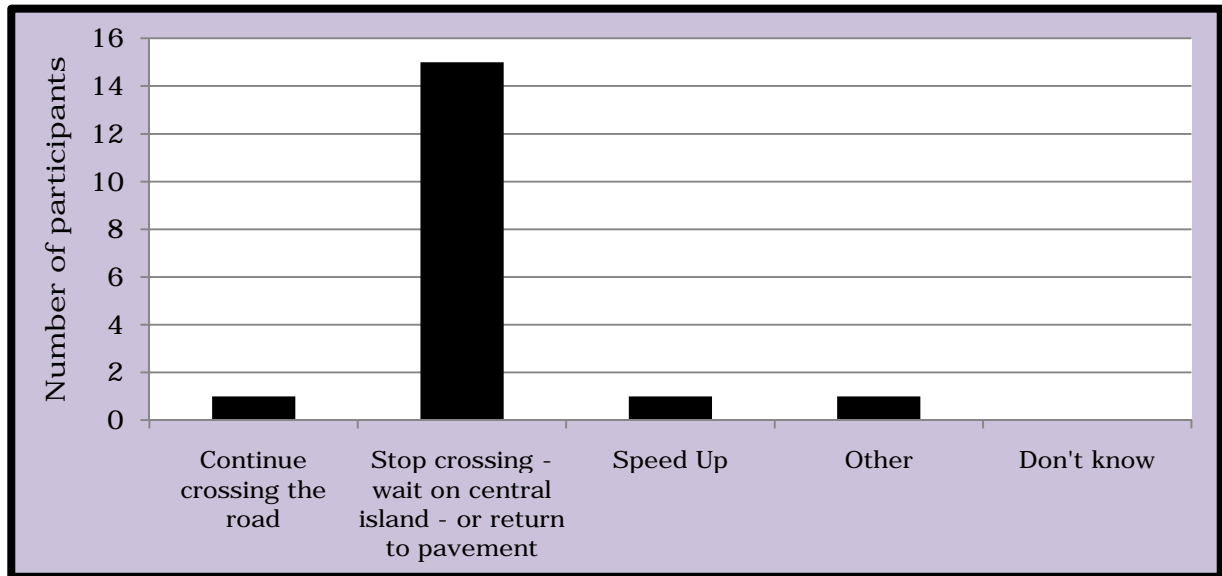


Figure 14 Response to the question 'What does the Red Man mean to you if it appears when you are close to half way across the crossing?' for mobility impaired participants

- The majority of participants (83%) stated they would wait on the central island or return to the pavement if the Red Man appeared whilst they were on the crossing
- One of the participants stated they would continue to cross to the other side, and another participant stated that they would continue to cross and speed up

There was therefore, an implied understanding that the Clearance period was coming to an end and priority would be returning to vehicles.

Children were not asked this more difficult question; instead they were asked what they would wait for before crossing the road. As expected, all but one of them said that they would wait for the Green Man before crossing the road.

4.4.3 Blackout

Previous sections have shown that both the Green Man and the Red Man are well understood. The next part of the questionnaire probed as to the mobility impaired and child participants understanding and reaction to the Blackout period between these two signals.

Mobility impaired participants were asked for the meaning of the Blackout if it was showing when they arrived at the crossing (one answer permitted) and the children were asked whether they had noticed the Blackout and what it meant (with one or more answers permitted). The questionnaire also asked for their predicted actions if the Blackout period had started when they arrived at the crossing (Arriving) and if it started whilst they were crossing (On crossing). In all cases, except for children arriving at the crossing during the Blackout period, a range of possible answers were provided and the

participants were asked to choose one. For children arriving at the crossing during the Blackout period, they were only asked if they would cross or not.

The answers available varied slightly according to the situation being presented, and with the type of participant. However, they could all be categorised into one of six answers. This has been performed and the results are shown in Figure 15.

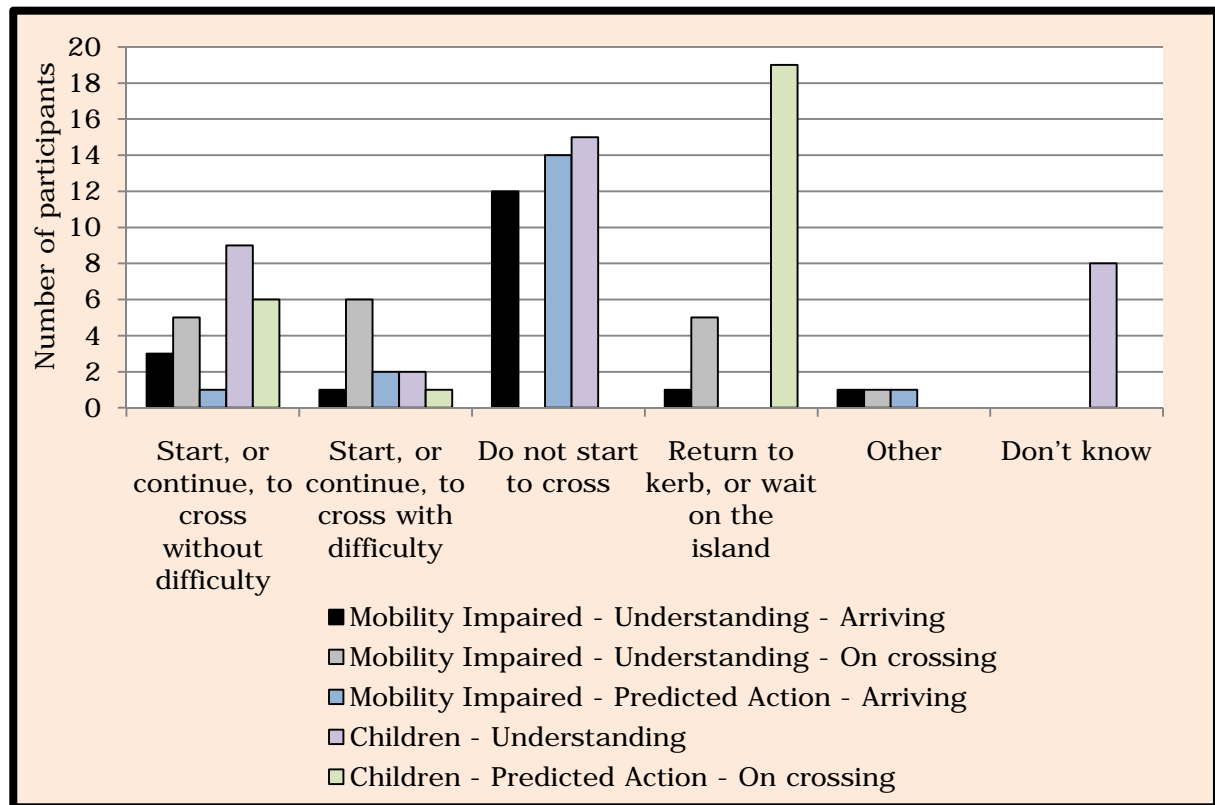


Figure 15 What does the Blackout period mean and predicted actions

The following trends can be seen within the answers:

- When asked how they should interpret the meaning of Blackout if it was showing on arrival at the crossing, a majority (67%) of mobility impaired participants responded that it meant that you should not start to cross. 4 (22%) thought it meant they could start to cross. The proportion who correctly understood this meaning of the Blackout was less than that of the proportion who understood the Red Man (89%), as discussed in Section 4.4.2.
- When asked how they should interpret the meaning of the Blackout period if it started while they were already crossing, a majority (61%) of mobility impaired participants stated that it meant they could continue to cross. Many (33%) of the participants stated they could continue to cross although it was with difficulty. This may be a result of their speed and consequently their ability to traverse the crossing within the Clearance period. This is to some extent supported by the fact that 28% of them stated they would either return to the kerb, or wait at the pedestrian island.
- Mobility impaired participants were also asked what they would choose to do if Blackout was showing when they arrived at the crossing. They stated that they would generally (77,8%) not start to cross the road if they arrived in the Blackout period. Although 3 (17%) stated they would cross, which is general agreement with the answers obtained as to their understanding of the Blackout period.
- Most children 23 (85%) stated that they had noticed the Blackout

- Most children identified at least one of the correct meanings of the Blackout period: 15 (56%) stated they should not start to cross and 11 (41%) stated they could continue to cross, although 2 considered this was with difficulty. However 8 (30%) did not know what it meant
- None of the children stated they would cross the road if they arrived during the Blackout period. Of those that answered the question only 4% stated that they did not know what they would do, the remaining stated they would not cross
- Most children (19, 70%) would wait at the pedestrian island, if the Blackout period started whilst they were crossing. The remaining children who answered the question (26%) would continue crossing

4.4.4 Countdown

The participants were given no information about the Countdown timers at the crossings prior to the trial. In order to ascertain if they had understood the meaning of the timers they were asked what they thought they meant and how they would react if they came across the timer whilst at and on a crossing. Mobility impaired and child participants were asked what they would expect to do if they encountered the start of Blackout whilst on the crossing. The mobility impaired participants were also asked for their expected action if the Countdown was showing on arrival, and then the specific situations where it showed the values 10 and 5. As with the Blackout period questions their answers could be placed into the same categories. The children were also asked whether they would cross if the Countdown displayed each of 15, 10 and 5 when they arrived. The participants' answers to these questions are summarised in Figure 16 and Figure 17.

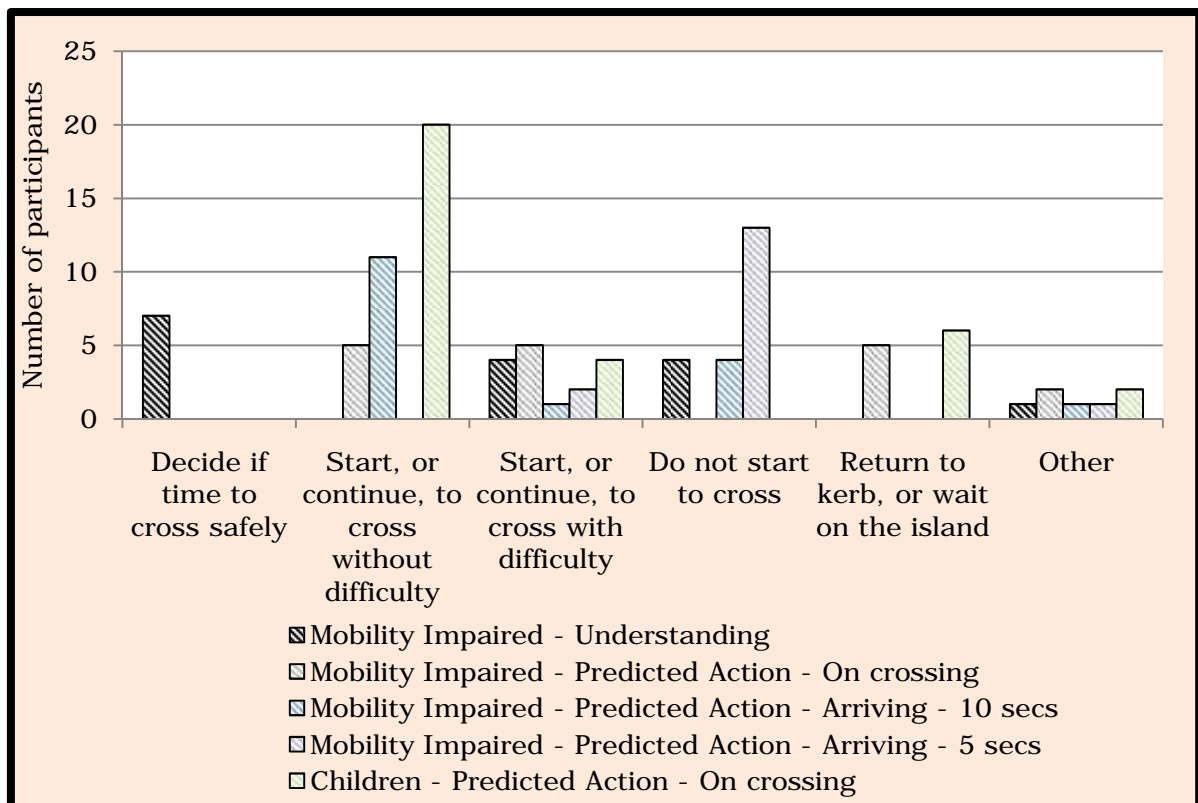


Figure 16 Understanding of Countdown and actions taken if showing on arrival at the crossing

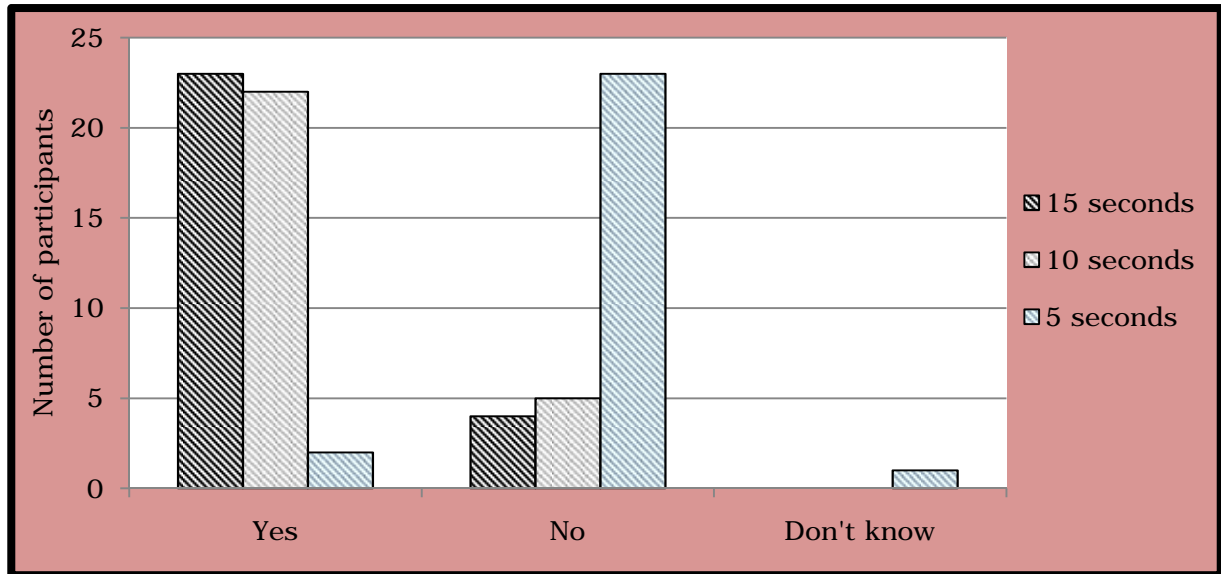


Figure 17 Would children cross when arriving with stated times displayed?

The following trends are found within the above graphs:

- Many of the mobility impaired participants interpreted the Countdown as permitting them to start crossing: 7 (39%) stated that it meant they could decide whether or not it was safe to cross; 4 (22%) that it meant they could cross with difficulty; and 4 (22%) considered it meant not to start crossing. As Countdown currently only has experimental status in the UK there is no definitive guidance for the public (e.g. Highway Code) on how they should interpret the Countdown phase. The responses suggest that users are not treating it as a Blackout phase and are instead forming their own judgement as to whether there is sufficient time to cross safely.
- Most mobility impaired participants 10 (56%) stated that they would continue to cross if the Countdown started whilst they were on the crossing, and 5 (28%) would return the kerb, or wait at the island. These percentages are in good agreement with their stated actions to the Blackout period starting whilst on the crossing, as is the percentage who considered they would continue with difficulty
- Many mobility impaired participants 12 (66%) stated they would start to cross the road with 10 seconds showing, and only 4 (22%) stated they would wait. This compares with 2 (11%) stating they would start to cross the road with 5 seconds showing, and 13 (72%) stating they would wait. This implies that the mobility impaired participants considered they were more likely to start to cross in the early part of the Countdown than in the Blackout period, as 78% stated they would wait if they arrived during the Blackout.
- Most 20 (74%) children stated they would continue to cross without difficulty if the Countdown started whilst they were crossing. Only 6 (22%) stated they would return to the kerb, or wait at the island. This implies that the children were more likely to complete crossing the road with the Countdown display than with the Blackout period
- With at least 10 seconds on the Countdown display, most 23 (85%) of the children would decide to start crossing the road, although this switches to 86% deciding not to cross the road with 5 seconds on the display. This compares with none of the children stating they would start to cross the road if the Blackout period had started

4.4.5 Last Time to Start Crossing

Both the child and mobility impaired participants were asked to state when was the last time they should start to cross the road. The only difference between the mobility impaired participants and the children's answers available was that the mobility impaired participants could differentiate between the start and the middle of the Clearance period. Only the start of the Countdown was presented as an option to the children, whilst there was no time specified in the Blackout period; this was necessary to simplify the questions for the children and therefore obtain meaningful answers. The children's answers which specified the Clearance period have been recorded under the start of the Clearance period, see Figure 18.

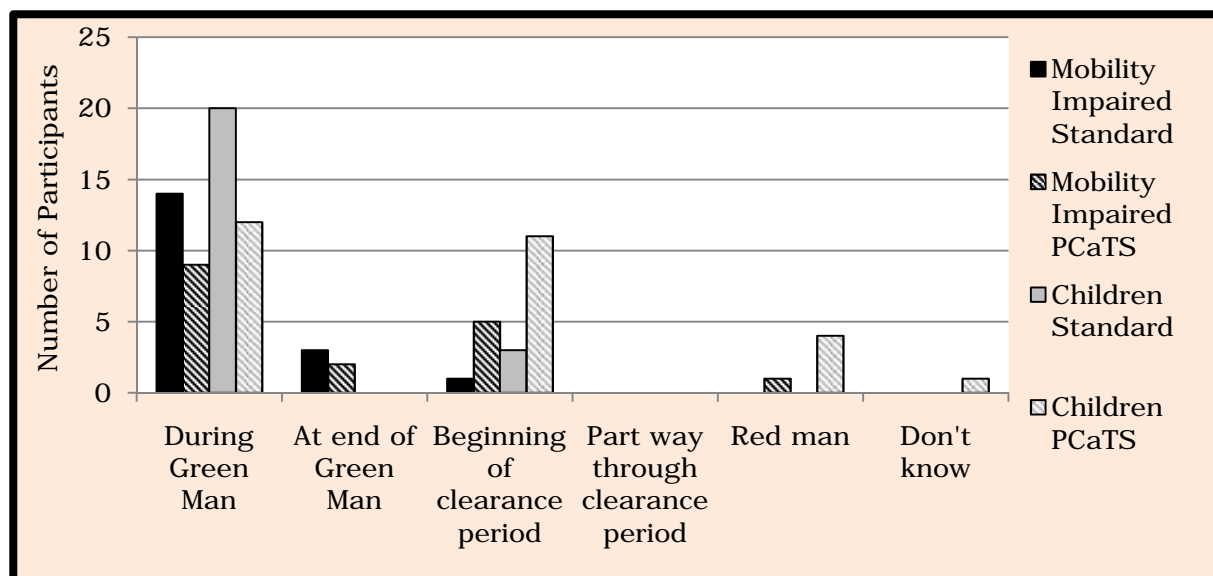


Figure 18 Last time participants should start to cross the road

These answers show that:

- Most mobility impaired participants considered that the last time they should start to cross the road at a standard crossing is in, or at the end of the Green Man 17 (94%). However, this dropped to 11 (61%) with PCaTS, with most of the others (28%) considering they can cross at the start of the Clearance period.
- Similarly, most of the children 20 (74%) considered that the last time they should start to cross the road at a standard crossing is in the Green Man. However, this dropped to 12 (44%) with PCaTS, with most of the others (41%) considering they can cross up to when the Countdown appeared.
- Overall, this implies that PCaTS did encourage the participants to consider crossing during the Clearance period.
- A small number in both samples considered they could start to cross when the Red Man was showing with PCaTS, whilst this mis-interpretation did not occur with the standard signals.

4.5 When They Crossed the Road

4.5.1 Start time

Mobility impaired participants were asked to look at the pedestrian signals at two different times during the Green Man at each of the two different pedestrian crossings (Standard and PCaTS). One was just before the change to Green Man, and the other was

part way through the Green Man phase. They were asked after the trial as to the time that they started crossing the road, their answers are summarised in Figure 19.

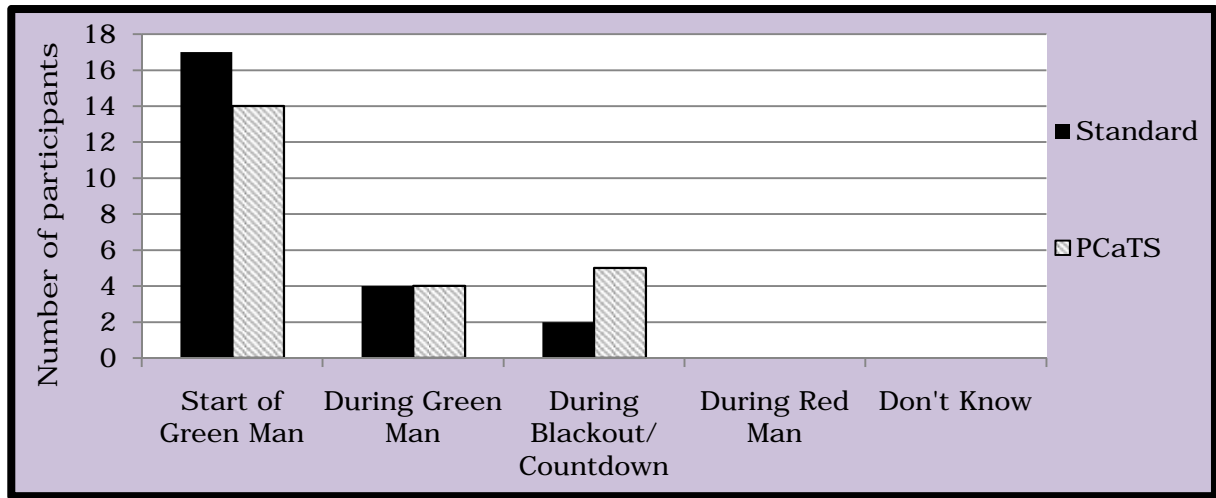


Figure 19 When mobility impaired participants reported they decided to cross Most clearly recalled the start of the Green Man and considered that they immediately made the decision to cross. Others also noted the decision part way through the Green Man, with some stating they made their decision after a few seconds delay, and in the Blackout, or Countdown.

Owing to differences in missing answers, and the ability to make multiple answers to this question, it is not possible to ascertain whether PCaTS had any effect on the time it took between looking at the information and making a crossing decision. However, their answers indicate they correctly remembered the circumstances of their decision.

4.5.2 Whether they waited at the island

The mobility impaired participants had the opportunity to either cross the road completely or cross the road to a central island and wait for the start of a new pedestrian phase. This choice was made twice at each of the types of crossing: Standard and PCaTS. Their stated choices are shown in Figure 20.

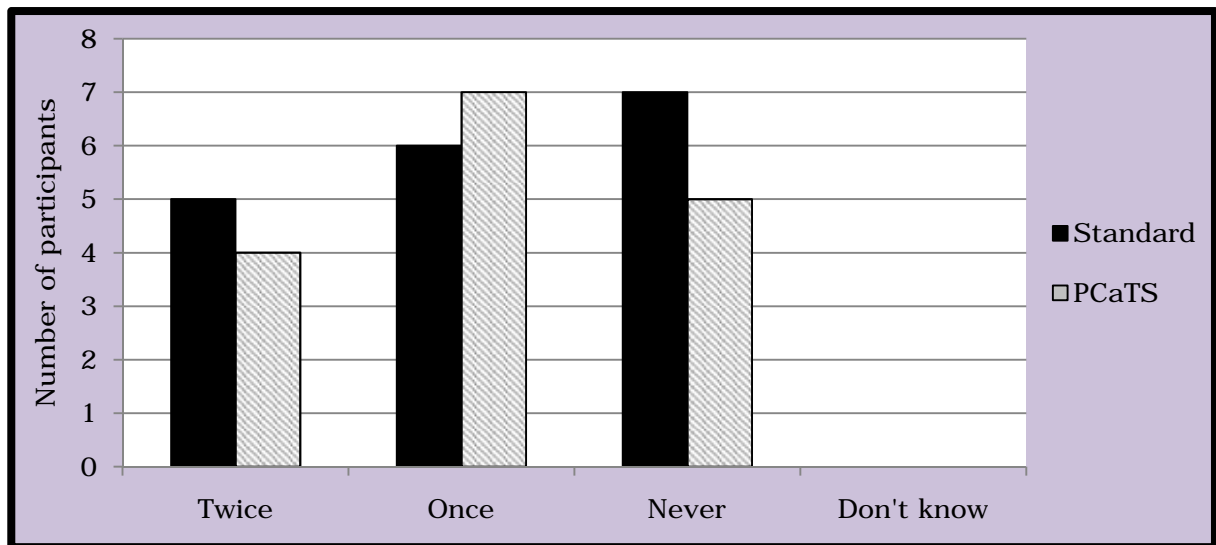


Figure 20 Whether the mobility impaired participants waited at the island

Most participants stopped at least once at an island, 11 (61%) at both type of crossing. There were small stated differences between the number of times people stopped at the island when using the two crossing types. However, the differences were too small to be significant. (It should be noted that not all participants answered this question for PCaTS).

4.6 Time to Cross the Road

4.6.1 Perceived Time Taken

Mobility impaired participants were asked how long they thought it had taken them to cross both the Standard and PCaTS crossings, their answers are summarised in Figure 21.

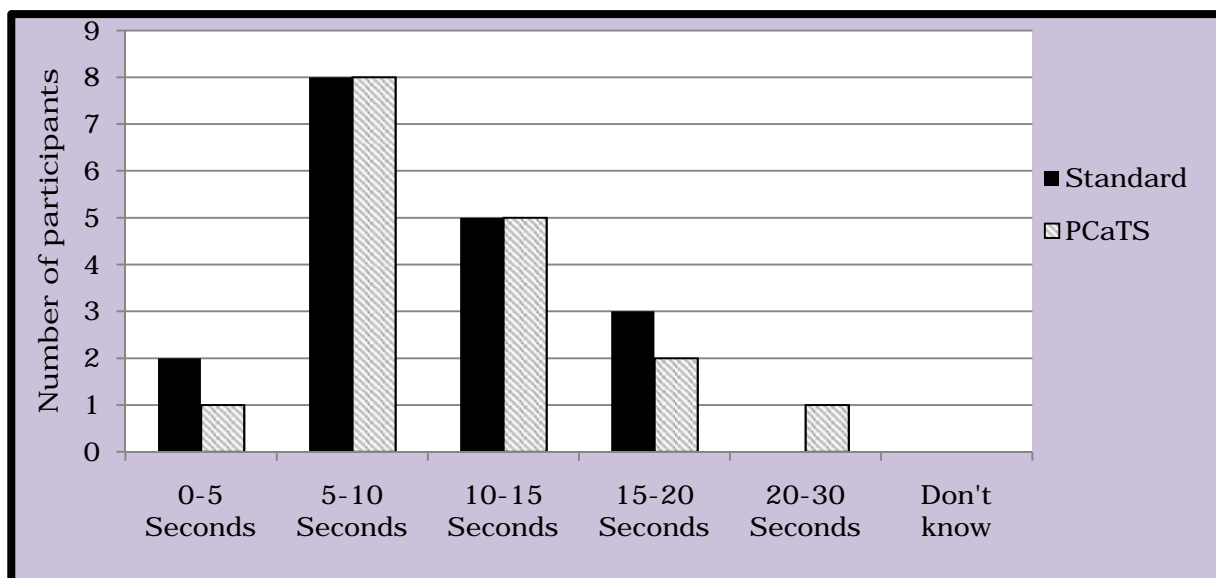


Figure 21 Time mobility impaired participants thought it took to cross the standard and PCaTS crossings

People’s perception of time is often poor (see for example Holland and Hill, 2010: Gender differences in factors predicting unsafe crossing decisions in adult pedestrians across the lifespan). A few (two at the Standard crossing) stated that they could cross in 5 seconds or less: i.e. at greater than 5.8mph, which is high for even the maximum

walking speed of a young person (Bohannon, 1997). Most considered they crossed in a maximum of ten seconds, implying a minimum speed of 2.9mph (1.3m/s). This is approximately equal to the observed average walking speed (see Section 6.2.7), and is in line with the comfortable walking speed of able bodied pedestrians over 60: it therefore appears to over-estimate their speed, given their reduced mobility.

However, even taking into account the perception issues it would appear that:

- Mobility impaired participants did not generally consider to have altered their walking speeds at the two types of crossings: i.e. there were no significant changes in the perceived time taken to cross the road.

4.6.2 Whether There Was Sufficient Time To Cross

The mobility impaired participants were asked if they felt they had sufficient time to cross the road at the two types of crossing. They could give one overall answer from the two occasions they used the crossing, or two different answers if their experiences varied according to crossing time. The distribution of the participants' answers were the same for those giving one, and those giving two answers, at the Standard crossing. The answers for those giving one answer are summarised in Figure 22, the differences between individual participants answers at the two crossings are summarised in Figure 23.

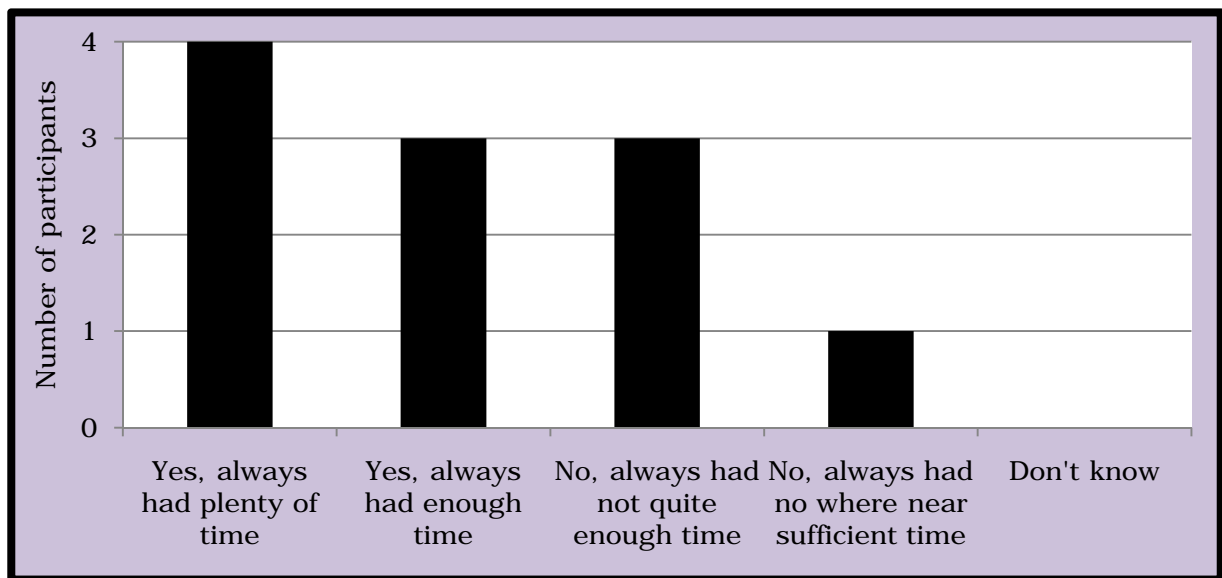


Figure 22 Mobility impaired participants perception - sufficient time to cross the standard crossing

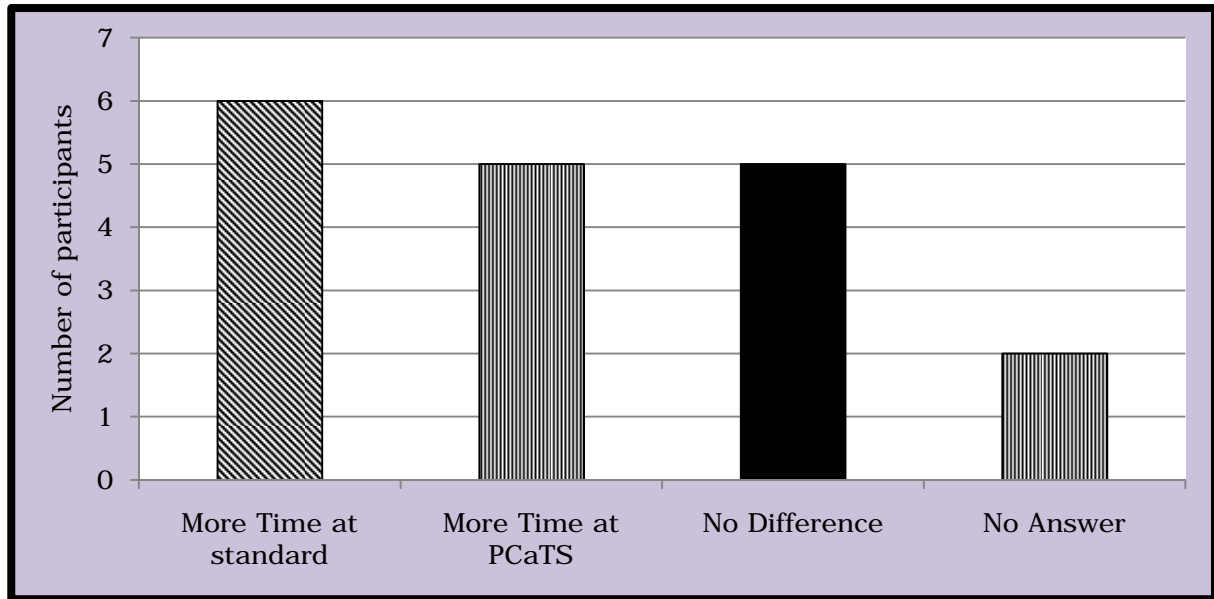


Figure 23 Mobility impaired participants perception - relative time to cross standard and PCaTS crossings

The following is evident with regard to the participants' perception of whether they had sufficient time to cross at the two crossings:

- Most (64%) felt they had sufficient time when using the Standard crossing.
- There was no consistent (or significant) change in perception of whether there was sufficient time to cross with PCaTS: five felt they had more time and six felt they had less time.
- Participants made their crossing decisions with the same amount of time until the end of the Blackout/Countdown period at the two crossings, so it would appear PCaTS had no overall effect on perceptions of individual crossing decisions.

Mobility impaired participants were also asked to give an overall direct comparison of whether they were more likely to have sufficient time to cross with or without a Countdown display, see Figure 24.

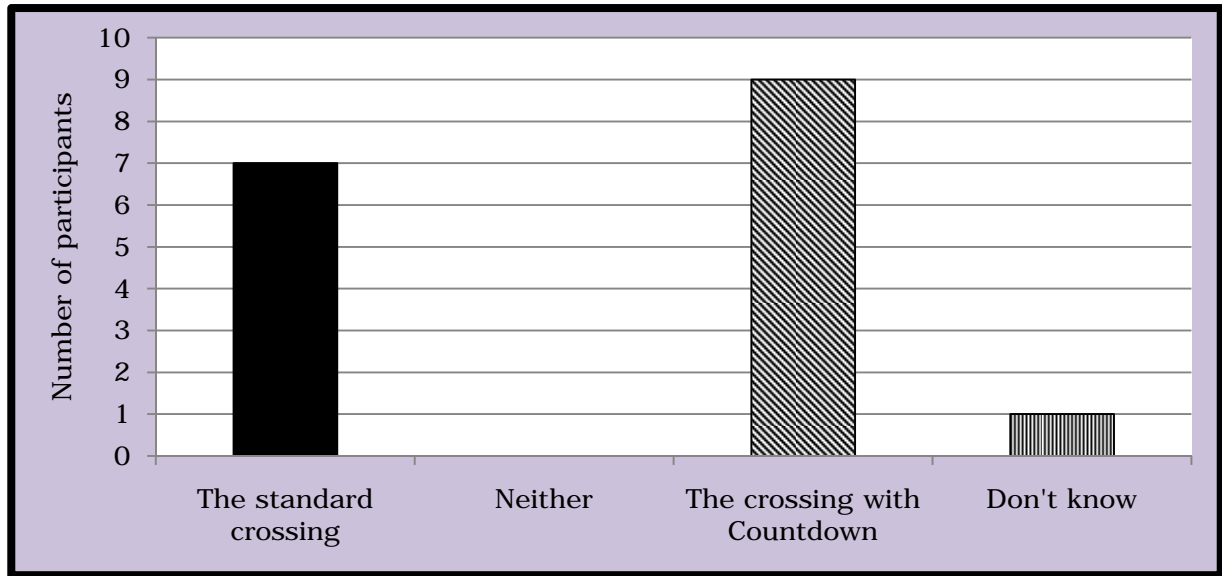


Figure 24 The crossing on which the mobility impaired participants felt they were more likely to have time to cross

There was no significant difference between the percentages choosing each of the crossings. Figure 24 therefore indicates that:

- Mobility impaired participants are evenly split as to which crossing was perceived to be more likely to provide sufficient time to cross.

4.7 Safety

People should feel safe when using a pedestrian crossing in the invitation to cross period, especially vulnerable people like those with a mobility impairment and children. Also, in line with this, they should not feel rushed, as there should be adequate time for them to reach the other side of the road before the end of pedestrian priority. This section explores the extent to which participants felt safe and rushed at the two crossings.

4.7.1 Extent of Feeling Safe

Mobility impaired participants were asked the extent they felt safe at the two types of crossings individually, and the type of crossing at which they felt safest. The children were asked the simpler question as to which crossing they felt safest. The answers for both groups are summarised in Figure 25 and Figure 26.

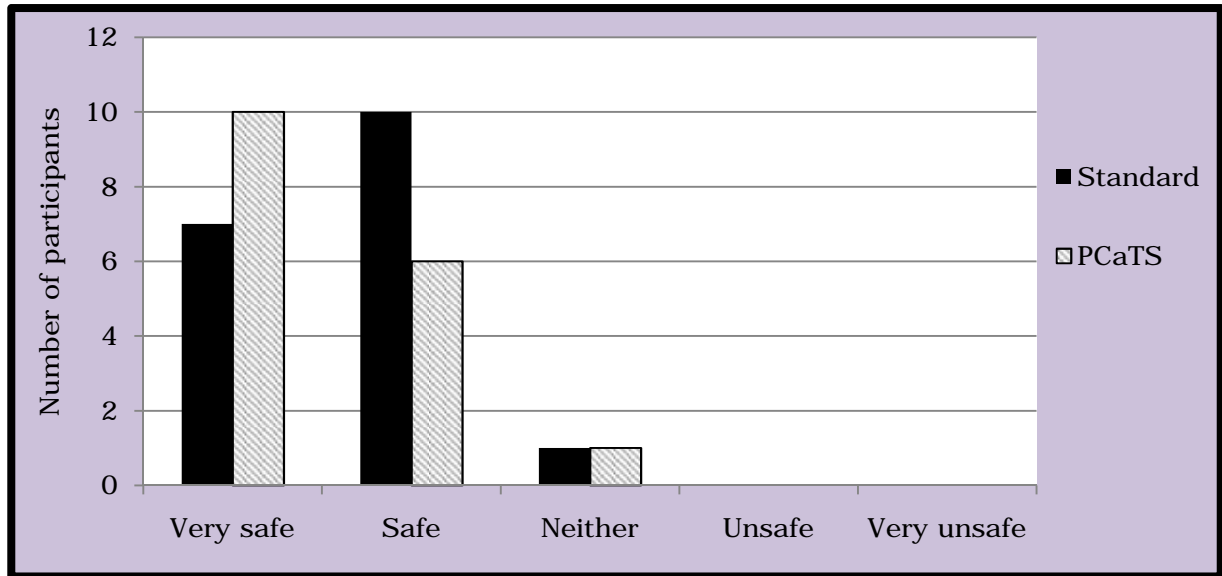


Figure 25 Mobility impaired participants’ perception of being safe

The following is evident from the mobility impaired participants’ answers:

- The mobility impaired participants generally felt safe at all the crossings.
- There was an indication they felt safer at the PCaTS crossing, but this small difference in opinion was not significant.

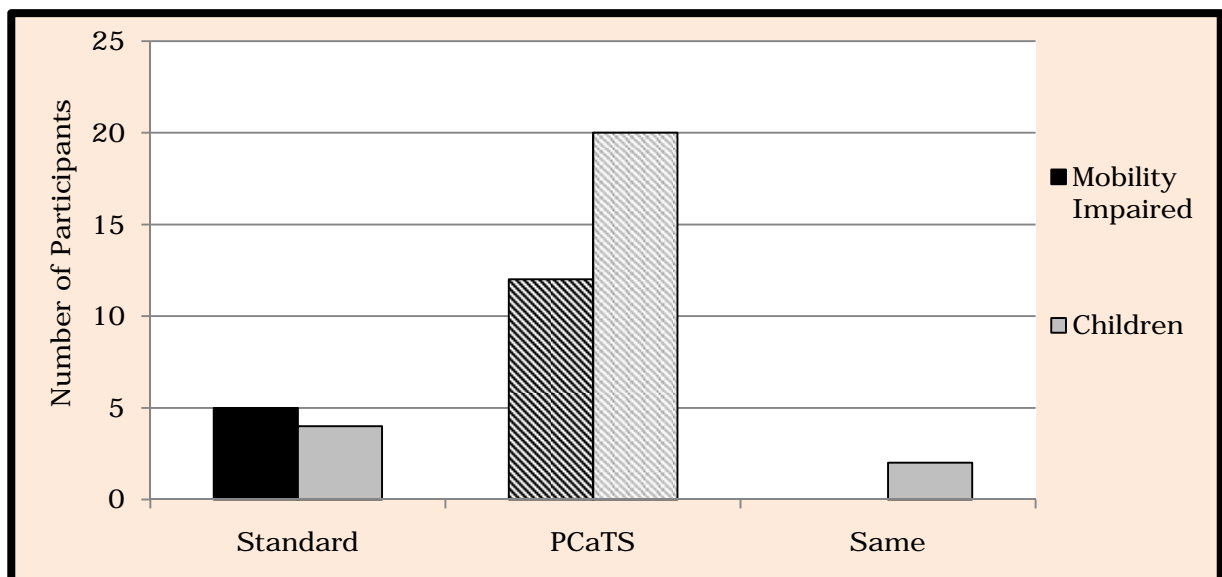


Figure 26 The crossing on which participants felt safest

The participants direct opinion on which crossing was safest show:

- Mobility impaired participants generally felt safer on the PCaTS crossing; this was significant at the 90% confidence level
- Children generally felt safer on the PCaTS crossing; significant at the 90% confidence level

4.7.2 Extent of Feeling Rushed

The mobility impaired participants were asked to what extent they felt rushed at the two types of crossings individually, and the type of crossing at which they felt least rushed. When asked for their individual opinions they could either provide an overall assessment for the crossing, or provide two assessments; one for each time they used the crossing. The children were asked the simpler question as to which crossing they felt they had more time to cross.

The mobility impaired participants' answers, for those that gave an overall assessment of the Standard crossing are shown in Figure 27, and the differences individuals expressed with regard to the two crossings are shown in Figure 28.

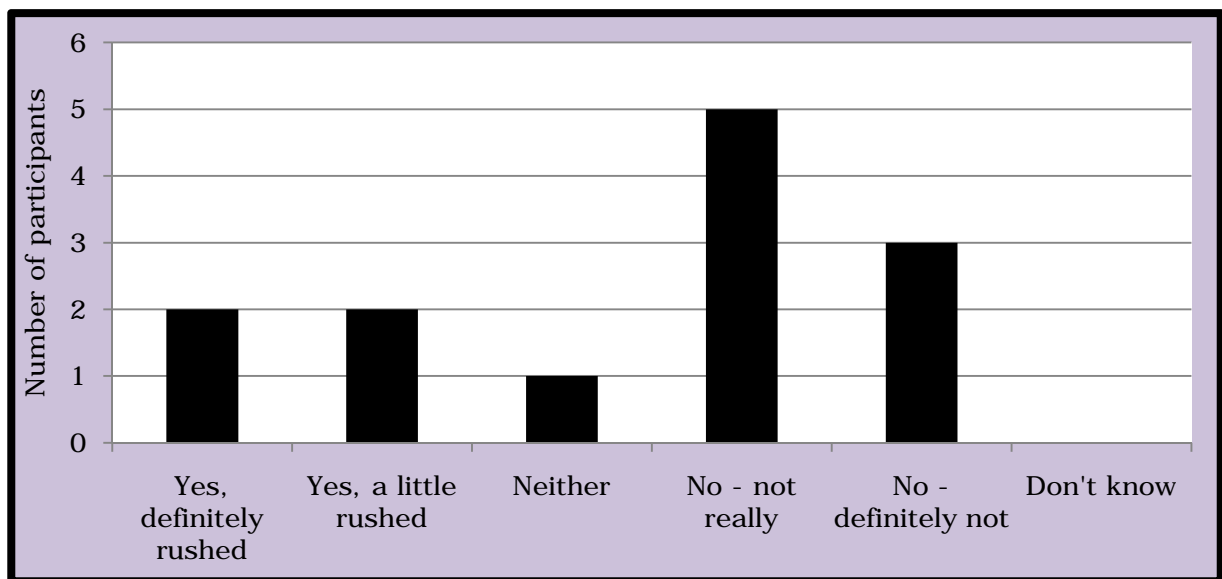


Figure 27 Mobility impaired participants' perception of feeling rushed at the standard crossing

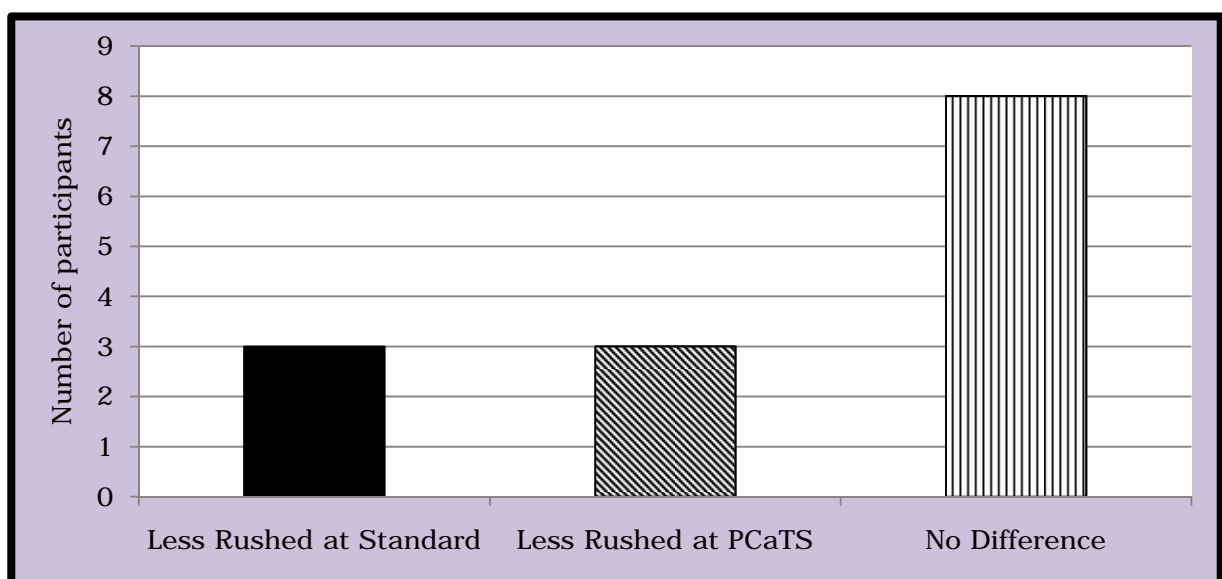


Figure 28 Crossing type Mobility impaired participants feel less rushed at
The mobility impaired participants felt:

- Generally (62%) not rushed at the Standard crossing
- The most common answer was that they felt no difference in the extent to which they were rushed at the two crossings

The mobility impaired participants and children’s direct opinions as to at which crossing they felt less rushed (described to children as the crossing they had more time to cross) are summarised in Figure 29.

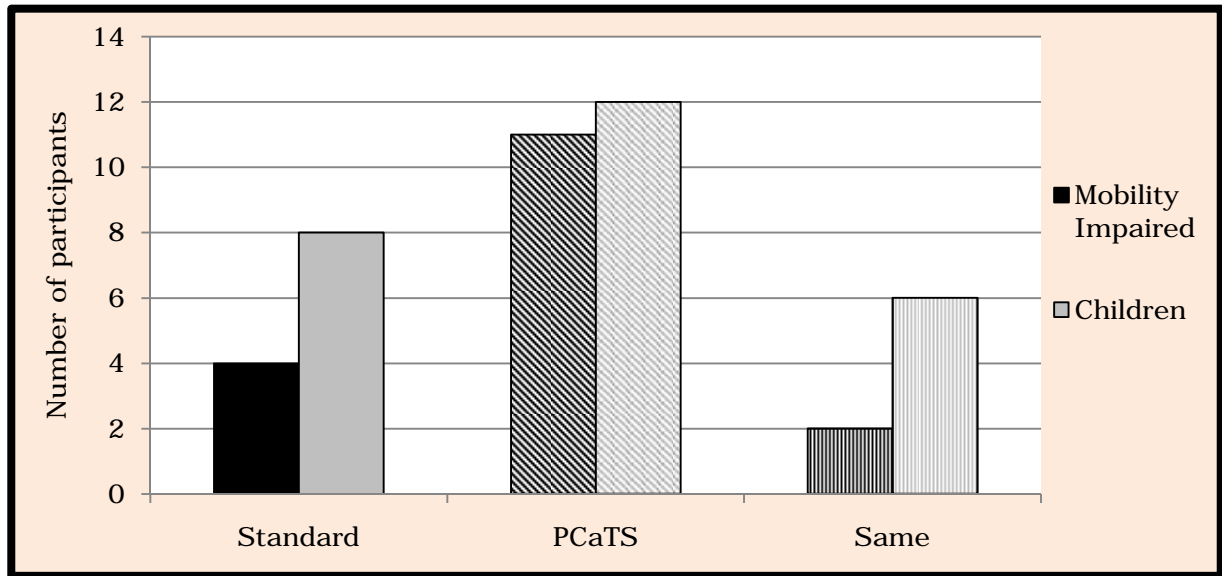


Figure 29 The crossing on which participants felt less rushed

When the mobility impaired participants were asked whether they felt less rushed at the Standard or the PCaTS crossing:

- More mobility impaired participants said they felt less rushed at the PCaTS crossing; significant at the 95% confidence level (Figure 29).
- However, when they were asked to rate their perception of feeling rushed at the Standard and PCaTS crossings individually on a scale of “Yes, definitely” to “No, definitely not”, there was generally no difference between the two crossings (Figure 28). This suggests that there was little difference in perceived time available to cross between the Standard and PCaTS crossings.

When the children were asked whether they felt they had more time to cross when using the Standard or PCaTS crossing:

- More children felt they had longer to cross when using the PCaTS crossing compared to the Standard crossing, but the difference was not statistically significant.

4.8 Whether PCaTS is Liked

Both the mobility impaired participants and the children were asked as to whether they liked the Countdown at the crossing, and which of the PCaTS and Standard crossings they preferred. The difference between the questions administered to the mobility impaired participants and to the children was that the mobility impaired participants were asked as to the extent they liked the pedestrian Countdown, whilst the children were asked whether they liked the counting numbers and whether they were useful. These answers for both groups are summarised in Figure 30 and Figure 31.

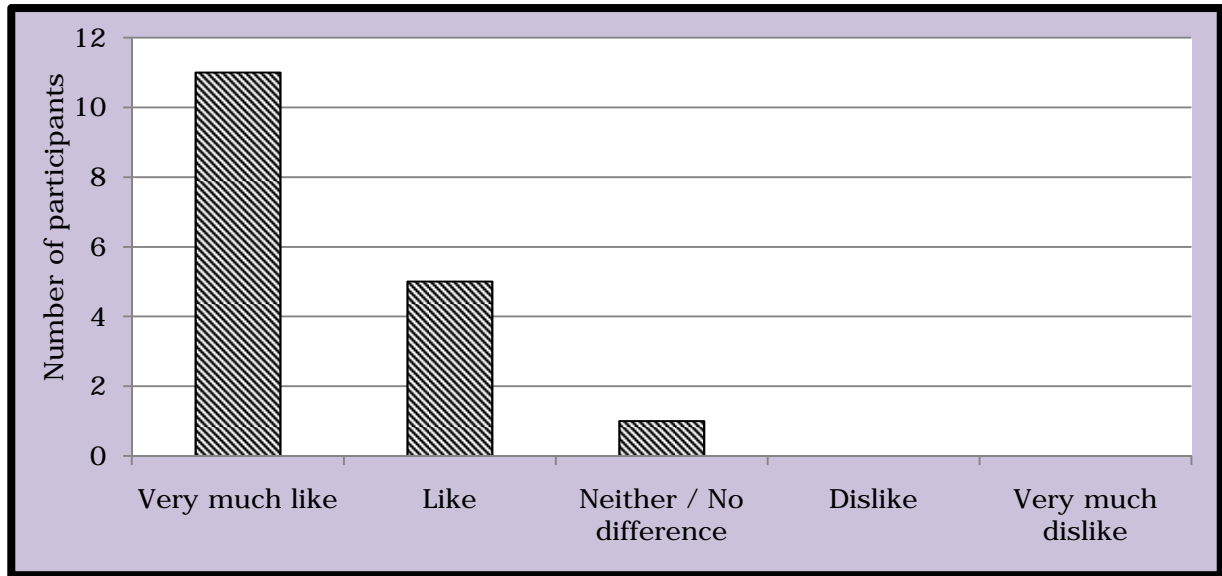


Figure 30 The extent mobility impaired participants liked the Countdown

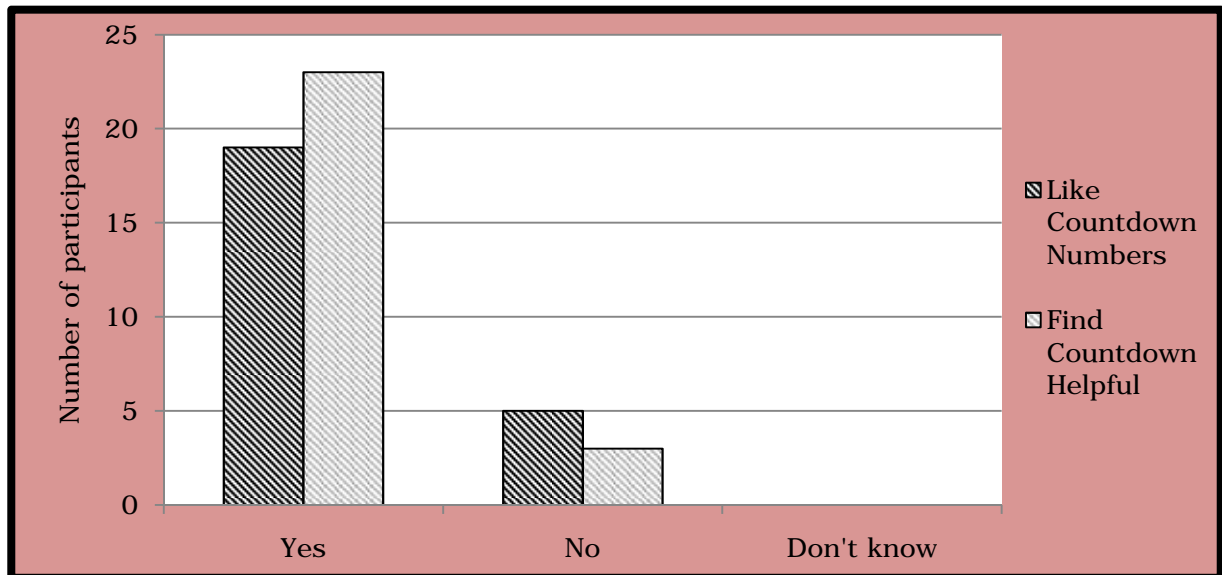


Figure 31 The extent children liked the Countdown and found it helpful

The mobility impaired participants and children’s opinions were:

- Nearly all mobility impaired participants who expressed an opinion 16 (94%) liked, and many 11 (65%) very much liked the Countdown on the PCaTS crossing.
- Nearly all children who expressed an opinion 19 (79%) liked, and 23 (88%) found the Countdown helpful.

Given that they liked the Countdown, it is not surprising how many preferred the PCaTS crossing, see Figure 32.

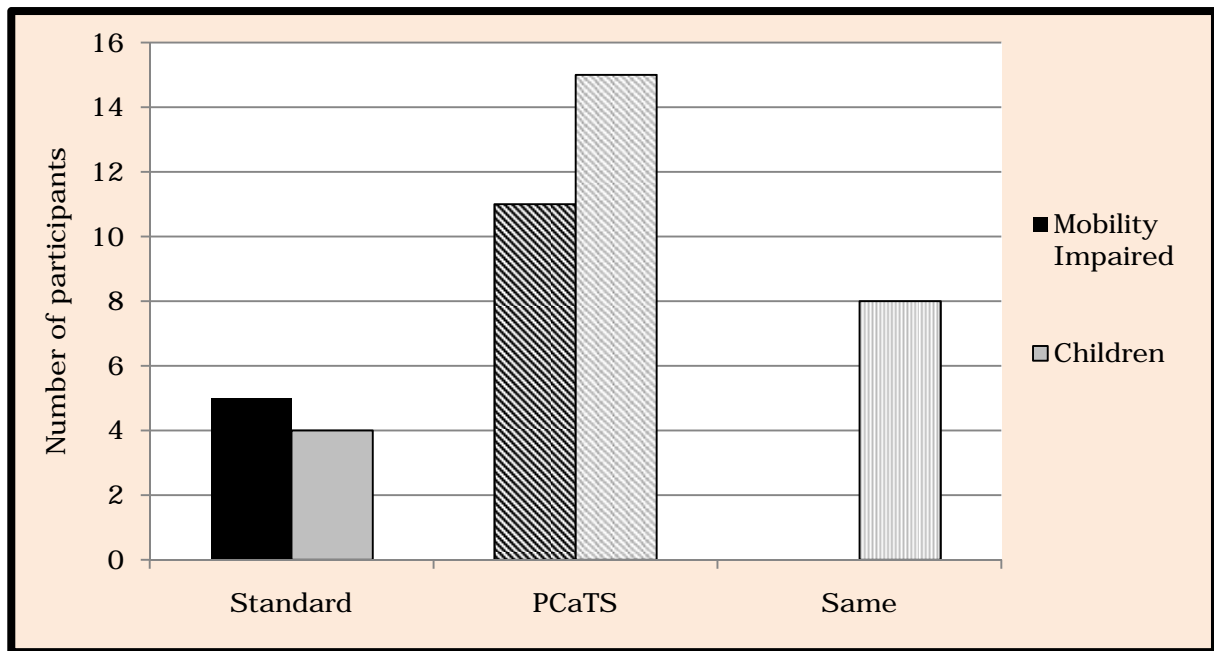


Figure 32 Which crossing the participants preferred

Most participants in the two trial preferred PCaTS, and:

- Most mobility impaired participants (11, 69%) who expressed an opinion preferred PCaTS, but this was not significant. The remainder preferred the Standard crossing.
- Significantly more children (56%) preferred PCaTS to the Standard Crossing (15%), with approximately a third having no preference for either.

4.9 Summary of Findings

4.9.1 Sample Characteristics

1. During an accompanied walk, 18 mobility impaired people were surveyed. A good cross-section of mobility impaired pedestrians was obtained. All of the participants were over 60 years of age. The gender composition of the sample appeared slightly biased towards women, but this was not significantly different from the National average. Nearly all mobility impaired participants used pedestrian crossings regularly.
2. During another accompanied walk, 27 children were surveyed. The gender split was approximately equal and all children were aged 11. Most (85%) of the children had used a crossing before.

4.9.2 How PCaTS affects understanding of Signals

3. All the mobility impaired and child participants understood that the Green Man meant to cross, or it was safe to walk. Also, nearly all (over 89%) participants understood that the Red Man meant not to start crossing the road.
4. The Blackout period was less well understood than the Red and the Green Man. However, 67% of the mobility impaired participants correctly interpreted the Blackout as meaning that you should not start to cross if it shows on arrival at the crossing. Also, 61% of mobility impaired participants stated that they could continue to cross if the Blackout period started whilst they were crossing. The

majority of children identified one of the correct statements about Blackout, although 30% did not know what it meant.

5. The meaning of Countdown was also understood to be different from Blackout by the mobility impaired participants. If showing on arrival at the crossing, 39% stated that it meant they could decide whether or not it was safe to cross; 22% that it meant they could cross with difficulty; and 22% considered it meant not to start crossing. Therefore, although 67% understood the meaning of Blackout on arrival, far fewer attributed one particular meaning to Countdown, although a total of 61% attributed the meaning to be associated with the possibility of starting to cross. Therefore, a higher proportion considered it possible to start crossing during the countdown..
6. Most mobility impaired participants (94%) stated that the last time they should start to cross the road at a standard crossing is in or at the end of the Green Man. However, this proportion dropped (61%) with PCaTS. Similarly, most of the children (74%) considered that the last time they should start to cross the road at a standard crossing is in the Green Man. However, this proportion also dropped (44%) with PCaTS.
7. Most (85%) of children said that they would decide to start crossing the road if there was at least 10 seconds on the Countdown display; a minority (14%) said they would decide to start crossing the road if there was 5 seconds on the display.
8. Most children (74%) stated they would continue to cross without difficulty if the Countdown started whilst they were crossing. 56% of the mobility impaired participants stated that they would continue to cross if the Countdown started whilst they were on the crossing, whereas 28% said they would return the kerb or wait at the island.

4.9.3 Opinions of PCaTS

9. Nearly all (94%) mobility impaired participants who expressed an opinion liked, and many (65%) very much liked the countdown on the PCaTS crossing, with the remaining participants neither liking or disliking PCaTS. Nearly all children (79%) who expressed an opinion liked, and (88%) found the countdown helpful, with the remaining stating that they did not like PCaTS or did not find it helpful.
10. Most mobility impaired participants felt they had sufficient time when using a standard crossing, and there were no significant changes in this perception with PCaTS..
11. In general, the mobility impaired participants felt safe at both the Standard and PCaTS crossings. There was an indication they felt slightly safer at the PCaTS crossing: with a slight (although not statistically significant) increase in the number stating they felt very safe with PCaTS. However, significantly more (at the 90% confidence level) directly chose the statement that PCaTS was safer.
12. As an overall assessment, there was a statistically significant increase in the proportion of mobility impaired participants who felt less rushed at the PCaTS crossing.
13. Participants were asked whether they preferred the Standard crossing or the PCaTS crossing. Most, 69% of mobility impaired, and 56% of children, preferred PCaTS over the standard crossing. The remainder (31%) of the mobility impaired, and 15% of the children, preferred the standard crossing..

5 Results: Main Sample Pedestrian Perception (Questionnaire Data)

PCaTS increases the amount of information available to pedestrians: by informing them of the amount of time remaining until the change of priority to vehicles at the junction. Providing such information could affect how people use the crossing and their opinions of their crossing experience. It could also alter their interpretation of the information as to what the Clearance period represents.

These subjects were explored in a survey of users both before PCaTS were installed on the eight survey sites and directly after ('After 1' surveys), which were within two weeks of the site being fully operational, where possible. A further survey ('After 2' survey) was undertaken approximately 3 months after "going live ". In the surveys members of the public were selected at random as they completed using the crossing and asked to take part in a questionnaire survey; with the answers entered by the interviewer directly into a hand held Personal Digital Assistant (PDA) device.

5.1 Alternate Site Data

A target sample size of 60 was set for each survey day, i.e. for both the 'Before' and 'After 1' surveys at each survey (main) site. At most sites this sample was achieved. However, on three sites a high proportion of data failed quality checks, which resulted in the sample sizes in the 'Before' surveys as shown in Table 6:

Site	'Before' Sample Size
08/003 (Tower Bridge)	14
10/160 (Roehampton)	21
08/211 (Old Kent Road)	33

Table 6 'Before' data sample sizes

Such sample sizes were unsuitable for site by site analysis, and unfortunately the data issues did not emerge until after the PCaTS installation. It was therefore not possible to increase the sample sizes on the studied sites. The approach taken was to perform further questionnaire surveys on an alternative but comparable site. That is, the site had to be at a junction and have a pedestrian crossing without PCaTS. To maximise the suitability of the alternative site data for comparison with the PCaTS data from the main site, any differences between the crossing and the type of people using them were minimised to remove confounding factors. Therefore the alternative site had to be on a road with similar width as the main site, the same number of traffic lanes, and signal timings that were very close to those on the main site. Furthermore, if a pedestrian island was present on the main site, one needed to be present on the alternate site, and vice versa. The alternate site had to be close to the main site and have similar pedestrian flows. Also, if possible the alternate site had an ASL if the main site had one.

Statistical tests were performed to assess whether the types of pedestrians interviewed on the main and the alternate sites were comparable. If the pedestrian compositions on the main and alternate sites are comparable then it is possible to pool the data from the 'Before' data on the main site with than on the alternate site. The combined data set can then be compared with the 'After' (PCaTS) data from the main site. The results of whether the statistical tests found differences between pedestrian compositions on the main and alternative sites are summarised in Table 7.

Test	Whether any statistical difference		
	Tower Bridge	Roehampton	Old Kent Road
Gender	No	No	No
Age	No	No	No
Trip Purpose	Yes	No	No
Frequency of use	No	No	No
Feeling safe	No	No	No
Feeling rushed	No	No	No

Table 7 Statistical differences between main and alternate sites

There was uniformity between pedestrians (i.e. only one statistically significant difference) on the main and alternate sites. Also, there was uniformity in the pedestrians' overall assessments of the crossings. This implied it was possible to pool the data from the main and alternate site for comparison with the 'After' (PCaTS) data from the main site.

Furthermore, it was found that the variation between the 'Before' Main sites and Alternate sites was found to be less than that between the 'Before', and 'After 1', surveys on the Main sites.

5.2 Category definitions

The data was also examined for uniformity between different main (PCaTS) sites in order that it could be pooled. The conclusions drawn was that the sites could be pooled into 4 categories based on the presence of a pedestrian island, the crossing width and the pedestrian flow. All these three factors would be expected to influence pedestrian behaviour and opinions. The factors were banded by:

- Pedestrian island: Its presence (Yes), or absence (No)
- Crossing Width: Narrow (under 12m), Medium (12 to 16m) and Wide (over 16m)
- Pedestrian flow: Low (below 1000 pedestrians per hour) and High (at least 1000 pedestrians per hour)

The sites and how they fit into these bands are shown in Table 8.

Pedestrian Island	Crossing Width	Pedestrian Flow	Sites
No	Narrow	Low	10/008 (Balham)
	Narrow	High	
	Medium	Low	
	Medium	High	
	High	Low	
	High	High	
Yes	Narrow	Low	
	Narrow	High	
	Medium	Low	03/029 (Finsbury); 10/160 (Roehampton), 08/003 (Tower Bridge) and 08/211 (Old Kent Road)
	Medium	High	01/212 (Oxford Street)
	High	Low	
	High	High	02/045 (Kingsway) and 08/028 (Blackfriars)

Table 8 Bands for determining site categories

The four categories are therefore:

- Category 1 - Site with no island, crossing under 12 metres and with a pedestrian flow under 300 pedestrians per hour. (Balham)
- Category 2 – Sites with an island, crossing between 12 and 16 metres, and with a pedestrian flow under 1,000 pedestrians per hour. (Finsbury, Roehampton, Tower Bridge and Old Kent Road)
- Category 3 – Sites with an island, crossing over 16 metres, and with a pedestrian flow over 1000 pedestrians per hour. (Kingsway and Blackfriars)
- Category 4 – Site with an island, 13.2 metres wide, and with a pedestrian flow over 1000 pedestrians per hour (Oxford Street)

5.3 Sample Composition

5.3.1 Age

The age of respondents would be expected to affect their use of the crossing and their opinions and understanding of the information presented. Respondents' age was therefore collected in four age bands (16 to 30, 31 to 40, 41 to 60 and over 60). The distribution of ages on the four categories of site is shown in Figure 33.

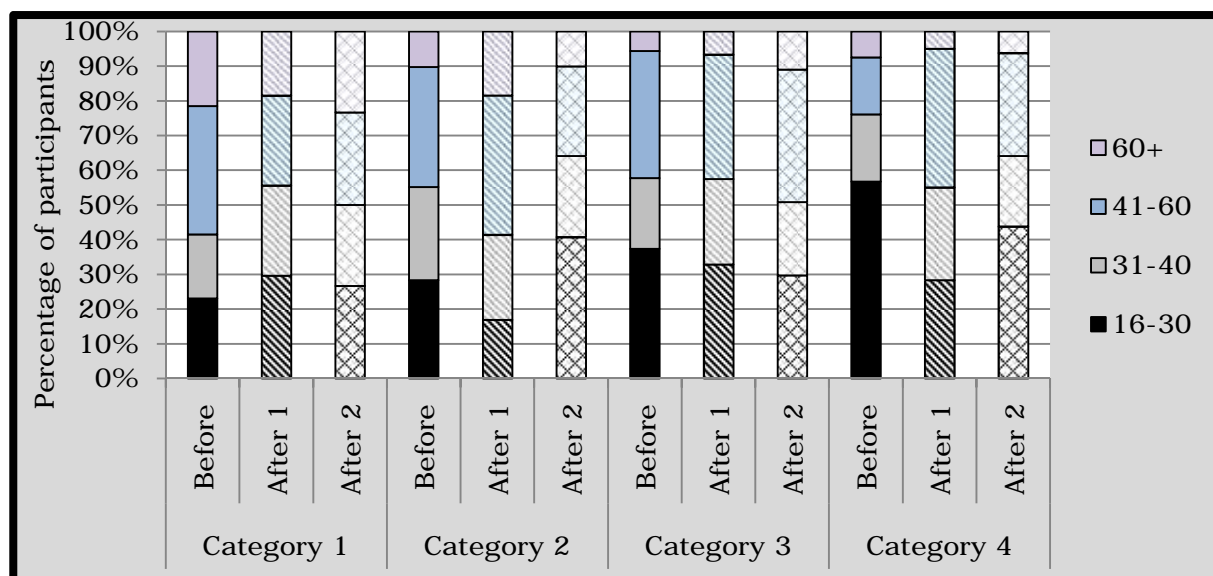


Figure 33 Percentage of participants in each age band in each site category

Overall, the age profiles remained reasonably consistent between 'Before' and 'After 2' surveys on all sites except those in Category 2. However, there was also some variation on Category 4 sites in the 'After 1' survey

On Category 2 sites there were fluctuations in the proportions of young and old participants between the surveys with a reduction in younger participants in the 'After 1', and an increase in the 'After 2' survey. This could be as a result of the survey timings with the 'After 1' surveys being close to (or in) the school summer holidays. Such changes could have an impact on the behavioural observations from these sites and will therefore be a confounding factor. It has not been possible within this study to isolate its relative effect to other changes made on the site.

The age distributions in Categories 1 and 3 were consistent from the 'Before' to the 'After 1' survey, and none of the differences were significant.

On Category 2 and 4 sites there did appear to be a change in the age distribution of the respondents with fewer of the younger participants and a corresponding increase in older participants: with a significant decrease in the percentage of 16-30 year olds in the 'After 1' survey in both categories. The reason for this is not totally clear, but it could be a result of the timing of the studies, with the 'Before' survey in school term time and some of the 'After 1' surveys in the school summer holidays.

On Category 1, 3 and 4 sites there were no significant changes in the age composition from the 'Before' survey to the 'After 2' survey and from the 'After 1' survey to 'After 2' survey.

The Category 2 sites saw a significant increase in those in the 16-30 year old category and a significant decrease in the 41-60 age group from both the 'Before' survey and the 'After 1' survey to the 'After 2' Survey. There was also a significant drop in the 60+ age group from the 'After 1' survey to the 'After 2'.

5.3.2 Gender

A persons gender could also affect their opinions, therefore the percentages in each survey were recorded, see Figure 34.

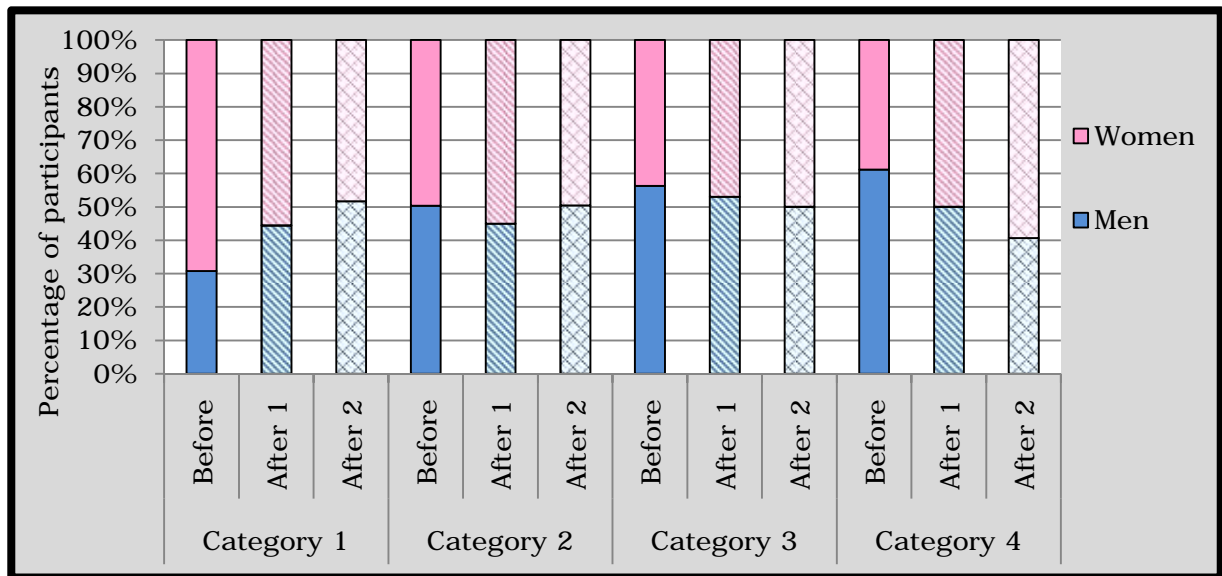


Figure 34 Percentage of men and women at each site category

Overall, the gender profiles remained reasonably consistent on Category 2 and 3 sites in all surveys.

However, there were some significant changes in the 'After 2' survey compared to the 'Before' survey on sites on Category 1 and 4 sites. There are no obvious reasons why these trends occurred and they could be a result of random fluctuations, however, they should be borne in mind within the analysis.

There were some minor variations between the percent of each gender between the 'Before' survey and the 'After 1' survey. However, none of these changes were significant (at the 95% confidence level).

Similarly, Category 2 and 3 sites showed no significant changes in participant gender from either the 'Before' survey, or the 'After 1' survey, to the 'After 2' survey. However, trends of increasing percentage of males in Category 1, and decreasing percentage of males in Category 4, resulted in the changes between the 'Before' and the 'After 2' surveys being significant.

5.3.3 Reason for trip

How pedestrians use the crossing and their opinions could also be affected by their reason for travelling. For example, it is conceivable that a participant travelling to work would be using the crossing regularly and therefore be familiar with the crossing and could also be in a hurry. In contrast a person pursuing a leisure activity is less likely to be in a hurry and may also be less familiar with the crossing. Participants were asked for their main reason for being in the area. A range of possible reasons were permitted, and these have been re-classified into the following four reasons:

- Work and Education

- Leisure
- Residential
- Other

The percentage of respondents travelling for each of these reasons are shown in Figure 35.

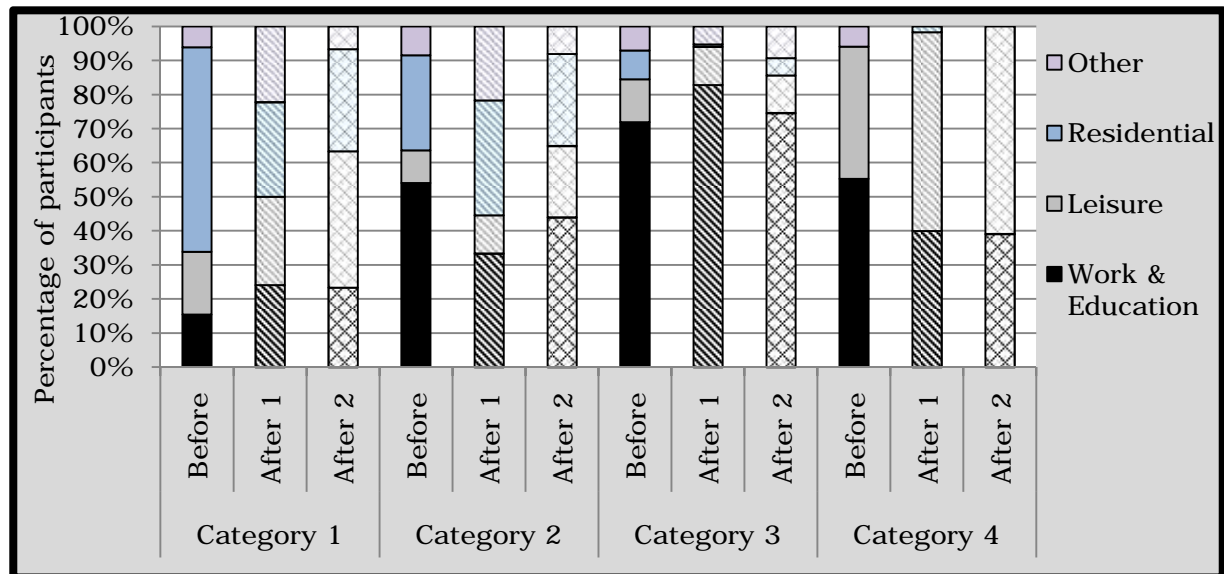


Figure 35 Participant's reason for being in the area of the crossing

Overall, there were some statistically significant differences between sample compositions with respect to trip purpose. There did not appear to be any underlying consistent trends either across the site categories or between the surveys, and were probably therefore owing to natural variation.

There was a significant decrease in the percentage of participants who lived local to the site (Balham) in Category 1, this was accompanied by a significant increase in the percentage of participants who were in the area for other purposes in the 'After 1' survey.

There were other smaller but significant changes in trip purpose from the 'Before' survey to the 'After 1' survey with the site categories:

- Category 2 had a significant decrease in the percentage of participants who were there for work and education purposes
- Category 2 had a significant increase in the percentage of participants who were there for other purpose,
- Category 3 sites had a significant decrease in participants who were residents
- Category 4 sites had a significant increase in participants travelling for leisure purposes. This was also the highest percentage of leisure users in both the 'Before' and 'After 1' survey. This was to be expected as the site was in a popular shopping area (Oxford Street)

Significant changes from the 'Before' survey and the 'After 1' survey to the 'After 2' survey were:

- Category 1 (Balham) saw a significant increase in the percentage of participants travelling for Leisure reasons, and a corresponding significant reduction in those who were residents, between the 'Before' survey and the 'After 2' survey.
- On the Category 2 sites the percentage of participants travelling for Work and Education in the 'After 2' was between the values observed in the previous two surveys, but was significantly different from both of them.
- On the Category 3 sites the percentage of participants who were residents in the 'After 2' was between the values observed in the previous two surveys, but was significantly different from the 'After 1' survey.
- On the Category 4 (Oxford Street) site the composition was consistent between the 'After 1' and 'After 2' surveys, but both varied significantly from the 'Before' survey with respect to the participants travelling for leisure activities.

5.3.4 Degree of Mobility and Encumberment

Participants were asked if they had any impairment and it was recorded as to whether they were encumbered or not, the percentages of participants with each of these are shown in Figure 36 and Figure 37: Where being encumbered included carrying large bags or pushing a child in pushchair, among others.

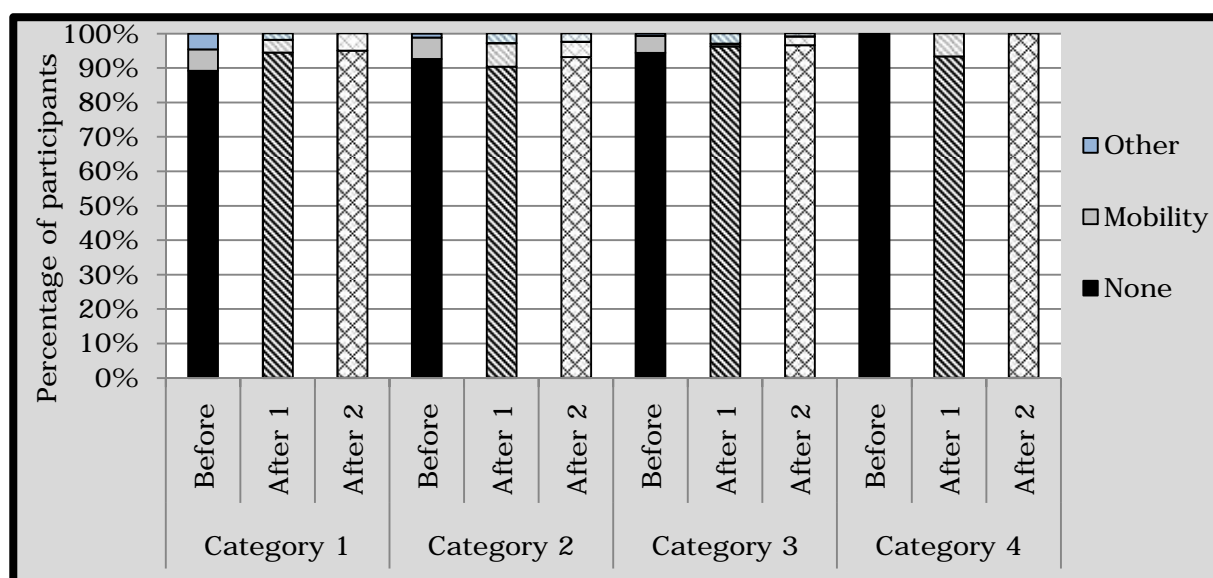


Figure 36 Impairment suffered by participants at each category of crossing site

Overall, the percentage of mobility impaired did not alter between the 'Before' and the 'After 2' surveys. However, there was variation in the 'After 1' survey on sites in two of the categories.

Categories 3 and 4 had a significant change in the percentage of participants with a mobility impairment between the 'Before' survey and the 'After 1' survey, and the percentage in the 'After 2' survey was in agreement with that in the 'Before' survey on all categories of sites.

Percentages of participants with a mobility impairment represented less than 7% of all samples, which is in line with the population in general, as approximately 18% of the population has a disability of some description (EFD 2010). Therefore although some statistically significant changes in the percentage of mobility impaired participants were observed, the small percentage they represented means that the variations are unlikely to affect any of the results.

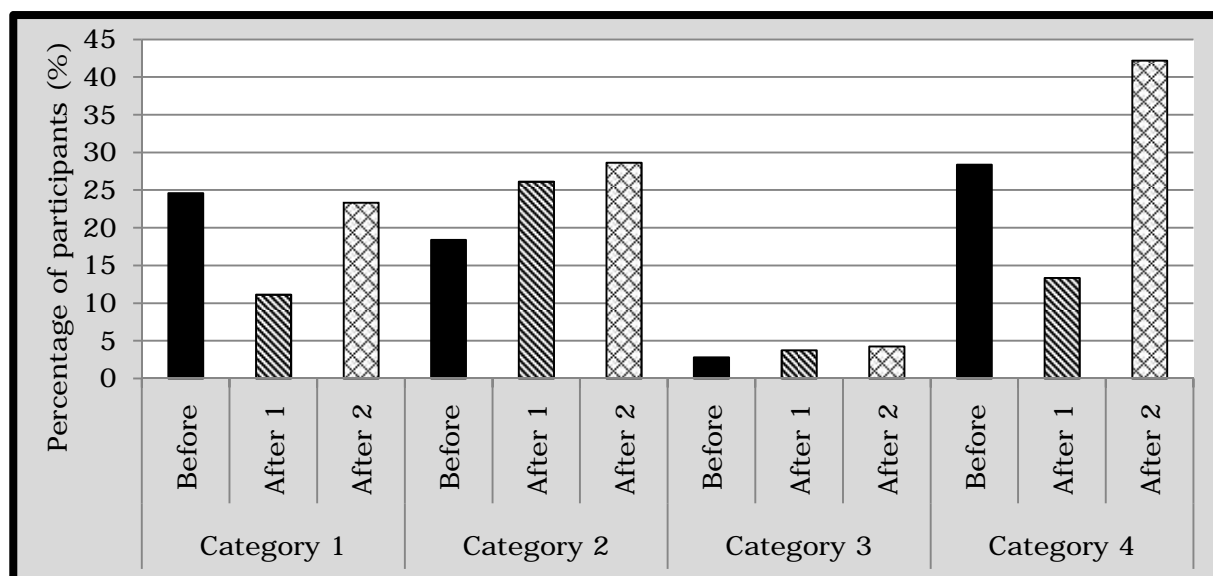


Figure 37 Percentage of participants who were encumbered at each category of crossing

In all categories less than 45% of participants were encumbered. There had been significant changes in the percentage encumbered in site Categories 2 and 4 between the 'Before' and 'After 1' surveys. However, there is no clear reason why such changes may have occurred. The change in Category 1 although large, was not significant (due to the smaller sample size). This variability in the number of participants who were encumbered was also found in the 'After 2' on the Category 2 and 4 sites, with statistically significant changes.

5.4 Understanding of Signals

It is important to understand peoples' understanding of the pedestrian signal phases, as this will affect their behaviour. They were therefore asked what the following signals mean to them:

- Green Man
- Red Man
- Blackout ('Before' survey only)
- Countdown ('After 1' survey only)

They were also asked how they would respond to the Red Man, the Blackout and the Countdown. Their answers are summarised and discussed within this section.

5.4.1 Green Man

The Green Man is the invitation to cross period for pedestrians. It therefore represents the time that they can start to cross the road with sufficient time to reach the other side of the carriageway safely. Respondents' actual understanding of the Green Man are summarised in Figure 38.

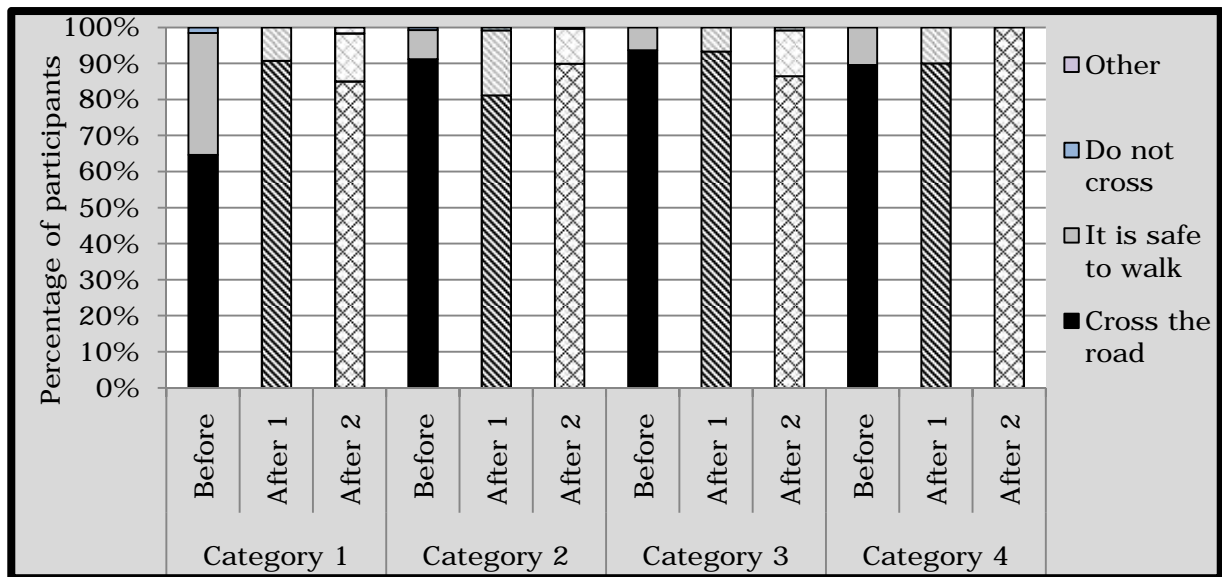


Figure 38 Level of understanding of the Green Man by participants

Overall, it is possible to conclude that the principle behind the Green Man is well understood and has been unaffected by the introduction of PCaTS.

There was a high level of understanding that the Green Man in all surveys. Pedestrians understood it meant they could start to cross the road; with between 0 and 35% considering it safe to cross.

Although some of the percentage changes between the surveys in participants saying 'Cross the road' and 'It is safe to walk' were statistically significant, there were no significant changes in participants giving the answer 'Do not cross'.

5.4.2 Red Man

The Red Man is an instruction not to start crossing the road as priority is either with vehicles, or vehicles are about to receive priority. Respondents understanding of the Red Man, if it is showing on arrival at the crossing, is summarised in Figure 39.

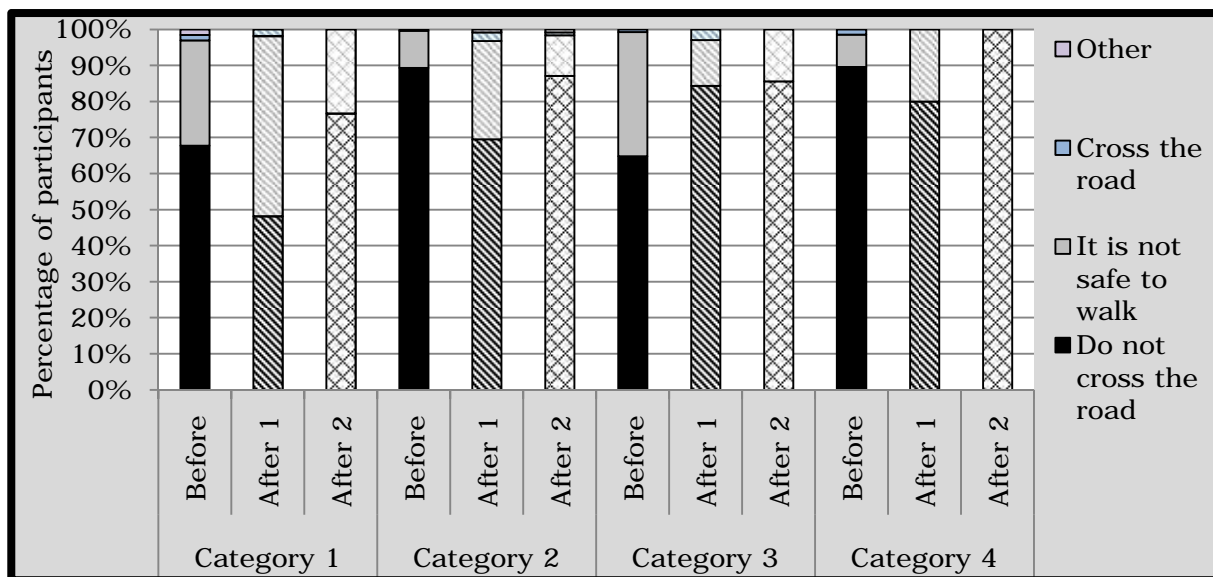


Figure 39 Level of understanding of the Red Man by participants

Overall, it is possible to conclude that the principle behind the Red Man is well understood and has been unaffected by the introduction of PCaTS.

The level of understanding of the Red Man, like the Green Man, was very high: with at least 97% of the sample stating that it means either 'Do not cross the road' or 'It is not safe to walk'.

As with the Green Man, there were high levels of understanding of the meaning of the Red Man. Similar to the Green Man findings, there were some significant changes in participants giving the answer, 'Do not cross the road', and 'It is not safe to walk', between the surveys, but there were no significant changes in the percentage of participants who answered Cross the road. Consequently, it is possible to conclude that the principle behind the Red Man is also well understood and has been unaffected by the introduction of PCaTS.

In addition to asking for their understanding of the Red Man on arrival, participants were asked what they would do if they were approximately half way across when the Red Man started to show. Their answers are summarised in Figure 40.

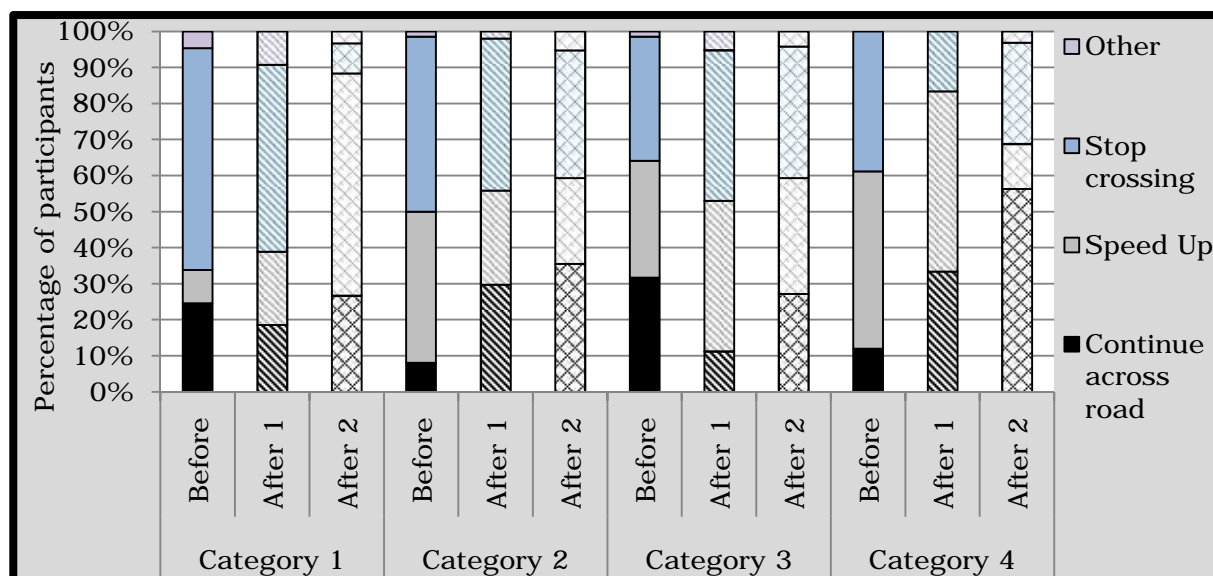


Figure 40 Likely response to the Red Man by participants

Overall, when considering participants' likely response to the Red man, in the 'After 2' survey (as in the 'After 1' survey) there was an increase in the percentage of participants stating they would continue to cross the road, except on sites in one category.

There was also a weak indication (on sites in two categories) that participants were less likely to speed up after the scheme had settled in ('After 2' survey). Although, there was an increase in those stating they would speed up on the one site without a pedestrian island.

At all but the Category 3 sites there was an increase in the percentage of participants who stated they would continue crossing the road at the start of the Red Man in some manner in both 'After' surveys than the 'Before' survey, and the percentage stating they could continue crossing the road increased on all sites between the 'After 1' and the 'After 2' surveys.

There was also an indicative trend of an increase in participants considering they would not speed up as the PCaTS settled in.

The increase in the percentage observed continuing to cross the road (i.e. without speeding up) was significant on the Category 2 sites and the Category 4 site (Oxford Street) between the 'Before' and 'After 2' surveys; although the percentage stating they would stop crossing increased between the 'After 1' and 'After 2' surveys on Oxford Street. There was also a significant increase in participants stating they would continue to cross by speeding up on the Category 1 site (Balham); the one site without a pedestrian island.

5.4.3 Blackout and Countdown

The participants were asked about the meaning of the Blackout period, or Countdown. These are the clearance times and therefore a pedestrian on the crossing when the Green Man ends should be able to safely complete crossing the road. However, pedestrians should not start to cross in this period. Their answers as to their

understanding of this period when they arrived at the crossing are summarised in Figure 41, and for it starting whilst they are on the crossing in Figure 42.

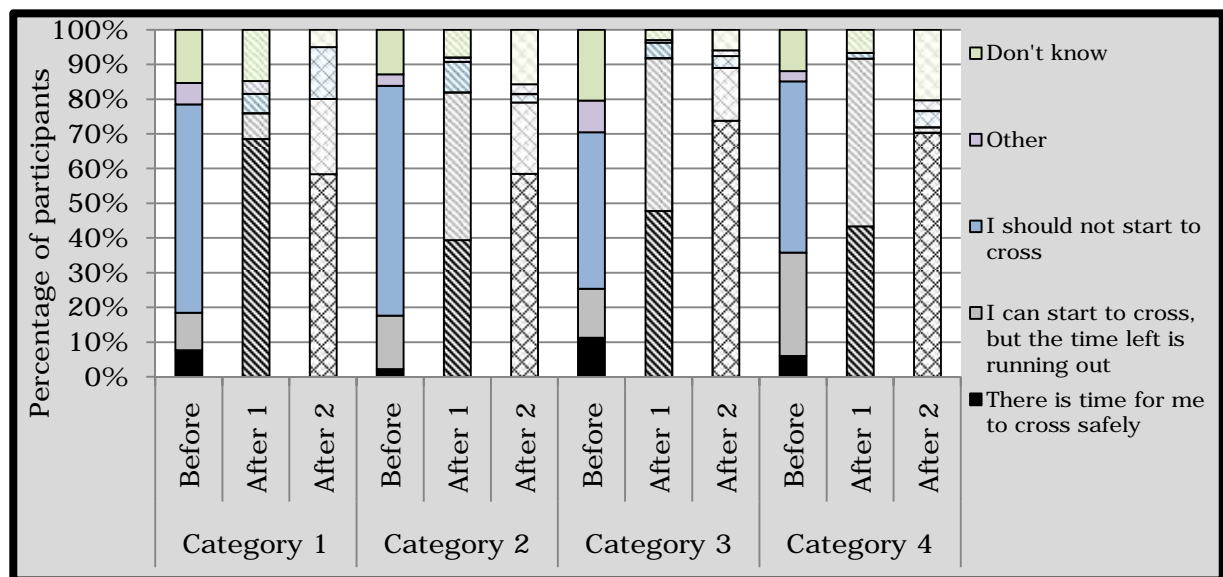


Figure 41 Level of understanding of the Blackout and Countdown periods by participants on arrival at the crossing

Overall, when participants were asked about their understanding of Countdown in the 'After 2' survey (as in the 'After 1' survey) there was an increase in percentage of participants considering they could start to cross (combining safely cross and crossing but the time is running out).

There was also a trend towards participants stating there was time to cross safely as the PCaTS scheme settled in the 'After 2' survey

On Balham (the site without a pedestrian island) there was an increase in the percentage in participants stating they could continue but time was running out in the 'After 2' survey.

On arrival at the crossing the greatest difference in understanding is with respect to the Blackout and the Countdown in the 'After 1' survey:

- The percentage of participants stating they could start to cross safely, or cross although the time is running out, increased significantly (at the 99% confidence level) for the sites in all categories: with 76 to 92% stating Countdown had one of these meanings, and 18 to 36% stating Blackout had one of these meanings
- The percentage who stated the meaning was they could cross safely varied from 2 to 11% for Blackout and 39 to 69% for Countdown for the 'Before' survey and the 'After 1' survey

The percentages of participants stating that Countdown meant they can start to cross (either safely or not) were similar in the 'After 1' and 'After 2' surveys: being 72 to 89%. There was, however, an increase in the percentage not knowing what Countdown meant on both Category 2 and 4 sites: to 15 and 20% respectively.

The trend that there was an increase in participants stating they had time to cross safely continued in the 'After 2' surveys. All increases between the 'Before' and 'After 2'

surveys were significant, and all but Category 1, were significant increases between the 'After 1' and the 'After 2' surveys: 58 to 74% stated they could cross safely. However, it should be noted that the average Blackout time for the unmodified crossings across all eight sites was 8.3 seconds, whereas the average Countdown time following PCaTS installation was 12.4 seconds.

On the Category 1 site (Balham), the only site without a pedestrian island, there was a significant increase in the percentage of respondents stating they could start to cross but that time was running out; possibly implying experience had potentially resulted in them appreciating there was a limited time when the option of stopping halfway was not available.

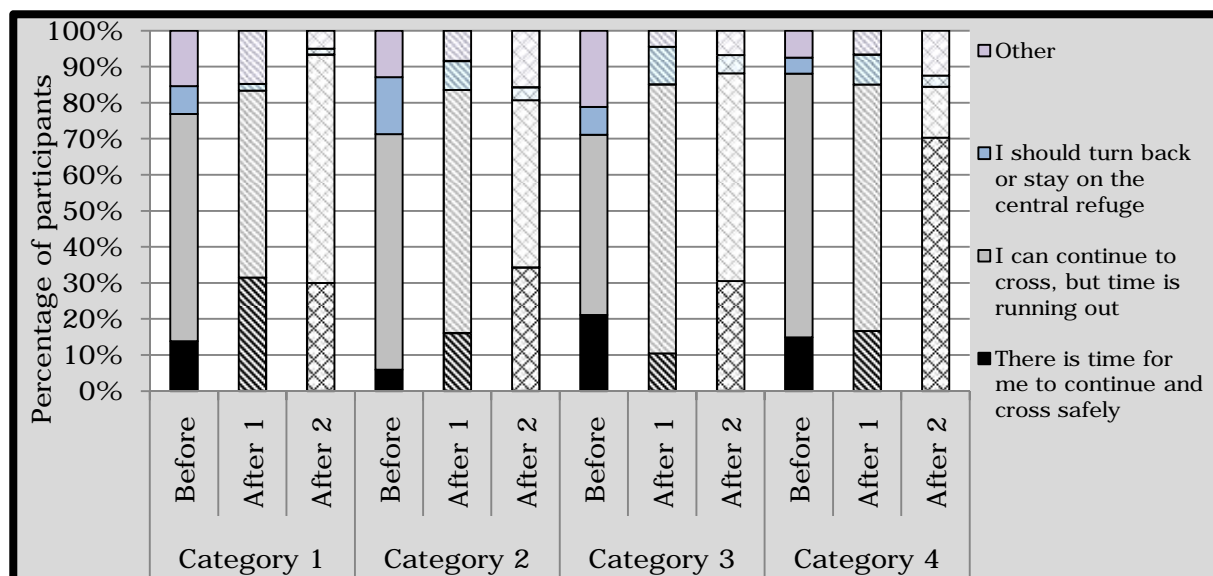


Figure 42 Level of understanding of the Blackout and Countdown periods by participants if it starts whilst they are on the crossing

Overall, the same trends in participants' understanding of Blackout and Countdown were found between the surveys whether they were arriving at, or on, the crossing.

Overall, taking into consideration all comparative answers on the meaning of Blackout and Countdown, there is an implication that participants tended to be more likely to interpret the Countdown as an invitation to cross and that they were more confident crossing, and generally this confidence had increased as the schemes had settled in.

Whilst on the crossing, if Blackout or Countdown appeared the participants' understanding was in the 'After 1' surveys compared to the 'Before' surveys:

- The percentage of participants stating they could continue to cross safely, or cross although the time is running out, increased significantly for sites in Categories 2 and 3, which had the largest sample sizes (at the 99% confidence level) from the 'Before' survey to the 'After 1' survey: although the increase was less than 15%
- The percentage who stated the meaning was they could cross safely varied from 6 to 21% for Blackout and 10 to 31% for Countdown

Participants were more likely to consider they could continue to cross (safely or not) at all sites except Oxford Street (Category 4) in the 'After 2' survey: 81 to 93% compared to 71 to 88% in the 'Before' survey

There was also a trend towards feeling they continue to cross safely with increases between the 'Before' and 'After 2' surveys in all Categories (significant except in Category 3). Also, increases from the 'After 1' to 'After 2' surveys, except for Category 1 (i.e. Balham which did not have a pedestrian island), all of which were significant: 30 to 70% in the 'After 2' survey compared to 6 to 21% in the 'Before' survey.

5.4.4 Countdown

Participants understanding of the Countdown gives an indication of their likely response if encountering the Countdown display. However, to confirm these findings they were also directly asked as to what their actions would be if the Blackout was showing when they arrived at the crossing, and if the Countdown showed either 10 or 5 seconds, see Figure 43 and Figure 44.

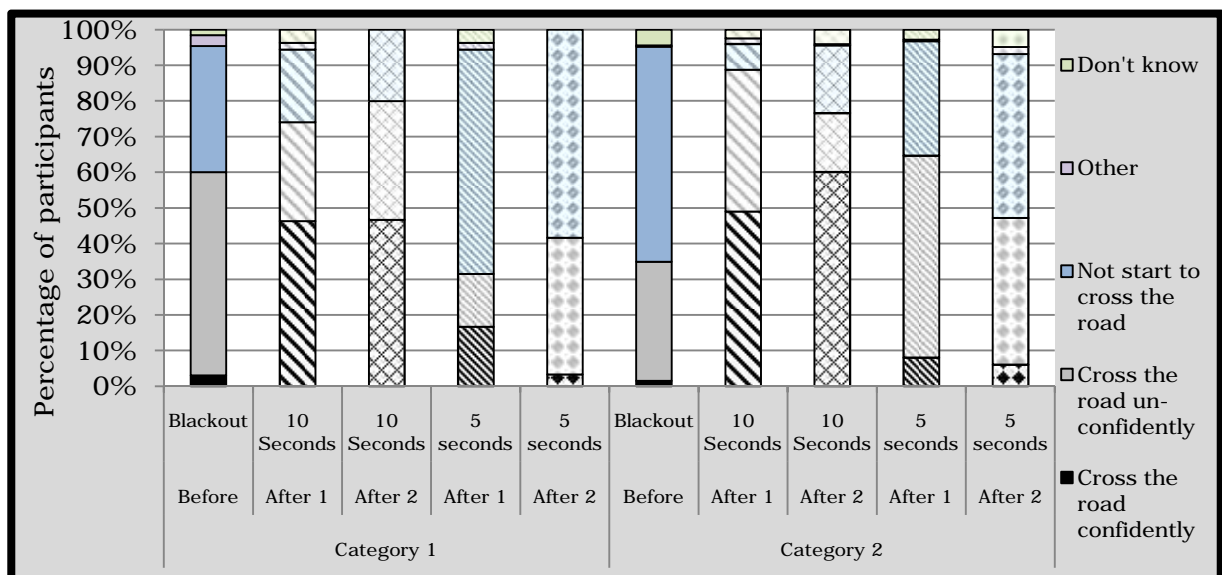


Figure 43 Predicted response to the Blackout and Countdown by participants (Part 1)

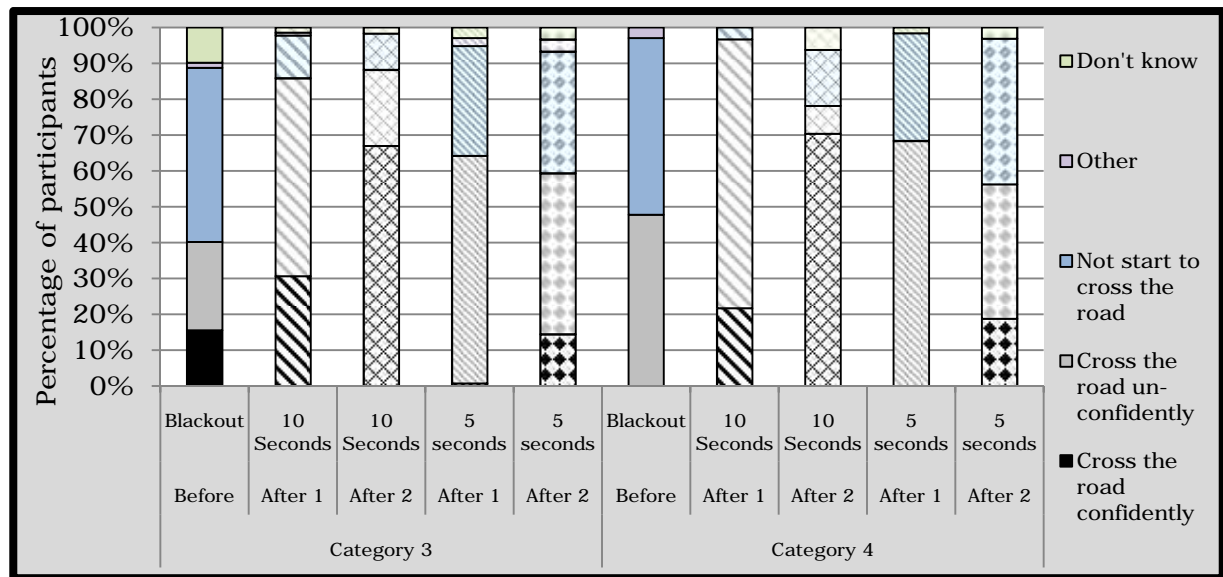


Figure 44 Predicted response to the Blackout and Countdown by participants (Part 2)

Overall, PCaTS in the 'After 2' survey (as in the 'After 1' survey) appears to have increased the likelihood of pedestrians starting to cross with 10 seconds of the Countdown remaining compared to arriving in the Blackout, although there was some evidence that the increase was slightly reduced since the 'After 1' survey, i.e. after the scheme settled in. However, more considered that they would cross confidently with 10 seconds displayed compared to with the Blackout, and this confidence increased in the 'After 2' surveys compared to the 'After 1' surveys.

With 5 seconds showing the percentage stating they would cross was similar in all surveys. However, again there were indications that pedestrians were more likely to consider they would cross with confidence in the 'After 2' survey on sites with a pedestrian island, but a decrease on the one site without a pedestrian island, compared to the 'After 1' survey.

Note: The site categories were formed to pool the data from similar sites in the analysis. Category 1 contained the only site without a pedestrian island (Balham). Category 2 contained crossings 12 to 16 metres wide with a pedestrian flow of under 1000 (Finsbury, Roehampton, Tower Bridge and Old Kent Road). Category 3 contained crossings over 16 metres wide with a pedestrian flow of over 1000 (Kingsway and Blackfriars), and Category 4 contained the only narrow crossing with a high pedestrian flow (Oxford Street).

- 35 to 60% of the participants would start to cross with the Blackout showing; 0 to 15% confidently
- 74 to 97% of the participants would start to cross with the Countdown showing 10 seconds; 22 to 49% confidently in the 'After 1' survey
- 31 to 68% of the participants would start to cross with the Countdown showing 5 seconds; 0 to 17% confidently in the 'After 1' survey

- The difference between the percentages stating they would start to cross with 10 seconds on the Countdown in the 'After 1' survey was significantly greater than the percentage stating they would start to cross with a Blackout showing; for all site Categories except Category 1
- Overall participants during the 'After 1' survey would be expected to cross more often and more confidently with 10 seconds on the Countdown display than with a Blackout showing. However, there is an indication that they would treat the Blackout and 5 seconds on the Countdown display the same
- Overall the same trends in the propensity of pedestrians deciding to cross were found in both the 'After 1' and 'After 2' surveys compared with the 'Before' survey. In the 'After 2' survey:
 - 77 to 88% crossing with 10 seconds showing
 - 47 to 70% confidently crossing with 10 seconds showing
 - 42 to 59% crossing with 5 seconds showing
 - 4 to 19% confidently crossing with 5 seconds showing
- The changes in the percentage of pedestrians deciding to cross were less (maximum 19%) between the 'After 1' and 'After 2' surveys, than between the 'Before' and the 'After 1' surveys (a maximum of 54%), and the implied trends that occurred owing to familiarity with PCaTS were:
 - There was a significant decrease in pedestrians deciding to cross with 10 seconds displayed on Category 2 and 4 sites, and a significant decrease with 5 seconds displayed on the Category 2 sites.
 - There was a significant increase in the number of pedestrians who stated they would cross with confidence with 10 seconds displayed on Category 2, 3 and 4 sites, and a significant increase with 5 seconds displayed on the Category 3 and 4 sites, but a decrease on the Category 1 site.

5.4.5 Last Time to Start Crossing

In the last of the hypothetical questions on the crossing behaviour, participants were asked when was the last time they should start crossing the road. Their answers are summarised in Figure 45.

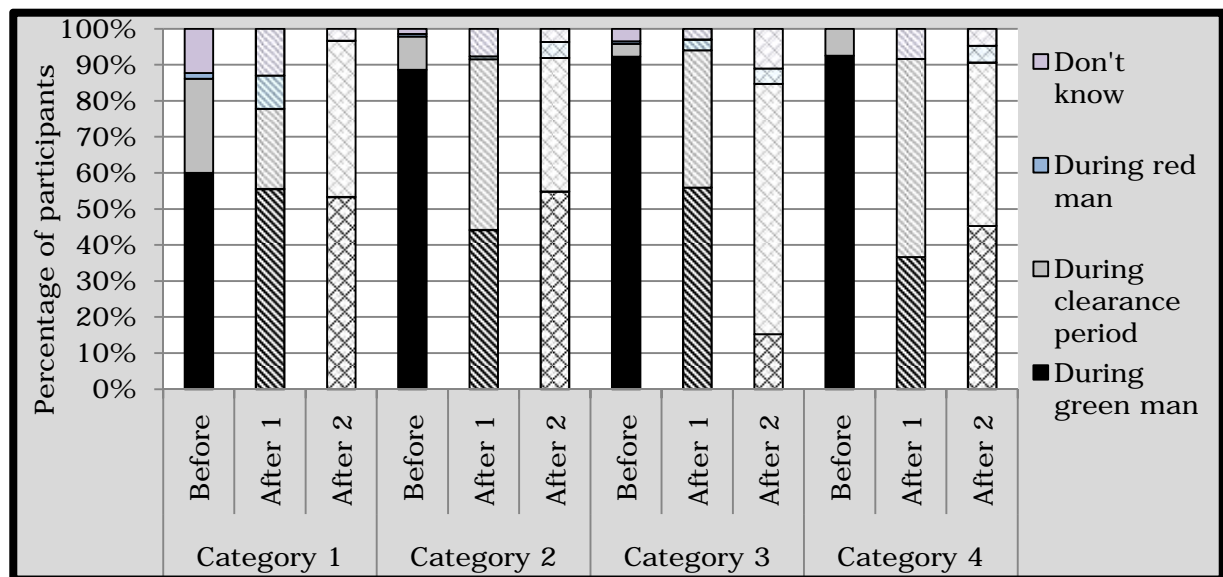


Figure 45 Point during crossing cycle that participants think is the last time it is suitable to start crossing

Overall, pedestrians were more likely to consider the last time they should cross the road was during the Green Man, and not the Blackout, in the 'Before' surveys. In contrast, they were more likely to consider they could cross during the Countdown with PCaTS in the 'After' surveys.

However, although there were fluctuations in the strength of this opinion between the two 'After' surveys, there were no clear trends: i.e. there was no evidence that pedestrians with greater familiarity of Countdown were more (or less) likely to consider it correct to cross during the Countdown period.

The main findings from the answers of when participants considered the last time they should start to cross in the 'After 1' survey were:

- The percentage stating each phase remained reasonably constant on the Category 1 site (Balham)
- There were statistically significant increases in the percentage stating that the last time to start crossing was the clearance period: i.e. Countdown, compared to the Blackout period at Category 2, 3 and 4 sites. The percentage changed from 4 to 9% stating Blackout compared to 38 to 55% stating the Countdown
- A similar reduction in the percentages stating the Green Man was the last time to start crossing, also occurred at Category 2, 3 and 4 sites: 88 to 93% at crossings with Blackout and 37 to 56% at PCaTS crossings
- Also, of interest, was that at Category 1 and 3 sites there were (non-significant) increases in the percentage of participants stating that the last time to cross was during the Red Man with PCaTS
- At Category 2, 3 and 4 sites there were increases in the percentage of participants stating that the last time to cross was during the Red Man with PCaTS, the increase being statistically significant in one category and weakly statistically significant on the other two, in the 'After 2' survey.

In the 'After 2' surveys there were some modifications to the percentages recorded in the 'After 1' surveys, but the same trends compared to the 'Before' surveys were evident. There were decreases in those stating that the last time to cross was during the Green Man on all sites between the 'Before' and the 'After 2' survey, although the change was small on Balham (Category 1). In the 'After 2' surveys the percentage varied between 15 and 55% on Category 2, 3 and 4 sites.

There was a significant increase in the percentage of participants who said that the last time they should start crossing the road was during the Countdown instead of the Blackout between the 'Before' survey and the 'After 2' survey at all sites, although the changes in this percentage between the 'After 1' and 'After 2' surveys were not consistent: 37 to 69% stated during the Countdown in the 'After 2' survey.

5.5 When They Crossed the Road

5.5.1 Start time

Predicted and actual behaviour of participants can differ. Consequently, a test question was included that asked participants when they had crossed the road. This could then be compared to any predicted changes in understanding and behaviour that were apparent in the answers to the previous questions. The pedestrian phases in which they started to cross on individual sites are shown in Figure 46 and Figure 47.

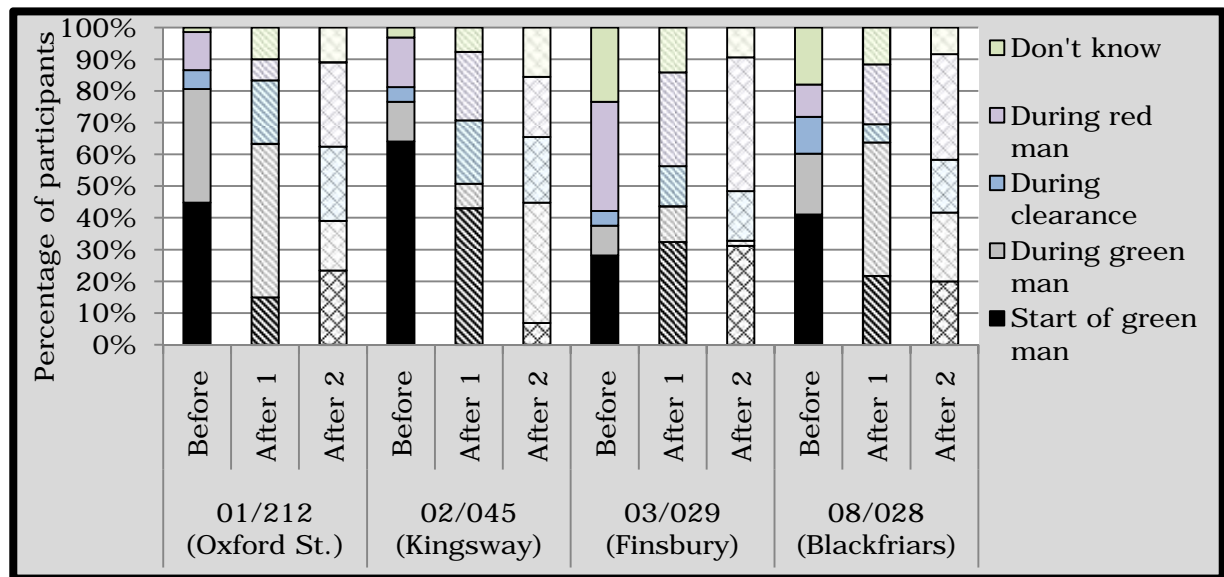


Figure 46 Point at which participants crossed the road during the trial - Group 1 sites

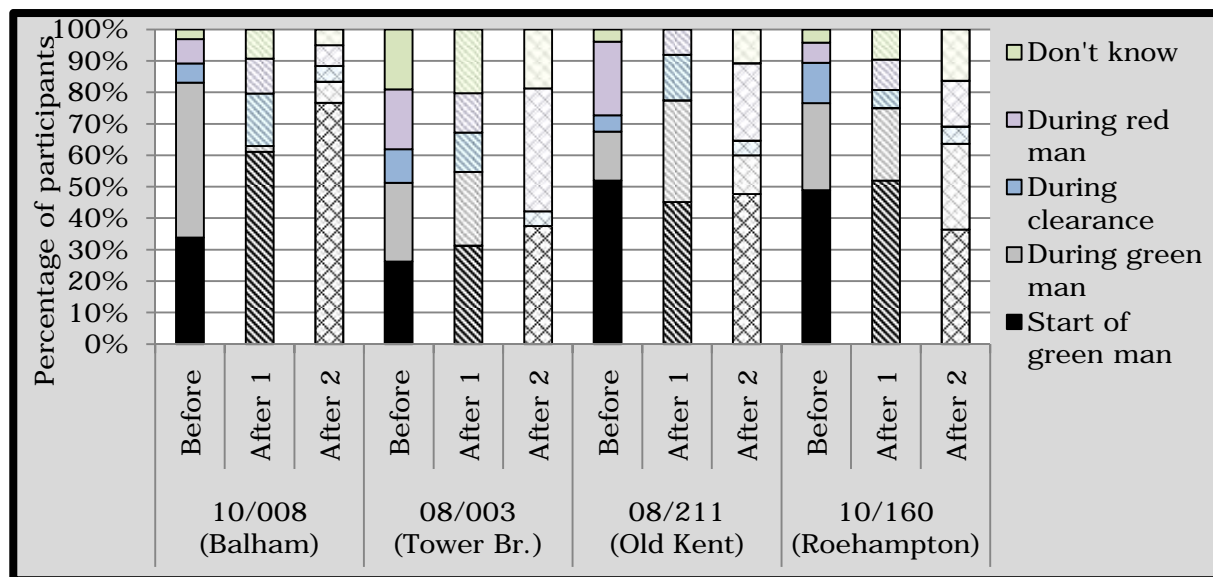


Figure 47 Point at which participants crossed the road during the trial - Group 2 sites

Overall, there is an implication that participants were more likely to cross during the Clearance period on high flow (Group 1) sites, particularly after the schemes had settled in ('After 2' surveys).

However, this did not occur on lower pedestrian flow sites. Whilst there was an initial increase in the percentage of participants crossing in the clearance period on some of the sites, this diminished after they had settled in.

There was some evidence that participants were more likely to cross during the Red Man on some sites after the installation of PCaTS and the associated signal timing changes: Oxford Street, Blackfriars and Tower Bridge

There were only two significant changes in the percentage of participants who stated they crossed during the Clearance period from the 'Before' survey to the 'After 1' survey. However, Figure 46 and Figure 47 show that at six out of the eight sites this percentage had increased. This change in actual behaviour does appear to mirror participants expressed understanding of the pedestrian phases at the Standard ('Before') crossings and the PCaTS ('After 1') crossings, although it may have also be influenced by the increase in its duration: i.e. the Countdown times were greater than the Blackout durations (see Section 6.1.3).

At two out of the four Group 1 sites there was a significant increase in the percentage of participants who crossed during the Clearance period from the 'Before' survey to the 'After 1' survey (Oxford Street and Kingsway): i.e. in the Countdown compared to the Blackout. At these two sites there was no significant change from 'After 1' survey to 'After 2' survey during the clearance period, i.e. the percentage increase compared with the 'Before' survey remained. In addition, there was a significant increase in the percentage crossing in the Clearance period on Finsbury between the 'After 1' and 'After 2' surveys. This implies there was generally an increase in participants crossing during the Clearance period on the higher flow sites with PCaTS.

In Group 2 sites there were no significant changes in the percentage of participants who crossed during the Clearance period from the 'Before' survey to the 'After 2' survey. On two of the sites where there were weakly significant increases between the 'Before' and

the 'After 1', there were significant decreases between the 'After 1' and the 'After 2' surveys.

There were significant increases in the percentage of participants crossing during the Red Man in the 'After 2', compared to the 'Before', survey on three sites (Oxford Street, Blackfriars and Tower Bridge)

5.5.2 Whether they waited at the island

It is possible that pedestrians will use the extra (Countdown) information at PCaTS sites to be more confident in crossing completely in the Clearance period, than with the Blackout period. Participants were therefore asked whether they waited at the island. This was used to assess whether PCaTS had an impact on whether people crossed the road completely without stopping at the island, see Figure 48.

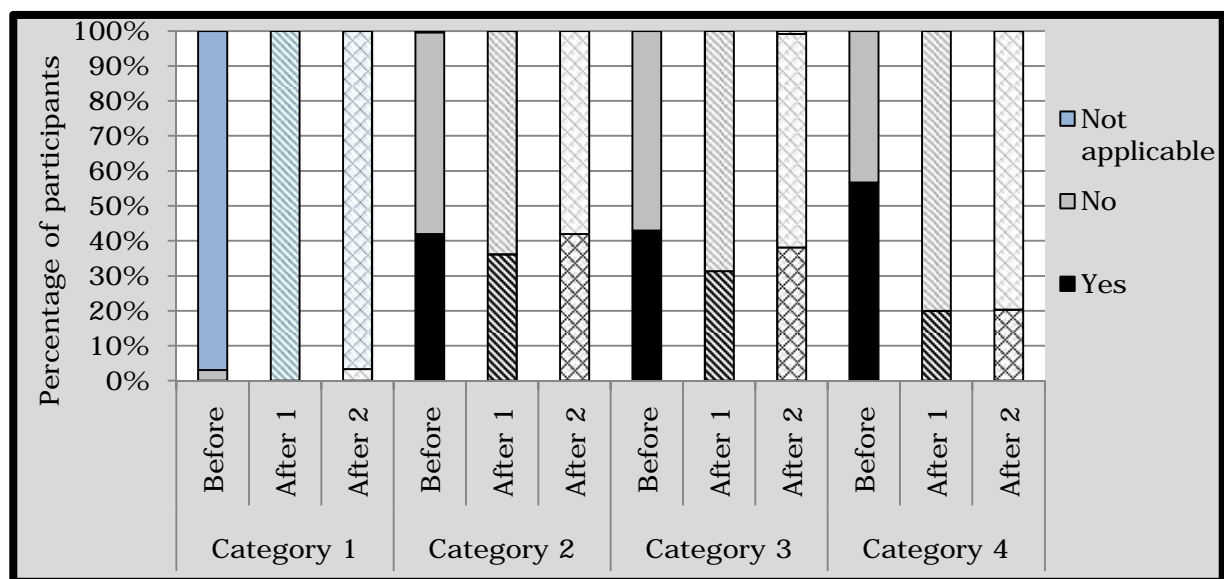


Figure 48 Percentage of participants who waited at the island when using the crossing

Overall, the analysis shows that participants were less likely to stop at the island with PCaTS on Oxford Street in both 'After' surveys. However, the significant reduction observed on Category 3 sites in the 'After 1' survey, was not maintained in the 'After 2' survey.

This implies that pedestrians used the Countdown and decided to complete crossing the road on the highest pedestrian flow site, but it had little effect on the percentage completing crossing the road on other sites after they had become accustomed to the Countdown.

The results as to whether the pedestrians waited at the island were:

- There was a significant decrease in the percentage of participants who stopped at the island in the 'After 1' survey compared to in the 'Before' survey at the Category 3 and 4 sites, but had reverted back to the 'Before' levels in the 'After 2' survey on Category 3 sites.
- At the Category 4 site (Oxford Street) there was a significant decrease in participants who stopped at the island from the 'Before' survey to 'After 2' survey.

- There were no significant changes in the behaviour in terms of whether or not participants stopped at the island between the 'After 1' and 'After 2' surveys.

5.6 Time to Cross the Road

5.6.1 Perceived Time Taken

Studies have shown that people’s ability to estimate their speed is poor (Holland and Hill 2010), and therefore their perception of time would also be expected to be generally poor. The participant’s perception of time was tested for the Standard Crossing ('Before' survey) and with PCaTS ('After 1'). It would be expected that the presence of a Countdown timer in the Clearance period would assist pedestrians crossing at that time to more accurately assess how long it took to cross. Participants were asked how long they thought it took them to cross the road, see Figure 49.

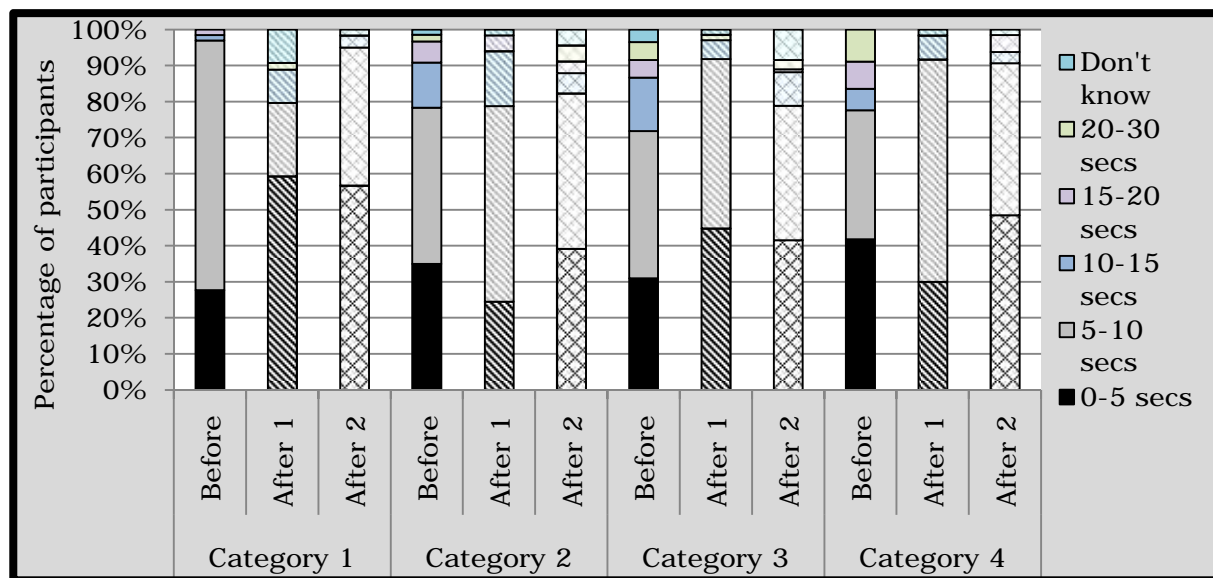


Figure 49 Perceived time taken to cross the road by the participants

Overall, it appears unlikely that PCaTS has improved the pedestrian’s perception of the time taken to cross the road, even after the scheme had settled in. There were two indicators that accuracy of assessing time to cross had decreased. Firstly, on some sites there was an increase in the percentage of pedestrians not knowing the time taken to cross in the 'After 2' surveys. Secondly, the percentage of participants incorrectly classifying their time to cross the road (and hence their walking speed) at up to 5 seconds had significantly increased on some sites in the 'After 2' survey: which would imply very fast walking speeds or possibly running.

If participant perception of time was good, it would be expected that the time to cross would increase with the width of the crossing. Thus the times taken to cross the crossing in Category 1 (Balham), would be less than that in Category 4 (Oxford Street), then

Category 2 and finally Category 3. Although some variation would also be expected with any differences in gender distribution, age distribution and percentage of mobility impaired between the sites. Such a distribution is not seen in those estimating 0-5 seconds and 5-10 seconds to cross.

In terms of absolute accuracy of their estimates, in all categories over 70 per cent of participants thought it took them less than 10 seconds to cross the road. This implies they were walking at a minimum speed of 1.7 m/s on the wider crossings, and whilst this is possible it is above what would be expected for a healthy fit adult which is 1.4m/s according to Bohannon (1997)².

On Category 1 and Category 3 sites, where there was a significant increase (at the 95% level) in the percentage of participants who said it took them 0-5 seconds to cross the road between the 'Before' survey and the 'After 1' survey. This assessment of their speed is unlikely to be correct as it implies their speed was at least 2.4m/s on the Category 1 site, and 3.4m/s on the Category 3 sites.

In contrast, the Category 2 sites showed a significant decrease in the percentage of participants who thought it took them 0-5 seconds to cross the road between the 'Before' survey and the 'After 1' survey.

At the Category 1 site there was a significant increase in percentage of participants who thought it took them 0-5 seconds to cross the road, and a significant decrease in the percentage that thought it took them 5-10 seconds to cross the road from the 'Before' survey to the 'After 2' survey. The only significant change between the 'After 1' and 'After 2' surveys at Category one was an increase in the percentage that thought it took them 5-10 seconds to cross the road.

At Category 2 sites between the 'Before' survey and the 'After 2' survey there was a significant decrease in the percentage of participants who thought it took them 10-15 seconds to cross and a significant increase in the percentage who answered Don't know. Between the 'After 1' survey and the 'After 2' survey there were significant changes in the following percentages, 0-5 seconds (increase), 5-10 seconds (decrease), 10-15 seconds (decrease) 20-30 seconds (increase).

The only significant change at the Category 3 sites in the 'After 2' survey was an increase in the participants who responded "Don't Know" compared to the 'After 1' survey.

On the category 4 site there was a significant increase in the percentage of participants who stated it took them 0-5 seconds, whilst there was a significant decrease in the percentage stating 5-10 seconds from 'After 1' to 'After 2' survey. There was also a significant decrease in those who thought it took them 20-30 seconds to cross the road in the 'After 2' survey compared to in the 'Before' survey.

5.6.2 Whether There Was Sufficient Time To Cross

The increased information at the PCaTS sites (the Countdown display) could assist pedestrians by giving them confidence that they have sufficient time to complete crossing safely, particularly when crossing near to the end of the Green Man period. Consequently, participants were asked whether they had sufficient time to cross with the Standard crossing ('Before' survey) and at the PCaTS crossing ('After 1'), see Figure 50.

² Note: The Bohannon (1997) study has been used as a reference "yardstick" within this study, as it was a journal paper that estimates the walking speeds of pedestrian of different genders and age ranges (as well as other factors). A full literature review of walking speeds has not been performed as part of this research. However, other references, for example Knoblauch (1996) are in agreement: as in the walking speeds of young pedestrians were measured at 1.5m/s and older pedestrians at 1.3m/s at signal controlled crosswalks.

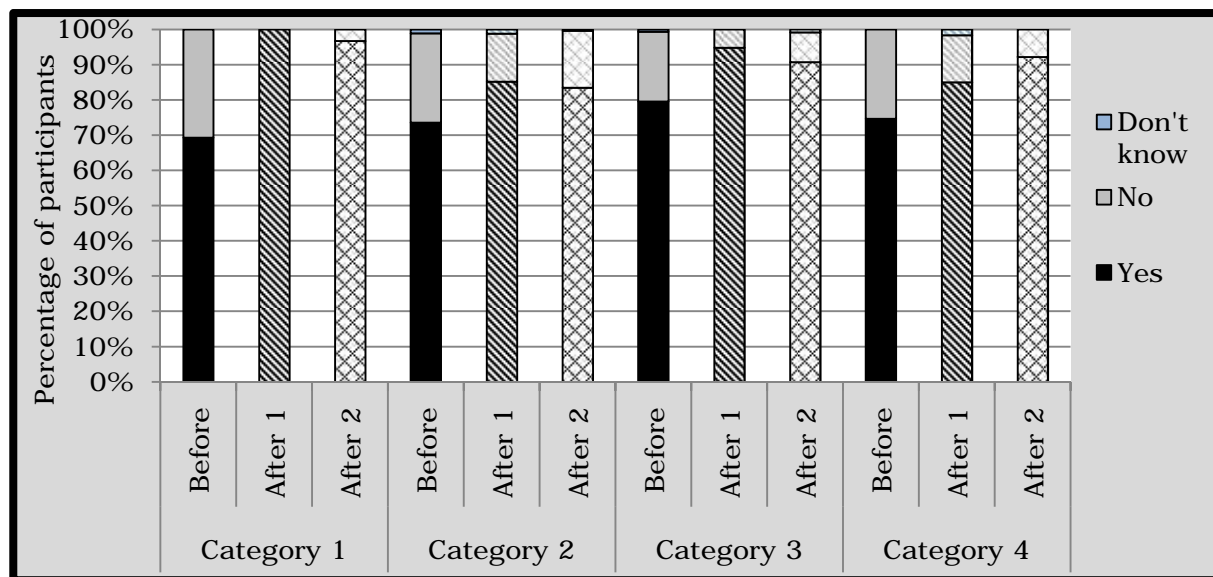


Figure 50 Percentage of participants who felt they had sufficient time to cross the road

Overall, the analysis shows that participants were more likely to consider they had sufficient time to cross with PCaTS. This change in perception was consistent in both 'After' surveys and therefore appears to have been maintained since the users had become accustomed to the new signals (i.e. the 'After 2' surveys).

The percentage of participants who felt they had sufficient time to cross the road ranged from 70% to 80% in the 'Before' survey and was over 80% in the 'After 1' surveys. The increases were significant (at the 95% level) at Category 1, 2 and 3 sites.

All categories had a significant increase in participants who responded Yes, there was sufficient time to cross between the 'Before' survey and the 'After 2' survey: 83 to 97% stated they had sufficient time in the 'After 2' survey.

For all categories there were no significant changes in whether participants felt they had sufficient time to cross the road from the 'After 1' survey to the 'After 2' survey.

5.7 Safety

In addition to feeling pedestrians have sufficient time to cross, other measures of their comfort when using the crossings are; the extent to which they feel safe and whether they felt rushed. Participants were asked to score the extent to which they felt safe and rushed at the survey sites both with the Standard crossings ('Before') and with PCaTS ('After 1').

5.7.1 Extent of Feeling Safe

The percentage of participants feeling safe and unsafe when crossing the road are summarised in Figure 51.

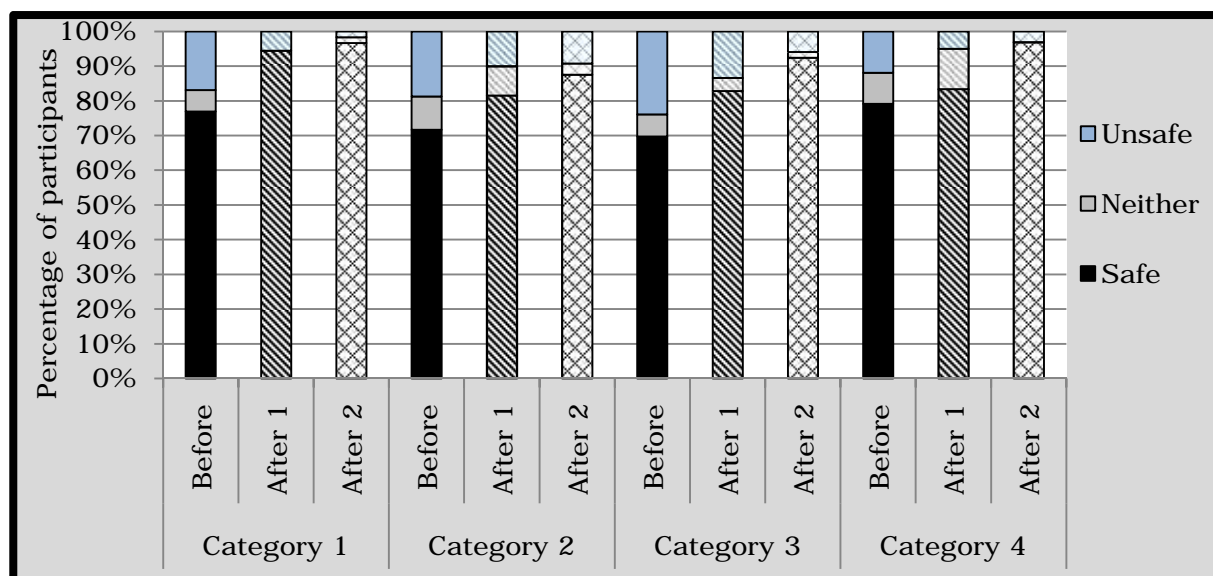


Figure 51 Percentage of participants who felt safe when crossing the road

Overall, the analysis shows that participants felt safe with both the Standard and PCaTS crossings. However, they were more likely to feel safe with PCaTS, and this was particularly the case after the scheme had settled in (i.e. the 'After 2' surveys)

Participants generally felt safe at all the crossings, with 70 to 80% feeling safe at the Standard crossings. However, this percentage was greater with PCaTS in the 'After 1' survey ranging from 80 to 95%: this increase was significant at Category 1, 2 and 3 sites, but not the Category 4 site.

After the scheme had settled in (comparing the 'Before' and 'After 2' surveys) there was a significant increase, in all site categories, in participants who said that they felt safe on the crossing: between 88 to 97% stating they felt safe in the 'After 2' surveys

For Categories 3 and 4 there was also a significant increase in participants who felt safe from the 'After 1' survey to the 'After 2' survey. These categories contained the widest crossings, and therefore this could indicate that perceptions had improved with familiarity with PCaTS.

5.7.2 Extent of Feeling Rushed

The percentage of participants feeling rushed when crossing the road are summarised in Figure 52.

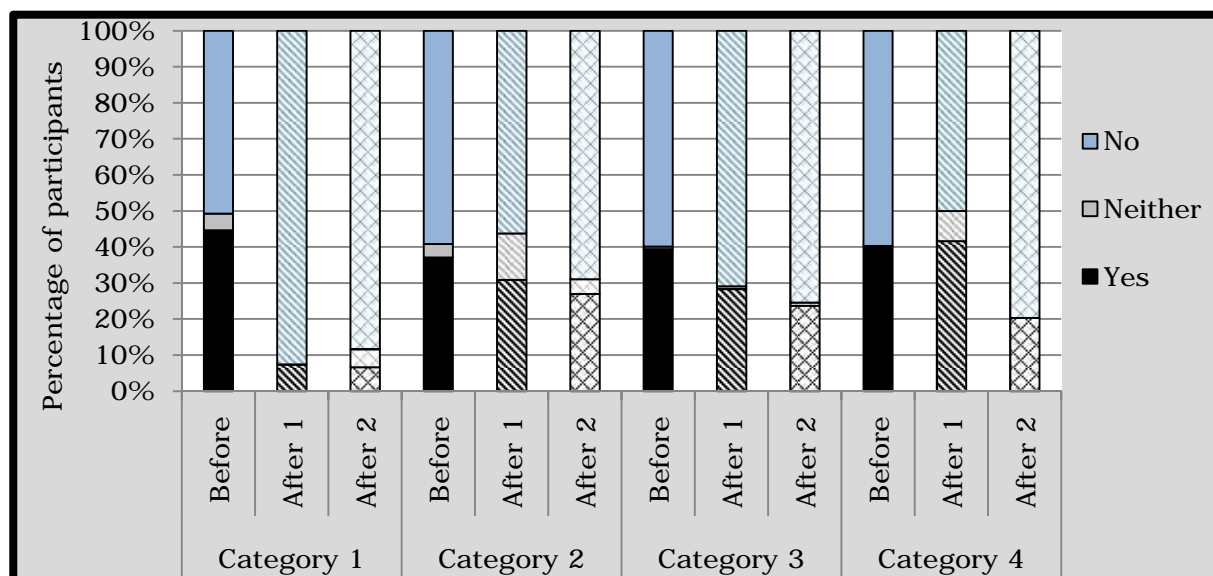


Figure 52 Percentage of participants who felt rushed when crossing the road

Overall, the analysis shows that participants felt less rushed with PCaTS than on a Standard crossing. This change was most notable in the 'After 2' surveys after the users had become accustomed to the new signals ('After 2' surveys).

The percentage of participants feeling rushed ranged from 37 to 45% with the Standard crossings and from 7 to 41% with PCaTS (in the 'After 1').

There was a decrease in the percentage of participants who felt rushed at all sites except Category 4 between the 'Before' survey and the 'After 1' survey. However, the only significant change was at the Category 1 site, the narrowest site.

There was a significant decrease in the percentage of participants who said that they felt rushed from the 'Before' survey to 'After 2' survey at all sites: 7 to 27% felt rushed in the 'After 2' survey.

Category 4 was the only category where there was a significant change from 'After 1' survey to 'After 2' survey, a decrease in participants who felt rushed.

Further analysis was undertaken to assess whether a person feeling safe or rushed was dependant on when they crossed the road. The results showed that when a person crossed the road did not affect whether they felt rushed, or safe.

5.8 Whether PCaTS is Liked

Participants in the 'After 1' survey were asked whether they liked PCaTS. Their answers are summarised in Figure 53 and Figure 54.

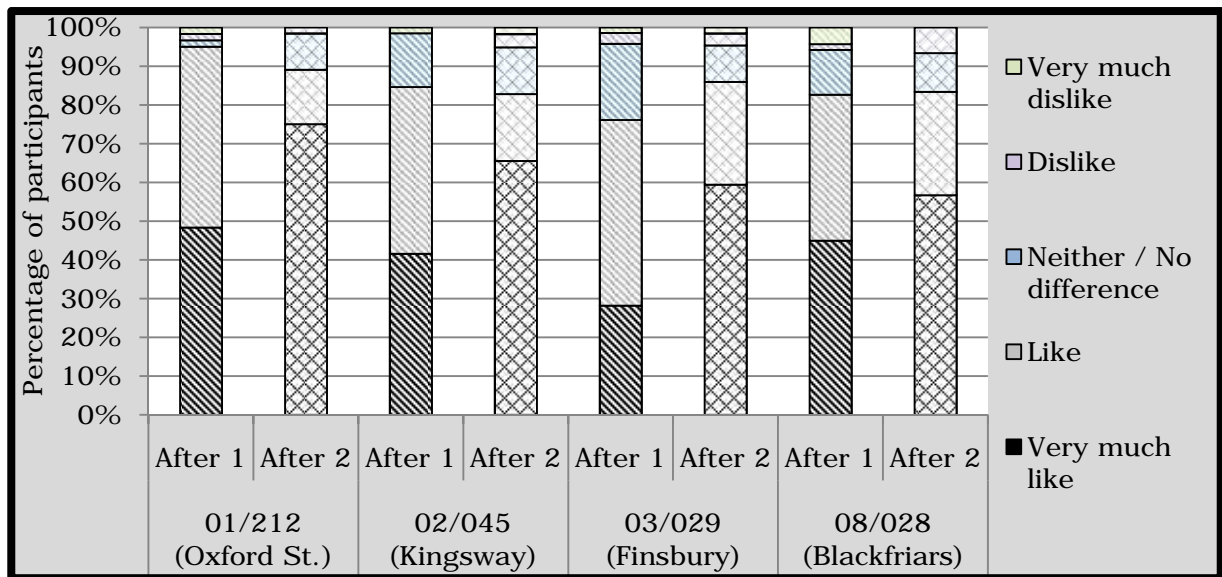


Figure 53 Participants' inclination towards the Countdown crossing – Group 1

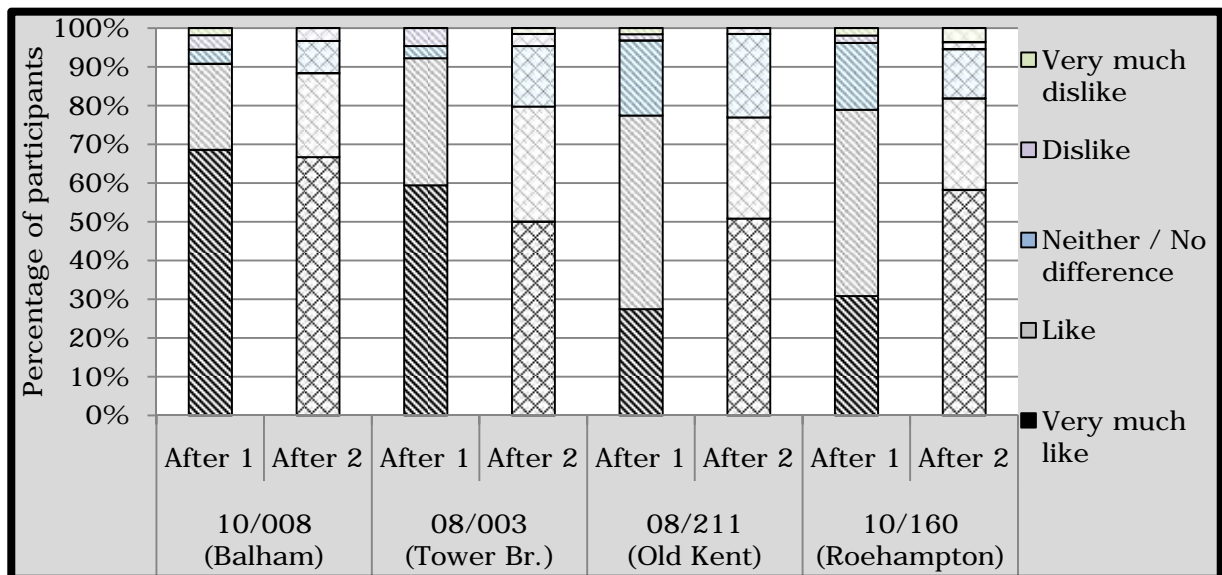


Figure 54 Participants' inclination towards the Countdown crossing – Group 2

Overall, participants liked PCaTS, with over 70% stating this on all sites and in both 'After' surveys. In addition, there was a general change to very much liking PCaTS after users became accustomed to the signals (i.e. the 'After 2' survey).

PCaTS was liked by over 70% of participants at all sites in the 'After 1' survey, with the maximum being over 90% of participants liking PCaTS at Oxford Street which was the busiest site. In contrast, less than 10% of participants at all sites disliked PCaTS.

Similarly, in the 'After 2' survey most participants liked PCaTS: between 77% and 89%. This compares with less than 7% disliking PCaTS. The only significant change was a 13% decrease on Tower Bridge, where there was an associated increase in answers of neither liking nor disliking. However, at six of the sites there was an increase in those who very much liked PCaTS in the 'After 2' survey, and this change was significant at five of the sites. In contrast, at Balham there was a small and insignificant decrease in those who said that they very much liked PCaTS.

5.9 Summary of Findings

5.9.1 Sample characteristics

1. The age distributions remained consistent between the surveys, However, the gender and trip purpose distributions did show some variation between the surveys; for example, on some sites there was a decrease in the number of trips for work and education purposes. This appeared to be a result of when the surveys were conducted: the 'Before' surveys were in school term time and some 'After 1' surveys were in the school summer holidays. Such changes could have an impact on the behavioural observations from these sites and may therefore be a confounding factor. Note that the main report and conclusions are based on After 2 data.
2. For the main perception analysis, the eight trial sites were divided into four categories based upon their physical layout and pedestrian flows.
 - Category 1 – Balham
 - Category 2 – Finsbury, Roehampton, Tower Bridge and Old Kent Road
 - Category 3 – Kingsway and Blackfriars
 - Category 4 – Oxford Street

5.9.2 How PCaTS affects understanding of Signals

3. Almost all participants understood the meaning of the Green Man and Red Man signals in all surveys.
4. If Blackout or Countdown was showing on arrival at the crossing the percentage of participants stating they could "start to cross safely", or "cross although the time is running out", was significantly greater (72% to 89%) for Countdown in the 'After 2' survey (at the 99% confidence level) than for Blackout (18% to 36%) for the sites in all four categories. Also, the percentage who stated the meaning was they could start to cross safely varied from 2 to 11% for Blackout and 58 to 74% for Countdown in the 'After 2' survey and these increases were significant compared to both the 'Before' and the 'After 1' survey. There was however an increase (to between 15 and 20%) in those not knowing what it meant within two of the categories. It should be noted that the average Blackout time for the unmodified crossings across all eight sites was 8.3 seconds, whereas the average Countdown time following PCaTS installation was 12.4 seconds.
5. If Blackout or Countdown appeared whilst participants were on the crossing the percentage who understood it to mean they could continue to cross safely increased from between 6% and 21% for Blackout to between 30% and 70% for Countdown. The increase was significant for Category 1, 2 and 4 sites, and was a further increase to that found in the 'After 1' survey.
6. The percentage of participants who would start to cross with the Blackout showing varied between 35% and 60% across the four categories. Similar percentages of participants (42% to 59%) stated they would start to cross with the Countdown showing 5 seconds in the 'After 2' survey. However, the percentage of participants, who would start to cross with the Countdown showing 10 seconds, was substantially higher (77% to 88%). However, there were significant decreases in the percentage deciding to cross with 10 seconds displayed between the 'After 1' and 'After 2' surveys in two categories, and with 5 seconds displayed in one category. The other perception change between the

'After 1' and 'After 2' surveys was an increase in the percentage of participants stating they would cross with confidence (significant when 10 seconds was displayed in three of the site categories): 47 to 70% in the 'After 2' survey 22 to 49% in the 'After 1' survey.

7. At all category crossings there was a statistically significant increase in the number of respondents stating that the Countdown period was the last time to start crossing (37 to 69%) in comparison to those stating they could start crossing during the Blackout (only 4 to 9%), the percentages were similar in the 'After 1' surveys and no consistent changes had occurred between the two 'After' surveys.
8. On Oxford Street there was a significant decrease in the percentage of participants reporting that they stopped in the island, following installation of PCaTS in the 'After 2' survey. However, there was no significant effect on other sites after the scheme had settled in.

5.9.3 Opinions of PCaTS

9. The percentage of participants who stated that they had sufficient time to cross the road increased from 70% to 80% in the 'Before' survey to between 83% and 97% in the 'After 2' surveys. Similar percentages were observed in the 'After 1' survey, suggesting that the improvement was felt by new users as well as those who had become familiar with the scheme. The increases between the 'Before' and the 'After 2' surveys were significant at all categories of sites.
10. There was a reduction in the proportion of respondents stating that they felt rushed in all categories of sites: reducing from 37 to 45% in the 'Before' survey to 7 to 27% in the 'After 2' survey.
11. Paradoxically, participants in the 'After 2' survey displayed less awareness of how long it actually takes to cross the road than those in the 'Before' study, even though the presence of the Countdown display in seconds provides an accurate measure of actual crossing times. The percentage of participants not knowing how long it took them to cross the road increased on some sites, and the percentage underestimating their time to cross the road (at 5 seconds or less) increased significantly at some sites.
12. Participants generally felt safe at all types of crossings, with 70% to 80% stating they felt safe at the Standard crossings; however, with PCaTS, the percentage feeling safe was significantly greater, ranging from 88% to 97%. Although this did not change greatly between the 'After 1' and 'After 2' surveys, the percentage did increase significantly in the 'After 2' surveys on the Category 3 and 4 sites (the widest crossings).
13. PCaTS was liked by over 77% of participants at all sites in the 'After 2' surveys, compared to less than 7% disliking PCaTS; for most sites this was an increase from the 'After 1' surveys in which it was liked by over 70% of participants at all sites. The most favourable response was 89% of participants liking PCaTS at Oxford Street, the busiest site. At one site there was a significant reduction (of 13%) of the participants liking PCaTS between the 'After 1' and 'After 2' surveys; however on six sites (and significantly on five sites) there was an increase in the percentage of participants 'very much liking' it.

6 Results: Pedestrian Behaviour (Video and Observation Data)

Pedestrians adapt their behaviour according to a number of different factors. These include their knowledge and familiarity, the situation and the information available. PCaTS provides more information for pedestrians and therefore could affect their behaviour at, or near to, the crossings.

Video data was used to analyse pedestrian behaviour in the 'Before' and 'After 1' surveys. Section 6.1 describes the site characteristics of age and gender of the sample, pedestrian flows and the modifications to the signal timings. Section 6.2 is split into nine sections, each analysing how PCaTS has affected different pedestrian behaviours. These include when pedestrians crossed, whether they sped up, the occurrence of overcrowding and other behaviours of interest.

Section 6.3 analyses the pedestrian behaviour of the mobility impaired and children observed when they used a PcaTS and Standard crossing. These observations were made before these respondents were asked to complete a questionnaire survey regarding their experiences during the accompanied walks, the results of which are contained in Section 5.

6.1 Site Characteristics

6.1.1 Sample Composition

Age and gender affects walking speed, attitude and perception. Consequently, it needs to be consistent between surveys at different sites, in order that any observed changes in behaviour are attributable to the changes at the crossing and not a change in pedestrian type. It is therefore necessary to determine whether the sample is skewed by a particular gender or age.

Figure 55 shows the proportion of gender of the participants for each site. As discussed in Section 2, this analysis was taken from the Detailed Sample.

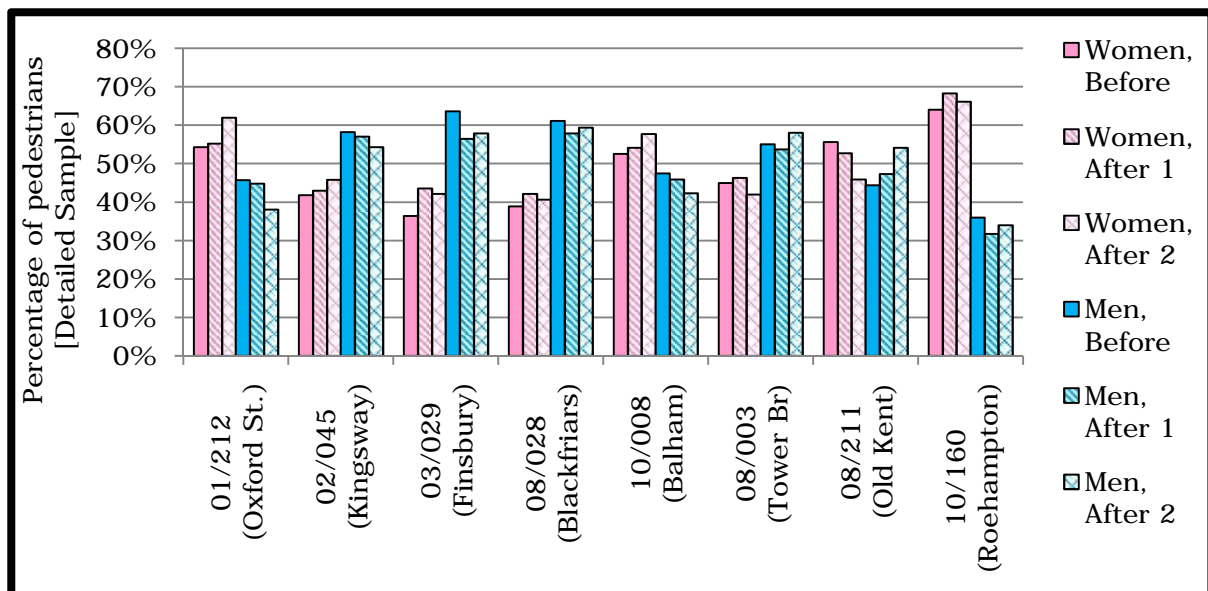


Figure 55 Percentage of pedestrians, by gender

The gender composition was consistent on four sites, whilst the percentage of men had increased on one and decreased on the remaining three sites.

The maximum change in percentage of the genders on any site (compared to the 'Before' survey was 10%.

- The split of gender varied over all sites and surveys, with the proportion of women ranging from approximately 35% to 70%
- There were also consistently more men than women in all surveys on Kingsway, Finsbury, Blackfriars and Tower Bridge. There were approximately the same number of men and women on Old Kent: with the percentage of women ranging from 46 to 56%.
- The only significant changes (at the 95% Level) between the 'Before' and 'After 2' surveys were an increase in women on Oxford Street (54% to 62%) and Finsbury (36% to 42%). There were also significant changes (at the 90% Level) between the 'Before' and 'After 2' surveys, with an increase in women on Balham (53% to 58%) and a decrease in women on Old Kent (56% to 46%).
- The only significant change between the 'Before' and 'After 1' surveys (at the 95% Level) was an increase of women on Finsbury from 36% to 43%

The consistency between the surveys suggests that the selected sites were a reasonably representative cross-section of pedestrians crossing, and not skewed towards one particular gender. There were some significant changes in gender at four sites, but these changes were no greater than 10% and so it is expected that this will not have an overall adverse effect on the analysis. However, on these four sites the changes in gender may be a causal factor for explaining some changes in pedestrian behaviour in Section 6.2.

Figure 56 and Figure 57 below show for each site and survey the proportion of pedestrians that were classified from the videos into the three age groups: Under 30, 30 to 60, Over 60 years old.

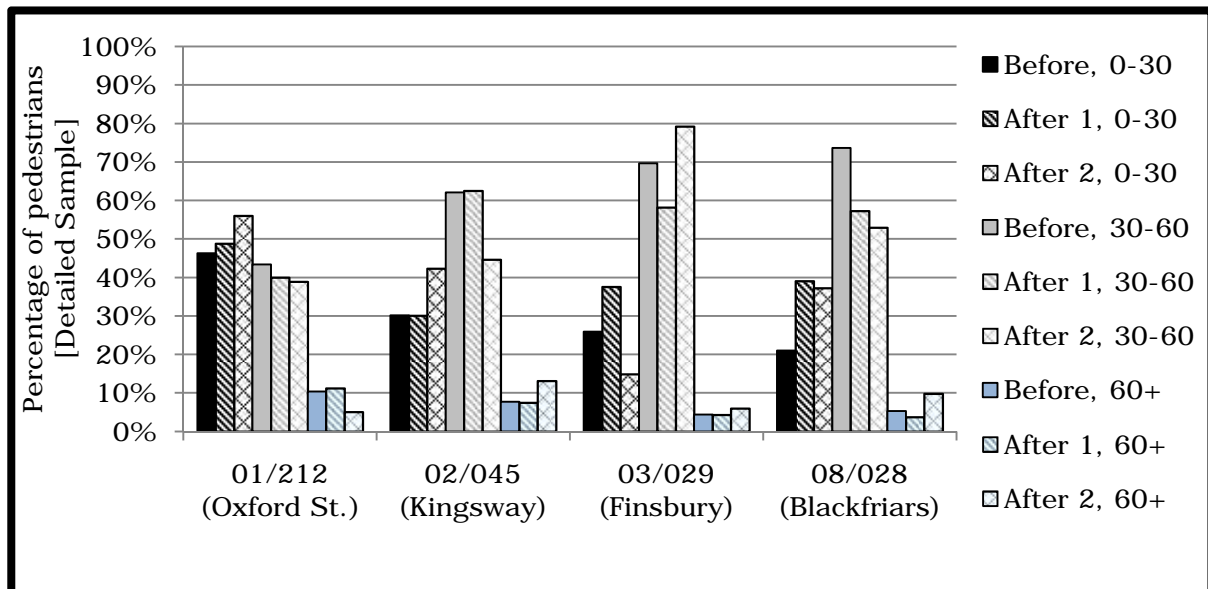


Figure 56 Percentage of pedestrians, by age - Group 1

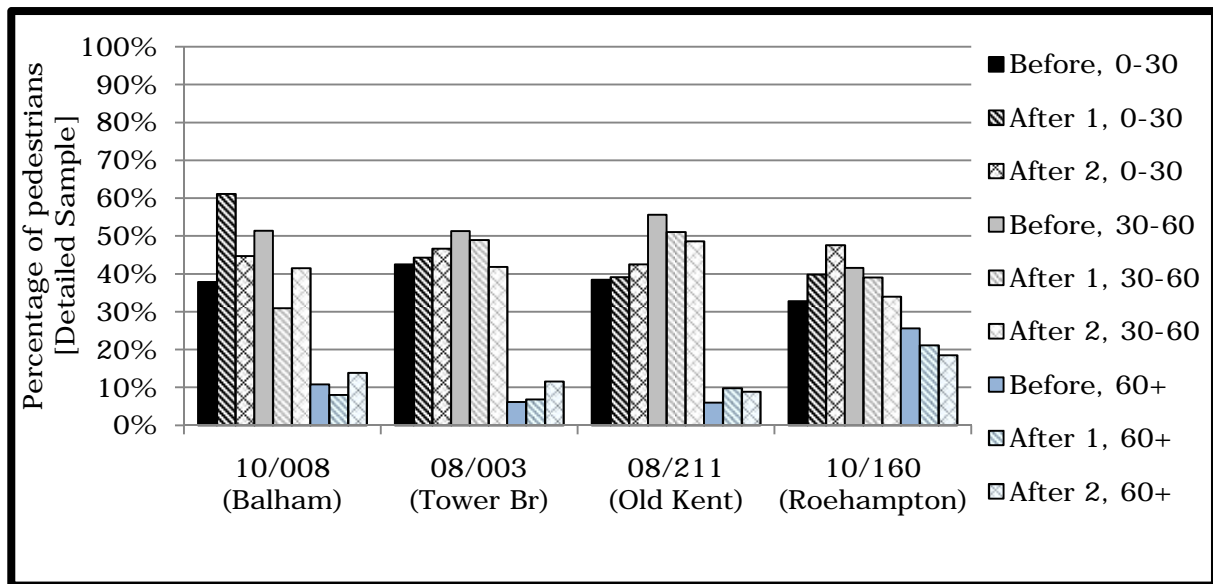


Figure 57 Percentage of pedestrians, by age - Group 2

Across all surveys, proportions of pedestrians in different age groups were reasonably consistent on three of the four high pedestrian flow sites: generally 40 to 70% were 30 to 60 years old. Also, generally 30 to 50% were in the same age group on the other five sites.

There were generally small, but significant, changes in the percentages in age categories on individual sites between the surveys. It is therefore possible that these changes could affect pedestrian behaviour, for example walking speed, and therefore they are considered in later sections.

- For most sites and surveys, the proportion of pedestrians aged over 60 was between 5% and 10%. For Roehampton in all three surveys, this proportion was approximately 20%, which was potentially owing to the location of the site near to a hospital
- Across the three surveys, the proportion of pedestrians aged 30 to 60 was generally 40% to 70% on Kingsway, Finsbury and Blackfriars, and approximately 30% to 50% on the other five sites.
- There were several changes between the 'Before' and 'After 2' surveys.
 - There was a significant increase (at the 95% Level) in the proportion of pedestrians aged over 60 at three sites and a significant decrease at one site: Kingsway (8% to 13%), Blackfriars (5% to 10%), Tower Br (6% to 12%) and Oxford Street (10% to 5%).
 - There was a significant increase (at the 95% Level) in the proportion of pedestrians aged under 30 on five sites, and a complementary significant decrease on four sites in the proportion of pedestrians aged 30 to 60.
 - On Finsbury the reverse was true, with a significant increase in pedestrians aged 30 to 60 and a significant decrease in those aged under 30.

Similarly for the ‘After 1’ surveys, there was a significant increase (at the 95% Level) compared to the ‘Before’ surveys in the proportion of pedestrians aged under 30, and a complementary significant decrease in the proportion of pedestrians aged 30 to 60 on three sites (Finsbury, Blackfriars, Balham). This may be possibly due to the date of the surveys as they varied in the time of year and the ‘After 1’ surveys were close (or in) the School Summer Holidays. However, the change in percentages of under 30 year olds were generally less than 15% and the more critical changes (in terms of walking speeds and decisions) in the percentage of over 60 year olds were less than 6%.

This suggests that age may be a causal factor in explaining some changes in pedestrian behaviour, and so will be considered in Section 6.2, but would not be expected to have a major impact on the study. In particular, Section 6.2.7 on walking speed may possibly be affected by changes in gender and age in the sample.

6.1.2 Pedestrian Flows

One of the characteristics that may influence pedestrian behaviour is the flow on each site; for example, high-flow sites are more likely to be susceptible to overcrowding. Also, the crossing behaviour can be directly affected, with pedestrians making decisions based upon those of people around them at busy sites. This section summarises the flows and flow profiles on each site. Figure 58 below shows the average hourly pedestrian flows for each site.

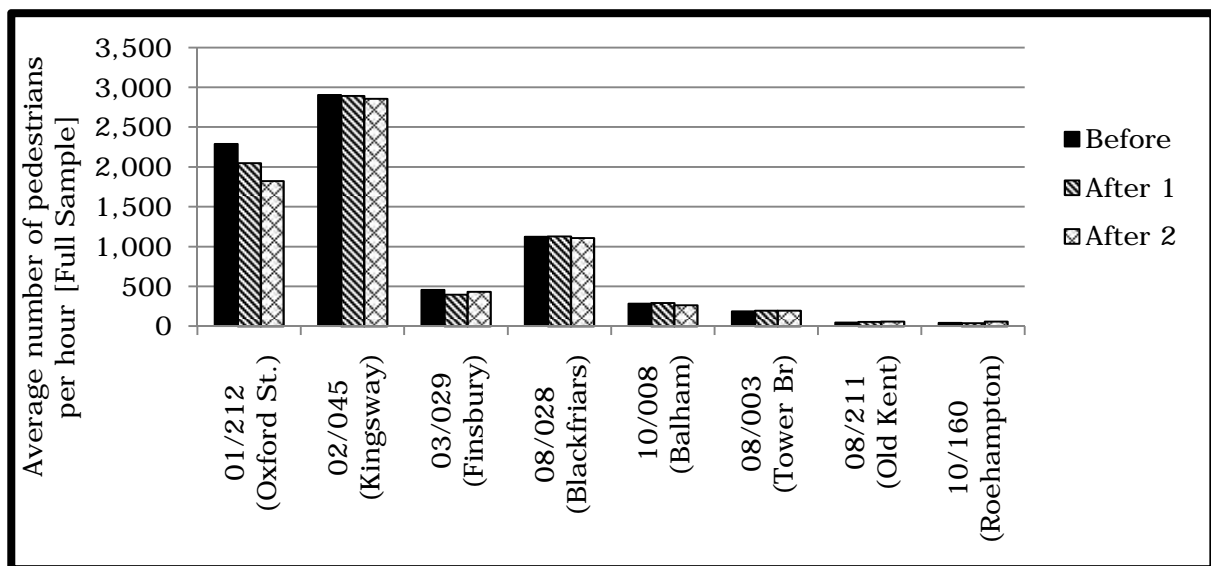


Figure 58 Average number of pedestrians per hour

On seven of the eight sites pedestrian flows were consistent between the surveys.

On Oxford Street there was a total decrease in flow of 20% between the ‘Before’ and ‘After 2’ surveys, probably owing to site-specific seasonal variations.

- The busiest site was Kingsway with almost 3,000 pedestrians crossing per hour, whereas the two least busy sites were Old Kent and Roehampton with approximately 40 pedestrians per hour
- T-tests were conducted to compare the average hourly flows and this showed that there were no significant changes in pedestrian flows using the crossing on seven out of the eight sites.

- On Oxford Street there was a decrease of approximately 10% from the 'Before' to the 'After 1' surveys.
- There was also a decrease of approximately 20% from the 'Before' to the 'After 2' surveys. On Oxford Street, the 'Before' survey was conducted at the start of July and the 'After 1' and 'After 2' surveys were conducted at the start and end of September, respectively (see Appendix A for dates of all surveys). Tourist data³ suggests that visits to London attractions typically drop from approximately 4 million in July to 2.5 million in September. Given that Oxford Street is a tourist destination, this may in part explain the decrease in pedestrian flows on this site.

The sites selected gave a very wide cross-section of sites, from around 1 pedestrian per minute up to around 50 per minute. This makes it difficult to pool data between sites in the Full Sample, because the higher-flow sites would dominate and pedestrian behaviour may vary with the pedestrian flow. Further, the variation in pedestrian flows should be borne in mind when considering percentage of pedestrians in Section 6.2; as, for example, 10% of the sample on Roehampton represents 4 pedestrians per hour, whereas on Kingsway, 10% of the sample represents approximately 300 pedestrians per hour.

Further information on pedestrian flows can be found in Appendix C, which gives details for how the flow varies throughout the day. This has been split into two groups of high and low flows to show the trends.

- Most sites had a peak of pedestrian flows at approximately 09:00, 13:00 and 17:00, whereas flows on Oxford Street increased throughout the day.
- For most sites, there were no major differences in the flow profiles throughout the day in the 'Before' survey compared to the 'After' surveys. However, on Oxford St. the decrease in pedestrian flows using the crossing was predominantly in the afternoon, after 14:00.

This suggests that with the exception of Oxford Street in the PM Peak, the sites had fairly stable pedestrian flow profiles using the crossing and the variation throughout the day should not need further consideration.

6.1.3 Pedestrian Signal Timings

Signal timings need to be considered as any variations in them could affect pedestrian decisions and behaviour. For example, if the duration of the Red Man increased, and pedestrians received less priority, then they may be more likely to decide to cross without waiting for the Green Man. Changes in the duration of the invitation to cross time, as well as the displayed information, may affect pedestrian behaviour; for example, pedestrians may be more likely to speed up if crossing when there is less available time.

Modifications to Green Man and Blackout times

Figure 59 and Figure 60 show the fixed signal timings for the Green Man and Blackout phases. These were fixed times, and those shown for 'After 1' surveys are also relevant to the 'After 2' surveys, whereas some Red Man times varied. The "All Red phase", i.e. the time when a Red Man shows to pedestrians and a Red Signal to traffic, is also presented on these figures.

³ Visit London, London Attraction Monitor, August 2010

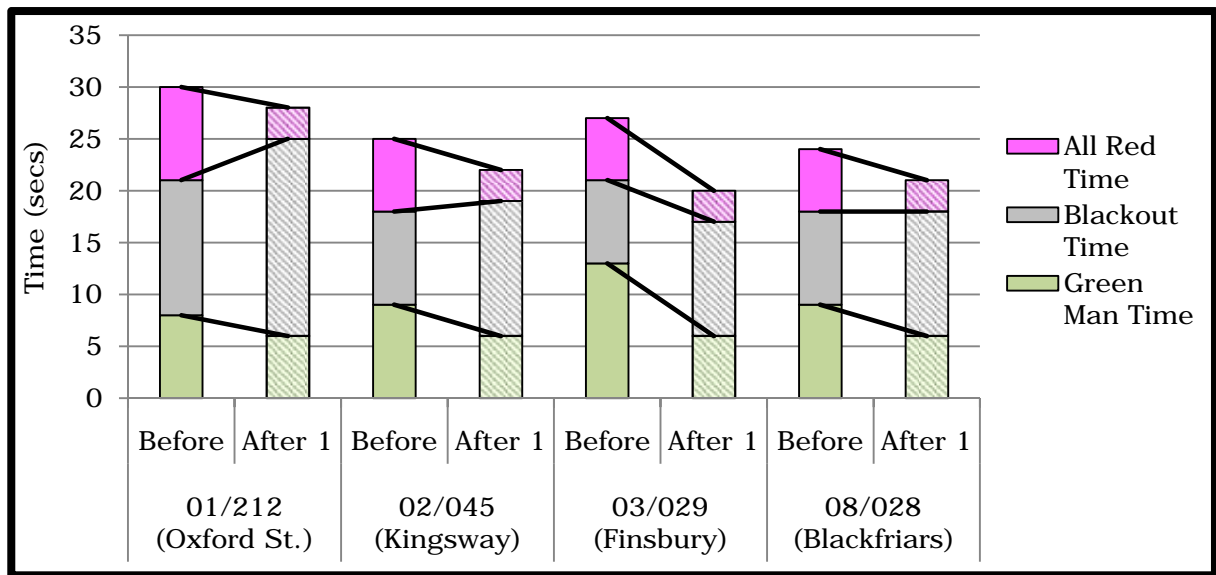


Figure 59 Fixed signal timings for Green Man and Blackout phases - Group 1

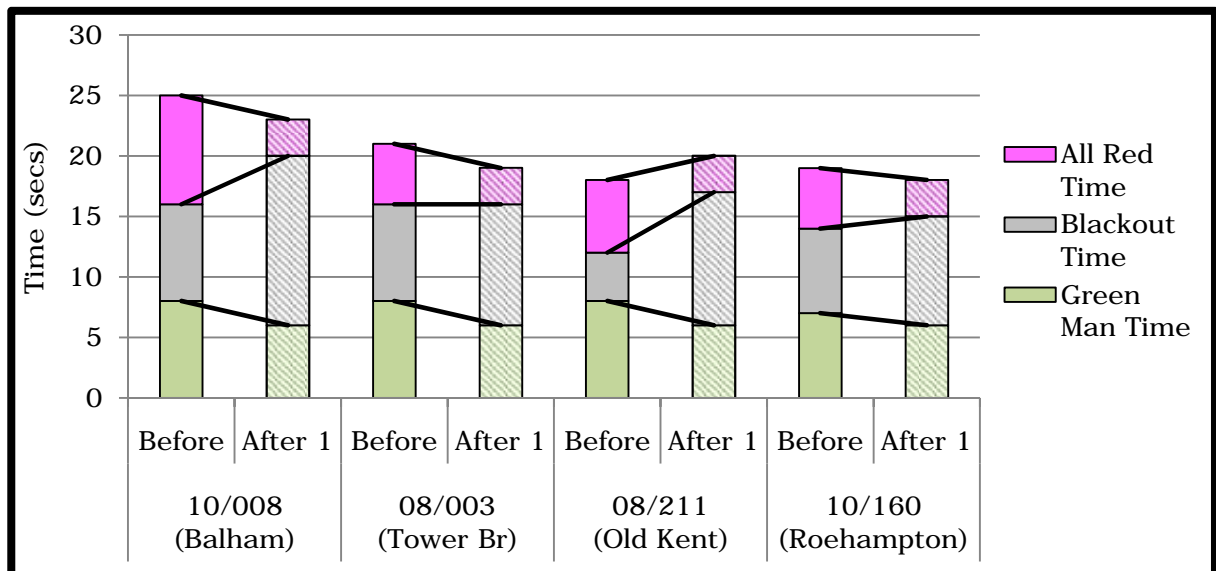


Figure 60 Fixed signal timings for Green Man and Blackout phases - Group 2

The Green Man time was reduced on all sites with PCaTS, and the Countdown time provided was longer than the Blackout time in the 'Before' surveys.

Overall, the "available crossing time" (Green Man time + Blackout time) increased by 4-5 seconds on three sites, decreased by 4 seconds on one site, and had a negligible or no change on the other four sites.

- For all eight sites, the Green Man time was reduced to 6 seconds in both 'After' surveys compared to the 'Before' survey⁴

⁴ There were several occurrences of pedestrian phases with 8-second Green Man times in the 'After 1' and 'After 2' surveys. These instances were removed from the analysis and so are not expected to affect the results. Specifically, there were: 7 occurrences on Old Kent in the 'After 1' survey; 3 occurrences on Old Kent in the 'After 2' survey; and 3 occurrences on Roehampton in the 'After 2' survey.

- For all eight sites, the Blackout time was increased in the 'After' survey compared to the 'Before' survey
- The "available crossing time" is defined as the sum of the Green Man time and the Blackout time. The difference in available crossing time between the 'Before' and 'After 1' surveys was:
 - 0 seconds on Blackfriars and Tower Bridge
 - 1 second extra on Kingsway and Roehampton
 - 4 seconds less on Finsbury, representing a 19% decrease
 - 4 seconds more on Oxford St. and Balham, representing a 19% and 25% increase, respectively
 - 5 seconds more on Old Kent, representing a 42% increase

The change in available crossing time was a limitation of the study. Any observed changes in behaviour will be a result of both the change to the signal timings and the introduction of PCaTS, that is, the effects are confounded. The results in this section are therefore the amalgam of PCaTS and signal timing changes; although where possible it has been discerned which behaviours were as a result of the change in signal timings and which were of a result of the introduction of PCaTS.

Modifications to Red Man times

The Red Man time is defined in this section as the pre-programmed time that a pedestrian would have to wait for the Green Man if they arrived at the very end of the Blackout phase and pressed the button. This definition gives a measure of the overall priority given to pedestrians. However, for the analysis reported in this section of the report, the indicator of Red Man time used is the proportion of time that the Red Man is observed to be on in the video recordings, which includes the time when pedestrians do not immediately request priority. The utilised indicator is most accurate when there are high pedestrian flows, and therefore the pedestrian phase is constantly requested.

The Red Man time is therefore directly related to the duration of the traffic green. In turn the traffic green is based upon the allocations provided by the associated signal control strategy (for example SCOOT). It is therefore responsive to traffic demand and will vary throughout the day. Consequently, the Red Man timings on most sites varied throughout the day, but on many sites they were fixed for certain periods. For example, there was a tendency to provide longer Red Man times in the peak periods, most likely as a result of responses to traffic demand.

On some sites, the Red Man times were different in the 'After' surveys compared to the 'Before' survey. Precise details of these changes are given in Appendix C, but overall the changes were as follows:

- Increase in Red Man time
 - Finsbury – 4-second increase
- Decrease in Red Man time
 - Oxford St. – 3-second decrease, except near 13:00 in the 'After 2' survey
 - Balham – 4-second decrease, except near 07:00 in the 'Before' and 'After 2' surveys
 - Old Kent – 5-second decrease, but no discernible pattern for the 'After 2' survey
- Negligible change in Red Man time
 - Kingsway – 1-second decrease

- Roehampton – 1-second decrease
- Blackfriars – no change, except near 12:00 in the ‘Before’ survey; also no discernible pattern for 11:00-17:00 in the ‘After 2’ survey
- Tower Br – no change, except near 18:00 in the ‘Before’ survey; also 8-second increase for 10:00-16:00 in the ‘After 2’ survey compared to the ‘Before’ and ‘After 1’ surveys (see Appendix C)

In summary in the ‘After’ surveys:

- Three sites had lower Red Man times (i.e. maximum waiting times) for pedestrians (Oxford St, Balham, Old Kent)
- The only site that had increased Red Man times was Finsbury
- There were minor changes on the other four sites. However, these changes were most likely not noticeable by pedestrians. On two of these sites (Blackfriars, Tower Bridge) there were inconsistencies with the Red Man time in the ‘After 2’ survey.

Figure 61 below shows the average Red Man times during the 07:00 to 19:00 period for each site in the ‘Before’, ‘After 1’ and ‘After 2’ surveys.

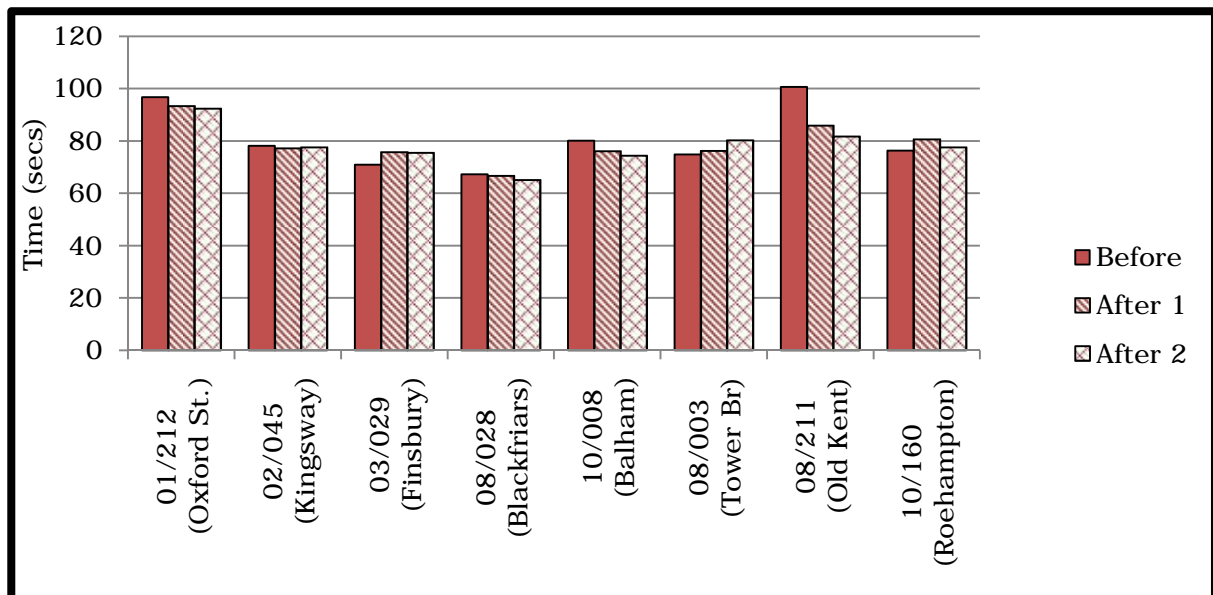


Figure 61 Average signal timings for Red Man phases, 07:00-19:00

Red Man time is an indicator of the time priority given to pedestrians with a reduction in time implying an increase in priority.

The Red Man time decreased on four sites, remained approximately the same on three sites and increased on one site

More detailed analysis indicated there was a high degree of variation in Red Man time on the low flow sites. This appeared to be as a result in variations in the number of pedestrian requests made on these sites.

As a result, it should be noted that there is not a direct correlation between Red Man time changes and Traffic Green time in Section 6.2.6. They should approximately mirror each other on sites with high pedestrian flows, where the pedestrian signals are called in

each of the vast majority of cycles. However at sites with lower pedestrian flows, whilst some of the signal cycles contained pedestrian phases, others did not. Therefore the Red Man time above has been estimated on a subset of the cycles observed for the traffic analysis.

Pedestrian Cycle Times

The cycle times can be calculated from the data, and consist of the fixed Green Man, the fixed Blackout times and the variable Red man times: which include the All Red phases, Red/Amber phases and traffic Green phases. Detailed results showing the average Red Man times are shown in Appendix C.

Pedestrian cycle times remained constant between the 'Before' and 'After 1' surveys, but there were variations of up to 5 seconds on the Tower Bridge and Blackfriars sites in the 'After 2' surveys.

The analysis shows that for most sites the average cycle times calculated from the pedestrian phases were the same (to within 1 second) in both the 'Before' and 'After' surveys for each site. However, there were changes in the average cycle time in the 'After 2' survey on Tower Bridge (5 second increase) and Blackfriars (2 second decrease), due to the variations in Red Man time on these two sites. See Appendix C for the average cycle times. These are consistent with the signal timing findings in Section 8, where they are examined using vehicle signal timings.

Although the average cycle times were mainly constant, the proportion of Red Man time compared to available crossing time (i.e. Green Man + Blackout) did change on some sites.

Modifications to the "All Red phases"

It should be noted that the "All Red phase" after the end of the Blackout phase (when both the pedestrian and vehicle signals are red) was reduced on all sites. It ranged over all sites from 5 to 9 seconds in the 'Before' survey. This was reduced to 3 seconds on all sites in the 'After' surveys (See Appendix C), followed by the 2 seconds of Red/Amber before the start of the traffic green. The implication of this is that a pedestrian on the crossing at the very start of the Red Man would be closer to when the traffic starts to move in the 'After' surveys than in the 'Before' survey, although TfL did maintain a 3 second All Red period. This should be taken into account when considering the safety of pedestrians crossing near the end of the Countdown period in the 'After' surveys.

The "All Red" phase decreased on all sites from 5 to 9 seconds in the 'Before' to 3 seconds in the 'After' surveys

The stage design (i.e. the order in which junction arms gained priority) resulted in the traffic gaining priority on the surveyed junction arm directly after the pedestrian stage finished on two sites (Finsbury and Tower Bridge), whilst other arms gain priority on the other sites. For the signals on the arm surveyed, the average All Red times after the end of the Blackout are shown in Appendix C.

The "All Red phase" before the start of the Green Man phase was unchanged on all sites. For the signals on the arm surveyed, the average All Red times before the start of the Green Man are shown in Appendix C.

6.2 Effect of PCaTS on Pedestrian Behaviour (Main Video Data Sample)

6.2.1 When Pedestrians Crossed

An important consideration in assessing the impact of PCaTS on pedestrian behaviour is when they cross. This is effectively determined by when they are able to cross and when they choose to cross.

The time when pedestrians are able to cross is determined by factors such as the traffic flow and the road width. Rather than wait for the Green Man, some pedestrians will cross as soon as they judge there is a suitable gap in the traffic. This behaviour can be observed at all types of crossings. In the context of assessing the impact of PCaTS, it is of more interest to focus on how they choose to cross, particularly within the Countdown period. This section assesses when pedestrians cross from several different perspectives.

Time pedestrians started crossing after arriving

Figure 62 shows the cumulative distribution of the time that pedestrians started to cross after arriving at the crossing. This is pooled over all sites from the Detailed Sample (up to 720 pedestrians per site).

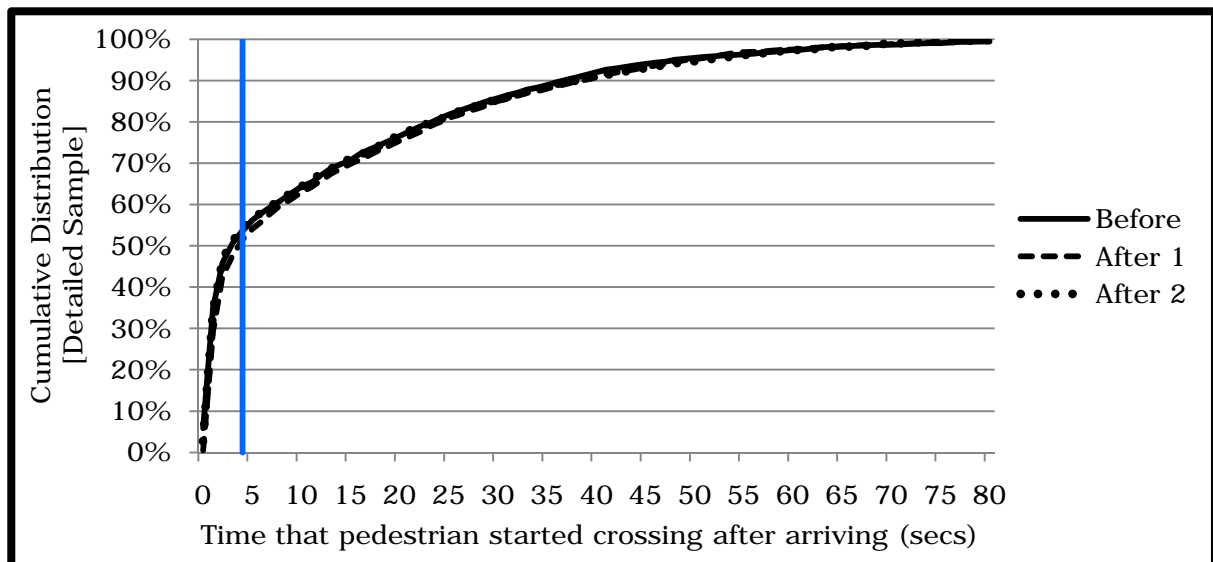


Figure 62 Time that pedestrian started crossing after arriving (all sites)

Most pedestrians started to cross within 5 seconds of arriving at the crossing, therefore many do not wait for priority

- Within 5 seconds of arriving at the crossing, 56%, 54% and 57% of pedestrians had started crossing in the 'Before', 'After 1' and 'After 2' surveys respectively. The blue line represents 5 seconds
- Within 15 seconds of arriving at the crossing, 71%, 70% and 71% of pedestrians had started crossing in both the 'Before', 'After 1' and 'After 2' surveys respectively

This suggests that a large proportion of pedestrians chose to cross as soon as possible after they arrived, regardless of the traffic signal; as, with random arrival, the average wait time would be greater than 15 seconds if they did not cross without priority. Also, although some pedestrians in Figure 62 would have arrived just before or in the Green

Man phase, and therefore easily started crossing in less than 5 seconds, the proportion of pedestrians that arrived in the Green Man phase was less than 50%.

Phase in which pedestrians started to cross

Figure 63 and Figure 64 below show in which phase pedestrians started to cross at each site. This has been taken from the Full Sample and is partitioned into two groups for ease of presentation.

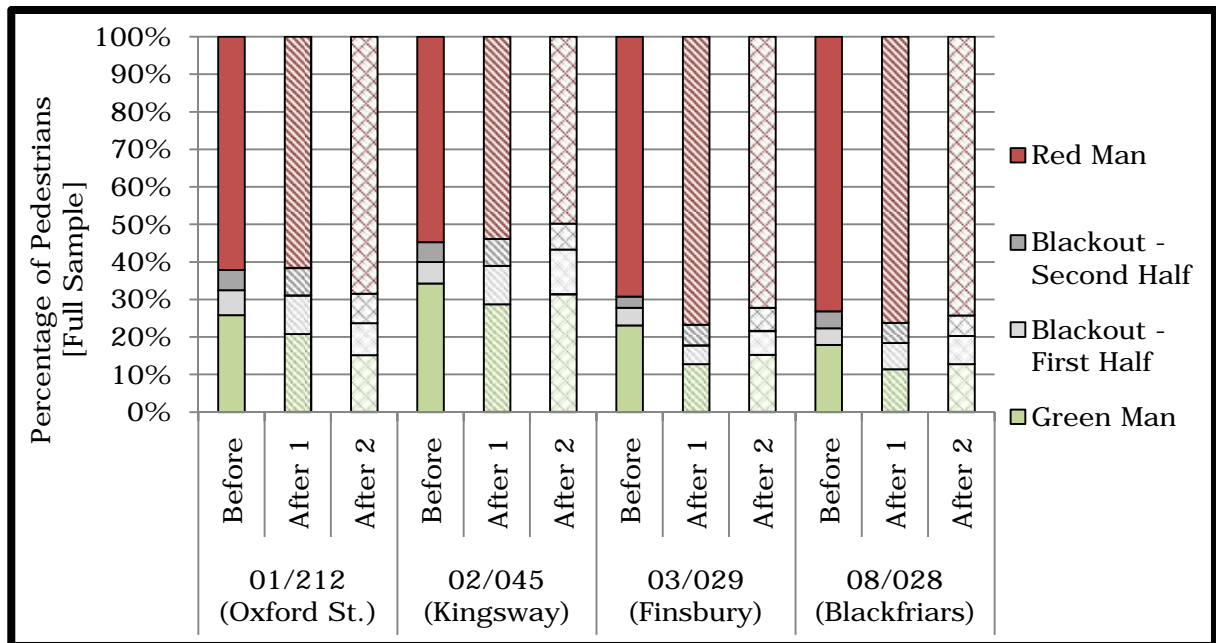


Figure 63 Phases in which pedestrians started to cross - Group 1

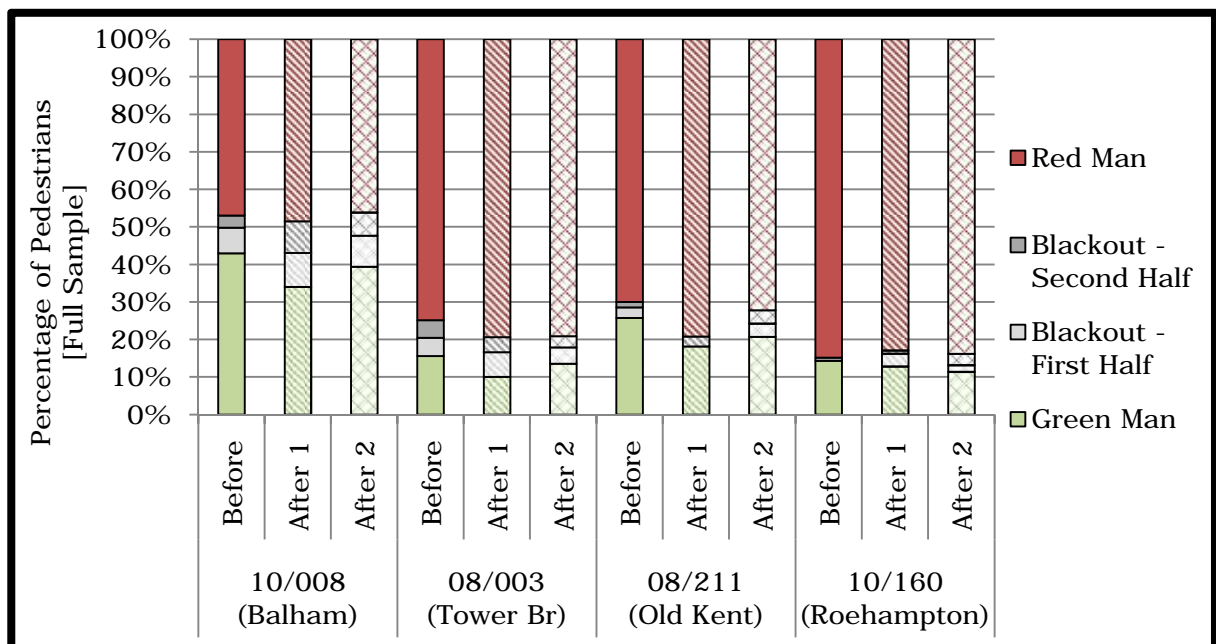


Figure 64 Phases in which pedestrians started to cross - Group 2

On most sites the majority of pedestrians crossed in the Red Man.

In line with timing changes, there was generally an increase in the percentage of pedestrians crossing in the Countdown (compared to the Blackout) and a decrease in the percentage of pedestrians crossing the Green Man.

In both the 'After' surveys compared to the 'Before' survey:

- Most sites had a significant decrease in pedestrians crossing during the Green Man phase
- Most sites had a significant increase in pedestrians crossing in the first half and/or second half of the Blackout phase

As discussed in Section 6.1.3, the signal timings were modified, so that for all eight sites the Green Man time was reduced and the Blackout time was increased in the 'After' surveys, compared to the 'Before' survey. This is the most likely explanation for the changes in proportions of pedestrians crossing in the Green Man and Blackout phases; therefore no conclusions can be drawn from this on the impact of PCaTS.

- In both the 'Before' and 'After' surveys, on four sites (Finsbury, Blackfriars, Tower Bridge and Old Kent) 70-80% of pedestrian crossed in the Red Man phase. On one site (Roehampton) this proportion was over 80%
- In both the 'Before' and 'After' surveys, on one site (Oxford St.) approximately 60-70% of pedestrians crossed in the Red Man phase.
- In both the 'Before' and 'After' surveys, on two sites (Kingsway and Balham) the proportion of pedestrians crossing in the Red Man phase was approximately 50%. Balham was the only site without an island. Kingsway was the widest crossing and also had the second highest traffic flow. These are the possible explanations why the proportion was lower on these two sites compared to the other sites
- In the 'After 2' survey compared to the 'Before' survey, the percentage of pedestrians crossing in the Red Man phase changed by between -6 to 5%, with increases on three sites. There was a significant increase in pedestrians crossing in the Red Man phase on Oxford Street (at the 95% Level) and Finsbury and Tower Bridge (at the 90% Level). There was also a significant decrease in pedestrians crossing in the Red Man phase on Kingsway (at the 95% Level).
- In the 'After 1' survey the percentage of pedestrians crossing in the Red Man phase changed by between -9.2 and 2%, with increases on three sites. There was a significant increase in pedestrians crossing in the Red Man phase on Finsbury and Blackfriars (at the 95% Level) and on Tower Bridge and Old Kent (at the 90% Level).

The significant increases in the proportion of pedestrians crossing in the Red Man phase are partially explained by the modifications to the Red Man signal timings, as described in the following section.

Phase in which pedestrians started to cross, relative to signal time changes

It may be expected that an increase in Red Man time would result in a greater proportion of pedestrians crossing in the Red Man for two reasons. Firstly, if a greater proportion of the cycle time is Red Man, more pedestrians are likely to arrive in the Red Man and, as shown above, over half of pedestrians crossed as soon as they arrived. Secondly, longer Red Man times mean longer maximum wait times, and pedestrians might therefore be less likely to wait for the Green Man. However, any trends observed on the sites that do not conform to these trends are more likely to be explained by other factors, including

the introduction of PCaTS. This section therefore considers changes in pedestrians crossing during the Red Man, isolates those that are explainable by the signal timing changes and then considers the remaining cases.

Table 9 compares the proportion of pedestrians who crossed in the Red Man phase with the proportion of cycle time that was the Red Man phase. The significant changes (at the 90% confidence level) in the proportion of pedestrians who crossed in the Red Man are highlighted in bold, whereas the substantial⁵ signal timing changes are highlighted with ticks.

As discussed in Section 6.1.3, three sites had a substantial decrease in the proportion of the cycle time that was Red Man: Oxford Street, Balham and Old Kent. The only sites that had a substantial increase in Red Man time were Finsbury in both the 'After' surveys and Tower Bridge in just the 'After 2' survey. There were only negligible changes in Red Man time for the other sites.

⁵ Substantial refers to greater than 1 second and is therefore distinguishable from zero owing to the inherent accuracies

Site	Survey	Proportion of signal cycle time that was the Red Man phase	Proportion of pedestrians who crossed during the Red Man phase	Substantial decrease in Red Man time	Substantial increase in Red Man time
01/212 (Oxford St.)	'Before'	82%	62%	✓	
	'After 1'	79%	62%		
	'After 2'	79%	68%		
02/045 (Kingsway)	'Before'	81%	55%		
	'After 1'	80%	54%		
	'After 2'	80%	50%		
03/029 (Finsbury)	'Before'	77%	69%		✓
	'After 1'	82%	77%		
	'After 2'	82%	72%		
08/028 (Blackfriars)	'Before'	79%	73%		
	'After 1'	79%	76%		
	'After 2'	78%	74%		
10/008 (Balham)	'Before'	83%	47%	✓	
	'After 1'	79%	48%		
	'After 2'	79%	46%		
08/003 (Tower Br)	'Before'	82%	75%		✓ (only in 'After 2')
	'After 1'	83%	79%		
	'After 2'	83%	79%		
08/211 (Old Kent)	'Before'	88%	70%	✓	
	'After 1'	84%	79%		
	'After 2'	84%	72%		
10/160 (Roehampton)	'Before'	85%	85%		
	'After 1'	83%	83%		
	'After 2'	83%	84%		

Table 9 Comparison of the proportion of pedestrians who crossed in the Red Man phase with the proportion of cycle time that is the Red Man phase

There are difficulties attributing the cause of percentage changes in pedestrians crossing in the Red Man, as there were changes in Red Man time alongside the introduction of Countdown information provided to pedestrians.

However, excluding variations explainable by pedestrian signal timing changes, four of the five statistically significant changes were increases in the percentage of pedestrians crossing in the Red Man and therefore are potentially a result of the introduction of the PCaTS package.

There were eight significant changes between the 'Before' survey and the 'After' surveys. Of these seven were increases in the percentage of pedestrians crossing in the Red Man phase. Of the increases, three (Finsbury 'After 1' and 'After 2' and Tower Bridge 'After 2') were associated with substantial increases in Red Man time, implying that it is potentially an underlying cause of the increase in pedestrians crossing in that phase. The details of the other changes are:

- Blackfriars, 'After 1' (73% to 76%) – but negligible change in Red Man time
- Tower Br, 'After 1' (75% to 79%) – but negligible change in Red Man time
- Oxford St, 'After 2' (62% to 68%) – but decrease in Red Man time
- Old Kent, 'After 1' (70% to 79%)⁶ – but decrease in Red Man time

Also the significant decrease in proportion of pedestrians crossing during the Red Man was not explained by signal timing changes:

- Kingsway, 'After 2' (55% to 50%) – but negligible change in Red Man time

In summary, although it is not possible to fully isolate the effects of signal timing modifications from the installation of the PCaTS package, the results indicate that the increase in proportion of pedestrians crossing in the Red Man on Blackfriars, Tower Bridge and Old Kent in the 'After 1' survey were possibly a result of the introduction of the Countdown package rather than changes in pedestrian signal timing. Furthermore, in the 'After 2' surveys, the 6% increase in the proportion of pedestrians crossing in the Red Man on Oxford Street is of particular note, given that there was a decrease in Red Man time on that site. However, to the contrary there was also a 5% decrease on Kingsway, which had negligible signal timing changes.

It should be noted that pedestrians who cross in the Red Man phase can be split into three categories, each with a different level of risk:

1. Pedestrians who cross at the very start of the Red Man phase are at risk of coming into conflict with vehicles as they start to move
2. Pedestrians who cross in the middle of the Red Man phase (when the vehicle traffic light is green) are at risk of coming into conflict with moving vehicles, but are likely to have considered there to be sufficient gap in the traffic for it to be safe to cross
3. Pedestrians who cross at the very end of the Red Man phase are at a relatively low risk as the traffic should have already stopped.

Time pedestrians started crossing, relative to the start and end of the Blackout and the end of the All Red

This section considers the proportion of arriving pedestrians that decided to start crossing if arriving in the Blackout and shortly before at the change in priority to vehicles: i.e. the end of the All Red occurs which 2 seconds before the start of the vehicle green. This latter measure is related to the number of pedestrians that would be expected on the crossing near the end of the pedestrian phase and could therefore be in potential conflict with any waiting vehicles. However, although the pedestrians who start to cross at this time will remain on the crossing for a number of seconds, this relationship can only represent an approximation. Therefore, the actual number of pedestrians on the crossing at the start of traffic green (and shortly before that time) is analysed in detail for Finsbury (03/029) and Tower Bridge (08/003) in Section 9.

⁶ The results for Old Kent (and Roehampton) should be treated with caution, because these sites had particularly low flows (see Section 6.1.2). This actually represents an increase from 33 out of 47 pedestrians per hour in the 'Before' survey, up to 41 out of 51 in the 'After 1' survey

Figure 65 shows the proportion of pedestrians who crossed within 3 seconds of arriving (on the vertical axis), against the arrival time after the start of the Blackout/Countdown phase (on the horizontal axis). This is presented for Finsbury as an example, with similar graphs for the other sites⁷ are included in Appendix C.

The top two bars represent the vehicle signal timings on the arm surveyed, whereas the 3rd and 4th bars represent the pedestrian signal timings. The 'Before' survey has a solid fill, while the 'After' surveys have a diagonal fill and pink is used to indicate the 'All Red' phase. Again, the signal timing modifications complicated the situation, but it is possible to see some trends. The area where the 'Before' and 'After' are comparable is near the start of the Blackout (0 on the horizontal axis).

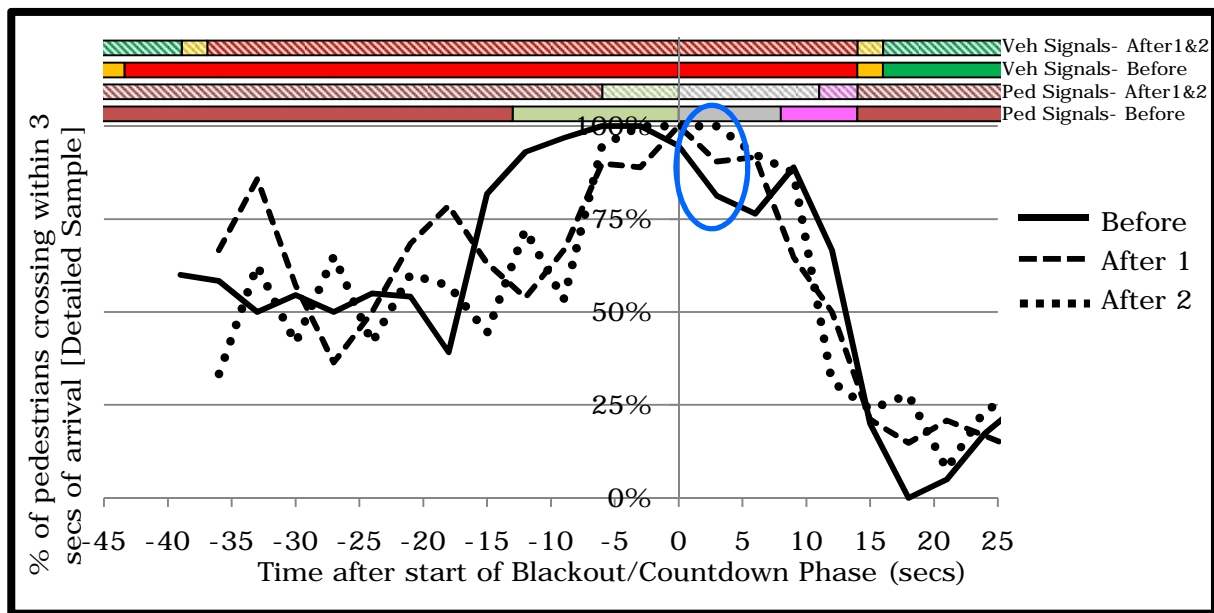


Figure 65 Impact of PCaTS on decision to cross, relative to the start of Blackout, (Finsbury)

On high flow sites, in particular Oxford Street and Kingsway, PCaTS had little effect on pedestrians crossing decisions with over 75% deciding to cross at the end of the Blackout or Countdown.

PCaTS appears to have had two effects on crossing behaviour in the Countdown compared to the Blackout on the other sites:

1. Pedestrians were more likely to start to cross in the first few seconds of the Countdown
2. Pedestrians were less likely to start to cross near the end of the Countdown
3. Pedestrians were equally as likely to decide to cross at the end of the "All Red"

- Up to approximately 5 seconds after the start of the Blackout phase (indicated by the oval), there is a trend of a larger proportion of pedestrians in both the 'After 1' and 'After 2' surveys choosing to cross than in the 'Before' survey.

⁷ With the exception of Old Kent and Roehampton, because it was not possible to conduct this analysis on these sites due to the low pedestrian flows.

- This trend was also apparent on the other sites with the exception of Oxford Street in the 'After 1' and 'After 2' and Tower Bridge in the 'After 1' (see Appendix C and also Table 10).

Figure 66 shows the same information as Figure 65, but shifted to be relative to the end of the Blackout phase rather than the start.

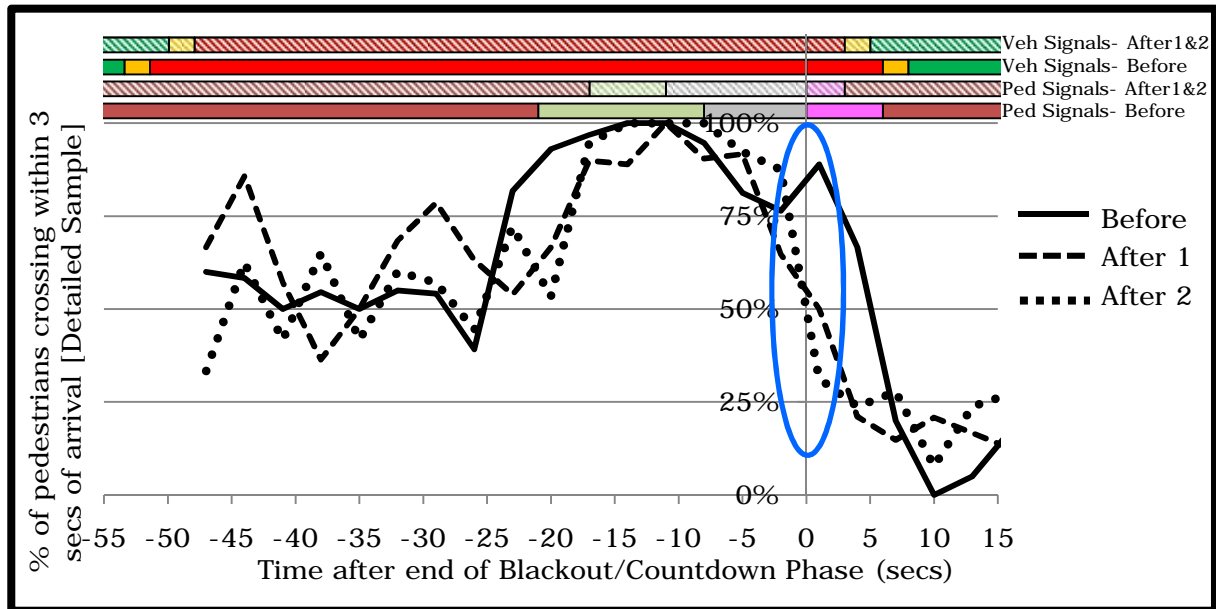


Figure 66 Impact of PCaTS on decision to cross, relative to the end of the Blackout, (Finsbury)

- Approximately 3 seconds before and 3 seconds after the end of the Blackout phase (indicated by the oval) on Finsbury, fewer (proportionally) pedestrians in the 'After' surveys choose to cross than in the 'Before' survey. This implies people are using their judgement based upon the information available.
- This trend was also apparent on the other sites with the exception of: Oxford Street in the 'After 1'; Kingsway in both the 'After' surveys; Blackfriars in the 'After 2' (where the reverse was true); and Tower Br in the 'After 2' (see Appendix C and also Table 10). This suggests that this trend is not as prevalent on sites with high pedestrian flows, in particular on Kingsway where pedestrian often follow each other onto the crossing irrespective of the signal displayed (see Figure 67).



Figure 67 - Kingsway pedestrians following on at the end of the crowd - after the end of the Countdown phase

It should also be noted that as discussed in Section 6.1.3, the “All Red” phase was reduced from 5-9 seconds in the ‘Before’ survey to 3 seconds in the ‘After’ surveys. The implication of this is that the safety critical point of when the vehicle traffic signals turn green was sooner after the start of the Red Man in the ‘After’ surveys than in the ‘Before’ survey. Figure 68 shows the same information as Figure 65, but shifted to be relative to the end of the All Red phase.

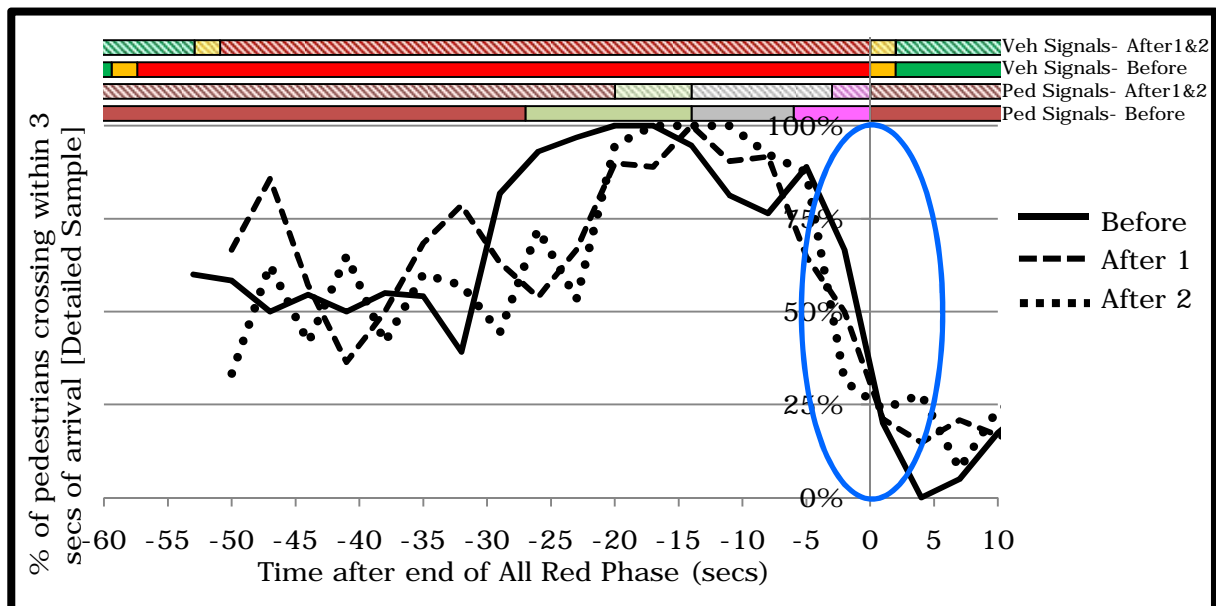


Figure 68 Impact of PCaTS on decision to cross, relative to the end of the All Red, (Finsbury)

- On Finsbury the proportion of pedestrians that started crossing at the end of the All Red phase (indicated by the oval), was approximately the same in the ‘After’ surveys as the ‘Before’ survey.

- For all other sites, at the end of the All Red phase, there was either no difference between the 'After' and 'Before' surveys, or slightly fewer pedestrians starting to cross in the 'After' surveys. The exception to this was the Oxford Street 'After 1' survey (see Appendix C).

Table 10 summarises the trends of whether more or less pedestrians started to cross as soon as they arrived in the 'After' surveys compared to the 'Before' survey.

Site	Survey	At the start of the Blackout / Countdown	At the end of the Blackout / Countdown	At the end of the All Red Phase
01/212 (Oxford St.)	'After 1'	same as 'Before'	same as 'Before'	more than 'Before'
	'After 2'	same as 'Before'	fewer than 'Before'	same as 'Before'
02/045 (Kingsway)	'After 1'	more than 'Before'	same as 'Before'	fewer than 'Before'
	'After 2'	more than 'Before'	same as 'Before'	fewer than 'Before'
03/029 (Finsbury)	'After 1'	more than 'Before'	fewer than 'Before'	same as 'Before'
	'After 2'	more than 'Before'	fewer than 'Before'	same as 'Before'
08/028 (Blackfriars)	'After 1'	more than 'Before'	fewer than 'Before'	fewer than 'Before'
	'After 2'	more than 'Before'	more than 'Before'	same as 'Before'
10/008 (Balham)	'After 1'	more than 'Before'	fewer than 'Before'	fewer than 'Before'
	'After 2'	more than 'Before'	fewer than 'Before'	fewer than 'Before'
08/003 (Tower Br)	'After 1'	same as 'Before'	fewer than 'Before'	same as 'Before'
	'After 2'	more than 'Before'	same as 'Before'	same as 'Before'

Table 10 Summary Table for the Impact of PCaTS on decision to cross

These trends can be seen for all sites (See Appendix C), similar to Figure 65, Figure 66 and Figure 68, which were just for Finsbury.

Figure 69 presents similar data, pooled over all sites. These figures are only relevant between approximately -5 seconds and +5 seconds due to the mixture of signal timings and modifications across the different sites.

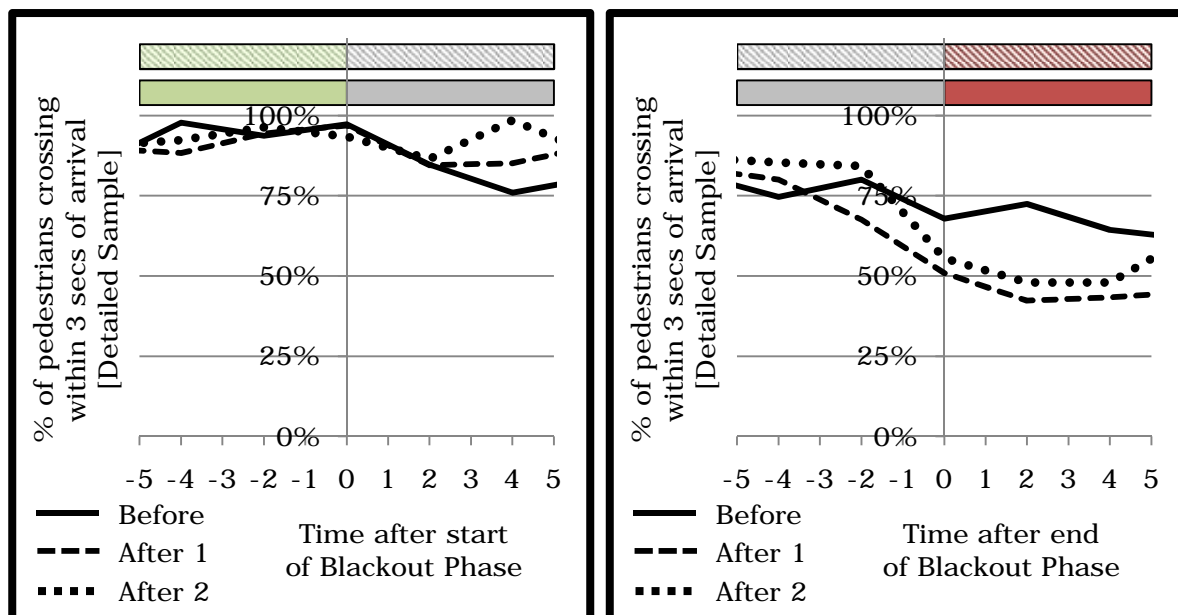


Figure 69 Impact of PCaTS on decision to cross, relative to the start (left) and end (right) of the Blackout (All Sites)

In summary, these trends suggest that PCaTS has influenced when pedestrians choose to cross. Specifically, with PCaTS in the ‘After’ surveys, more pedestrians chose to cross further into the Blackout period. However, also with PCaTS, fewer pedestrians chose to cross just before the vehicle traffic lights turn green. This second trend is potentially more critical, because this is just before the vehicle traffic lights turn green and where conflicts could occur.

Phase in which pedestrians crossed, of those who arrived in the Blackout phase

An alternative approach to examine the effect of PCaTS on crossing behaviour is to analyse in which pedestrian phases they crossed the roads compared to the phase they arrived at the crossing (taken from the Detailed Sample). Table 11 shows the phase in which pedestrians crossed the road for pedestrians who reached the crossing in the Blackout phase, summed across all sites. Only pedestrians who arrived in a comparable period towards the end of Countdown were considered in the ‘After’ surveys to account for signal timings differences (Countdown longer than Blackout).

Survey	Crossed near end of Blackout Phase	Crossed in Red Man Phase	Crossed in Green Man Phase	Total
'Before'	283	64	8	355
'After 1'	278	65	12	355
'After 2'	281	47	6	334
'Before'	79.7%	18.0%	2.3%	100%
'After 1'	78.3%	18.3%	3.4%	100%
'After 2'	84.1%	14.1%	1.8%	100%

Table 11 Phase that pedestrians crossed in, of those who arrived during the Blackout phase ('After 1' and 'After 2' surveys accounting for signal timing changes)

Overall, the percentage of pedestrians arriving in the Countdown/Blackout period who decided to cross was unaffected by PCaTS

- There was a small increase of 4.4% (79.7% to 84.1%) in the 'After 2' survey of pedestrians who arrived in the latter part of the Countdown and also crossed, compared to those arriving in the Blackout. There had been also a small decrease of 1.4% (79.7% to 78.3%) in the 'After 1' survey.

However, these changes were not statistically significant indicating that overall the percentage of pedestrians who arrived in the Blackout/Countdown and decided to cross remained the same. Although from the previous analysis it appears that the distribution according to the time when different percentages of pedestrians decide to start crossing was affected. It is possible that the increased percentage of pedestrians crossing earlier in the Blackout/Countdown is counteracted by the reduced percentage deciding to cross within 2 seconds of the end of the phase.

6.2.2 Whether Pedestrians Waited at the Island or Returned to Kerb

The two behaviours of interest are: whether pedestrians waited at the kerb; and also whether pedestrians returned to the kerb once they started to cross.

Figure 70 shows the proportion of all pedestrians that waited at the island in the 'Before' survey and 'After' surveys for all sites. All sites had an island, with the exception of Balham.

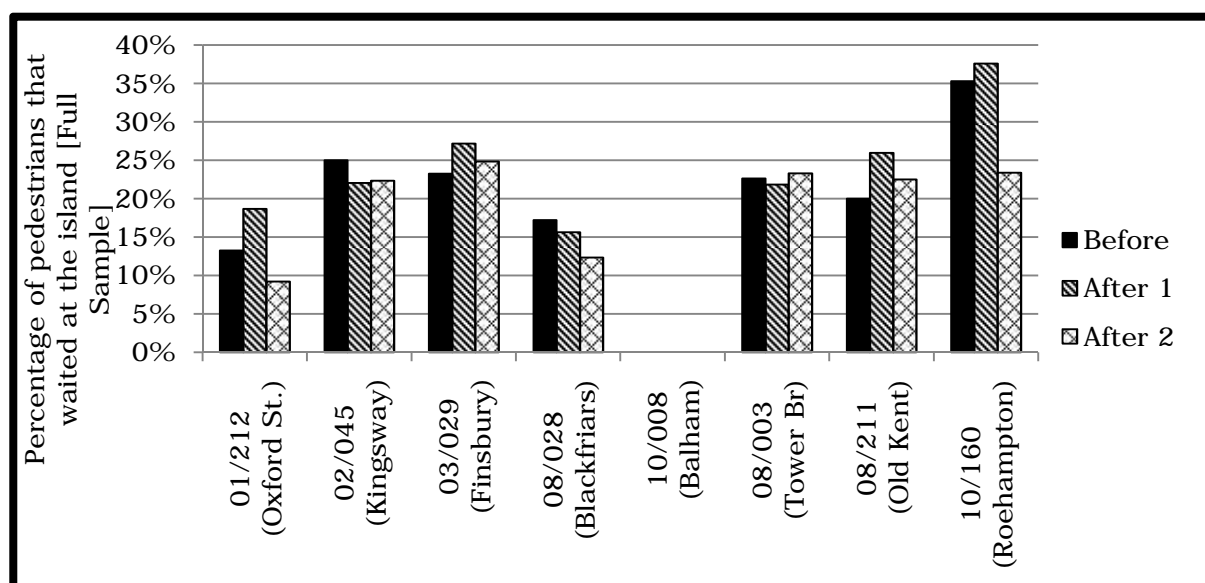


Figure 70 Percentage of pedestrians that waited at the island

Overall, after the scheme had settled in, pedestrians were slightly less likely to wait at the pedestrian island with PCaTS. However, there were some increases initially when the scheme was introduced.

- In the 'After 2' survey, there were statistically significant decreases (at the 95% Level) in the proportion of pedestrians that waited at the island on four sites: Oxford Street (13% to 9%); Kingsway (25% to 22%); Blackfriars (17% to 12%); and Roehampton (35% to 23%)
- In the 'After 1' survey, there was a statistically significant decrease (at the 95% Level) in the proportion of pedestrians that waited at the island on Kingsway (25% to 22%)
- Also in the 'After 1' survey, there were statistically significant increases (at the 95% Level) on Oxford Street (13% to 19%) and Finsbury (23% to 27%). There were also increases on Old Kent and Roehampton, but these changes were not statistically significant due to the lower flows. As mentioned previously, all results for Old Kent and Roehampton should be treated with caution owing to the very low pedestrian flows

The 'After 1' results, approximately two weeks after installation, suggested that the mixture of increases and decreases meant that PCaTS had no overall consistent effect on the proportion of pedestrians that waited at the island. However, the 'After 2' results, approximately three months after installation, suggested that on half the sites there was a decrease in the region of approximately 5 to 10% in the proportion of pedestrians that waited on the island.

Figure 71 shows the proportion of pedestrians that returned to the kerb after they had started crossing.

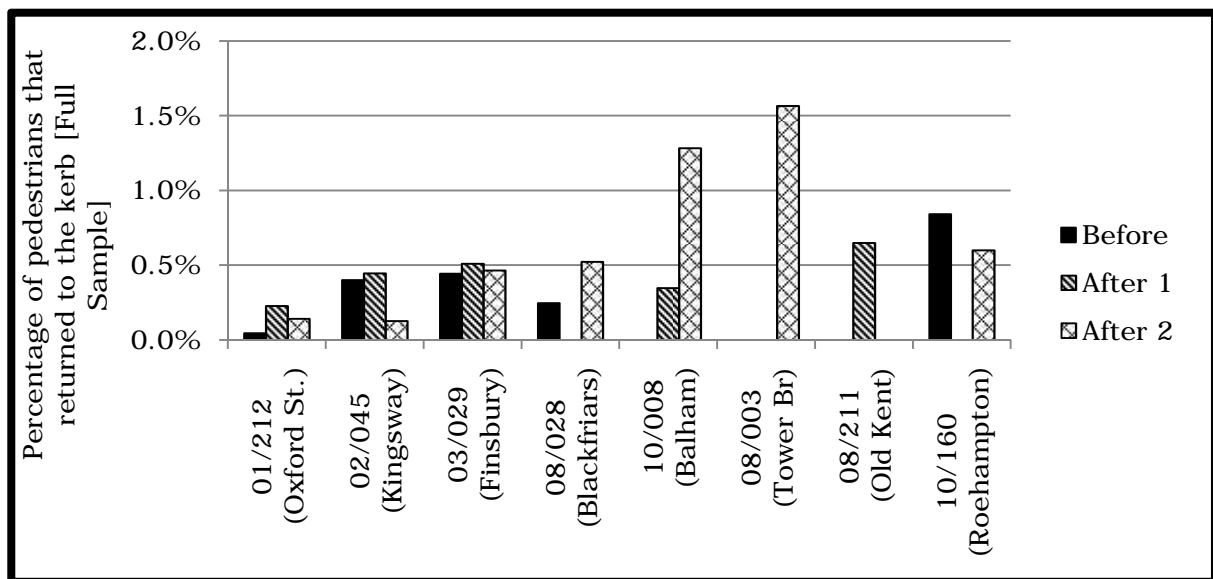


Figure 71 Percentage of pedestrians that returned to the kerb

Overall, very few pedestrians returned to the kerb in any of the surveys

There were some small significant changes between the surveys, but no consistent effect associated with PCaTS.

- Only a very small proportion (approximately < 2%) of pedestrians were classified as returning to the kerb after starting crossing
- In the 'After 2' survey, there were statistically significant changes (at the 95% Level) on three sites, with increases on Balham and Tower Bridge, and a decrease on Kingsway
- In the 'After 1' survey, there was a statistically significant increase for Oxford Street (at the 95% Level) and Balham (at the 90% Level). However, there was also a significant decrease for Blackfriars (at the 90% Level)

The mixture of increases and decreases suggest that PCaTS had no overall consistent effect on the proportion of pedestrians that returned to the kerb. Furthermore, 99% of those that returned to the kerb had started to cross in the Red Man, and therefore the observed changes are unlikely to have been influenced by the introduction of PCaTS.

6.2.3 Whether Pedestrians Increased Their Speed

With a Countdown Timer pedestrians may decide to cross at a later time. This can be achieved by using a higher walking speed to reach the other side in the time available. However, generally, if the pedestrian misjudges the time required to cross, they can also compensate for it by increasing their speed to reach the other side. Thus speeding up is an indicator that some pedestrians are revising their decisions according to the Countdown information displayed. This was investigated through a qualitative judgment made by the data analyst. Figure 72 displays the proportion of pedestrians that were judged to have increased their speed for each site and survey.

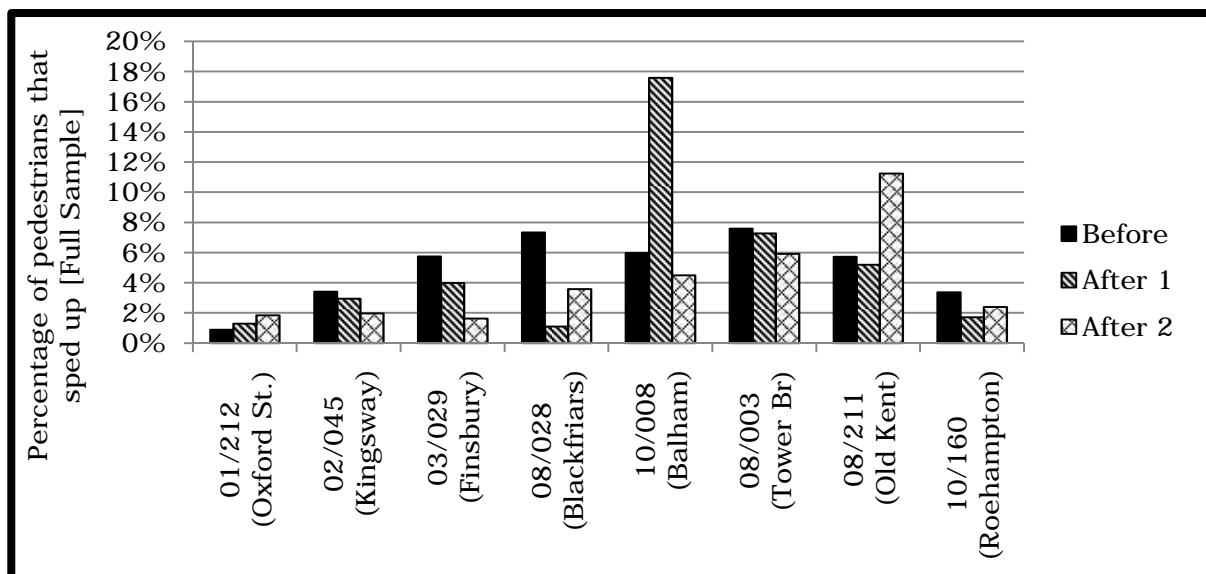


Figure 72 Percentage of pedestrians that increased their speed

Most pedestrians who sped up did so in the Red Man period.

On Balham (without a pedestrian island) a greater percentage of pedestrians increased their speed initially, but this was not evident once pedestrians had become accustomed to PCaTS.

On other sites there were no overall trends in percentage of pedestrians speeding up across the whole cycle, however, there was evidence that a greater percentage of pedestrians crossing in the Countdown increased their speed compared to those crossing in the Blackout period.

- In the 'After 2' survey, there was a significant increase (at the 95% Level) on Oxford Street (0.9% to 1.8%) and also (at the 90% Level) on Old Kent (5.7% to 11.2%). There were significant decreases (at the 95% Level) on three sites: Kingsway (3.4% to 2.0%); Finsbury (5.8% to 1.6%); and Blackfriars (7.3% to 3.6%).
- In the 'After 1' survey, there was a large significant increase on Balham (at the 95% Level) (6.0% to 17.6%) and also (at the 90% Level) on Oxford Street (0.9% to 1.3%). There were significant decreases (at the 95% Level) on Blackfriars (7.3% to 1.1%) and also on Finsbury (5.8% to 4.0%).

Balham was the only site without an island, which may explain the large increase in pedestrians who increased their speed in the 'After 1' survey possibly as pedestrians became accustomed to PCaTS and the time required to cross the road, as relatively fewer pedestrians sped up in the 'After 2' survey: i.e. it appears that the increase in pedestrians speeding up as they crossed the road was a short-term effect. The significant changes on the other sites were of a smaller magnitude compared to Balham. Figure 73 and Figure 74 show the breakdown by signal phase in which pedestrians started to cross.

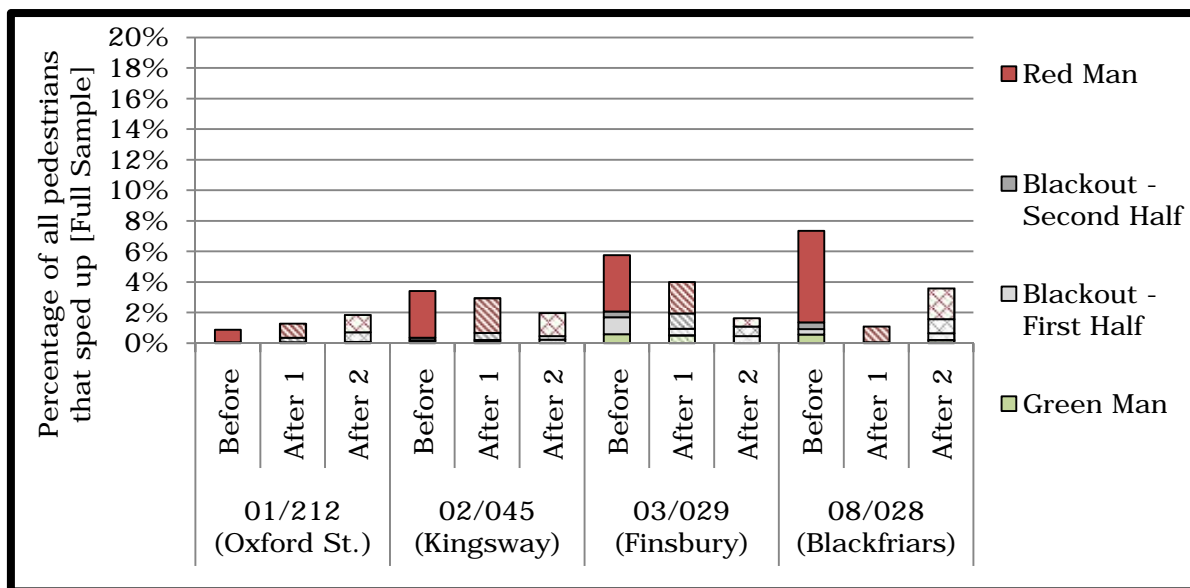


Figure 73 Percentage of pedestrians that increased their speed, by when they started crossing - Group 1

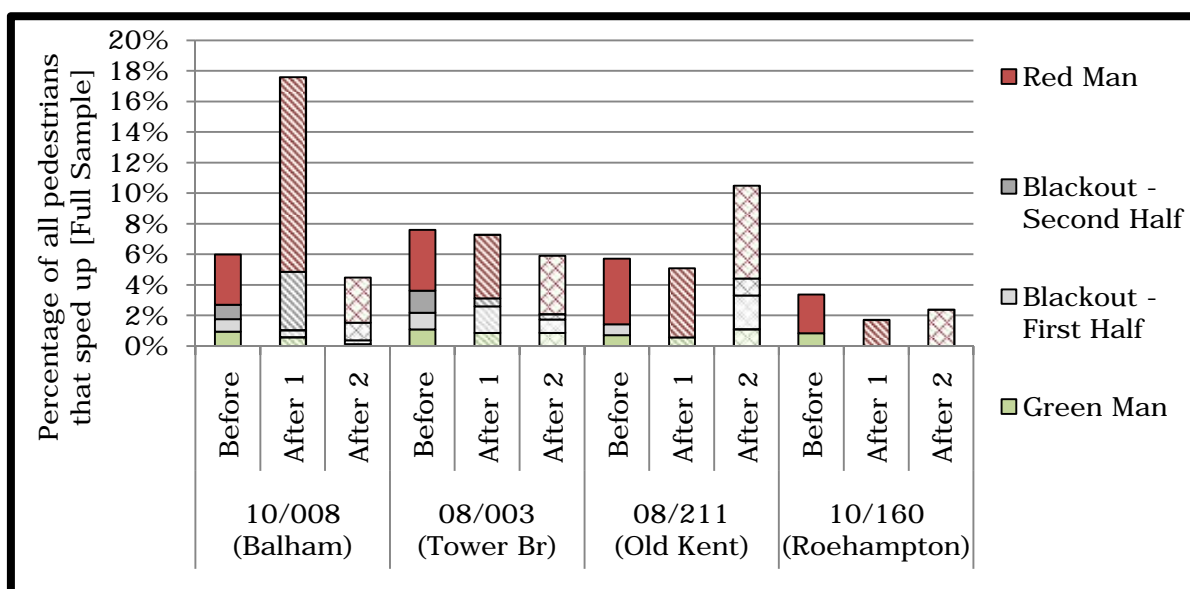


Figure 74 Percentage of pedestrians that increased their speed, by when they started crossing - Group 2

- Of the 17.6% of pedestrians that increased their speed in the 'After 1' survey on Balham, the majority started crossing in the Red Man phase (12.7% of all pedestrians). However there was also a significant increase that started crossing in the second half of the Blackout phase (3.8% of all pedestrians in the 'After 1' survey, compared to 0.9% in the 'Before'). It should be noted that the Blackout time increased by 75% on Balham from 8 seconds in the 'Before' survey to 14 seconds in the 'After 1' survey. However the increase in the second half of the Blackout is still of note, as it more than quadrupled.
- An increase the percentage of pedestrians speeding up during the Countdown compared to the Blackout was also evident on the other sites. On average the Blackout was 47% longer on these sites. However, whilst 7% of the pedestrians who sped up did so in the first half of the Blackout and 7% in the second half of Blackout, the percentages in the first and second half of the countdown were

12% and 21% respectively. So, the increases were greater than would be explained by the increased duration of the Countdown and imply that pedestrians used this extra information to speed up to cross the road.

Overall, this suggests that the introduction of PCaTS may have encouraged pedestrians to increase their speed during the Countdown period, but not increased the overall percentage of pedestrians speeding up at the crossing.

6.2.4 Overcrowding on Footway and Island

Overcrowding on the footway or island is when all pedestrians either using, or waiting to use, the crossing are unable stand in the area provided for them. On the footway this can result in other areas of the footway being used, or in the most severe cases it can result in pedestrians encroaching into the carriageway. Similarly, overcrowding on the pedestrian island can result can result in pedestrians standing on other areas of the central reservation, which may be hazardous, or encroaching into the carriageway. Therefore, although the measure of overcrowding used can include situations where pedestrians are spilling into the roadway, it also includes situations that may only be an inconvenience to pedestrians. It was therefore investigated whether PCaTS affected the level of overcrowding at the sites studied. This was investigated through a qualitative judgment made by the data analyst, in that they assessed whether the pedestrians waited on the island or footway without spilling outside the normal waiting area, however, more detailed methods involving exact pedestrian density measurements were not employed.

Figure 75 shows the percentage of signal cycles for which the footway was overcrowded. It may be expected that these results would be heavily related to the pedestrian flows in Section 6.1.2. For information, the average number of pedestrians per signal cycle is also included in Appendix C.

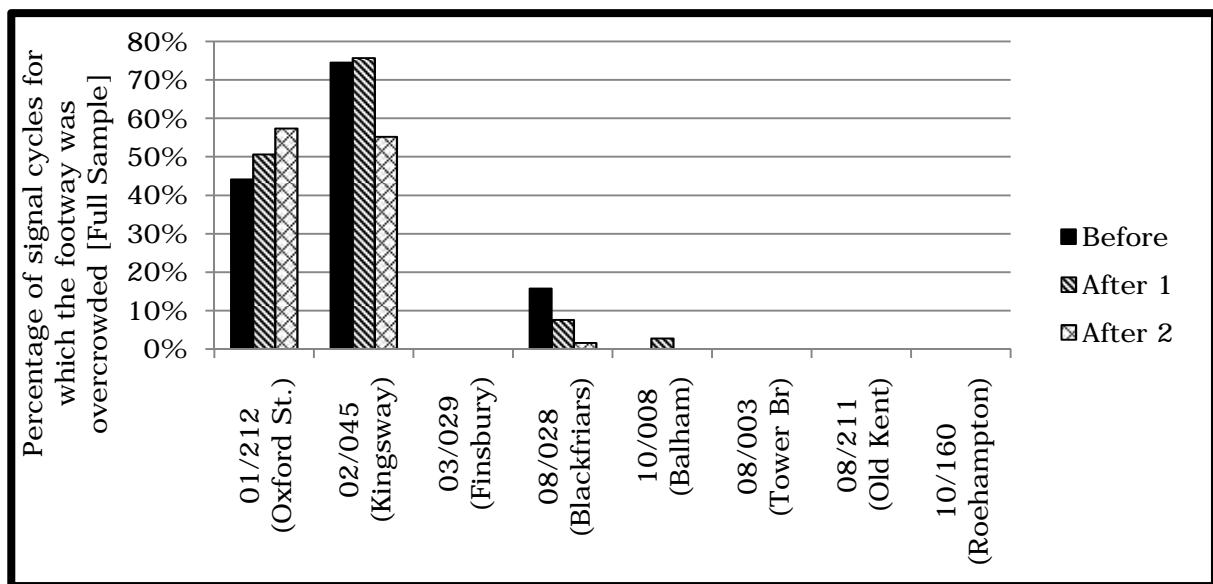


Figure 75 Percentage of signal cycles for which the footway was overcrowded

Any changes in overcrowding on the footways was generally explainable by pedestrian flows, or the removal of pedestrian guardrails on one site.

However, there was an 13% increase in overcrowding on the footway at Oxford Street that was not explainable by such changes nor by variations in weather, and could therefore be attributable the introduction of the PCaTS package.

- There was overcrowding on the footway, on 50-80% of all signal cycles on Kingsway, and on 40-60% of all signal cycles on Oxford Street across all surveys. Kingsway and Oxford Street had particularly high pedestrian flows and so this result is in line with expectation
- In the 'After 2' survey, there were significant changes (at the 95% Level) in overcrowding on the footway on three sites, with decreases on Kingsway (75% to 55%) and Blackfriars (16% to 2%), and an increase on Oxford Street (44% to 57%).
- In the 'After 1' survey, there was a significant decrease (at the 95% Level) in overcrowding on the footway on Blackfriars (16% to 8%), and a significant increase (at the 95% Level) on Balham (0% to 3%). There were no significant changes on Oxford Street or Kingsway in the 'After 1' survey.
- There was no overcrowding on the footway on the other sites.

The changes in the amount of overcrowding are, to some extent explainable by the changes in pedestrian flows. Between the 'Before' and the 'After 2' surveys the flows on Blackfriars decreased by 5% and those on Kingsway decreased by 12%. Furthermore, a pedestrian rail was present for the 'Before' and 'After 1' surveys, but this was removed for the 'After 2' survey, permitting pedestrians to utilise a greater area of the footway whilst waiting at the crossing.

The small, but significant, increase in overcrowding on the footway at Balham may be a result of a smaller proportion of pedestrians crossing during the Red Man phase compared to other sites, see Section 6.2.1.

However, on Oxford St pedestrian flows had decreased by 21%, while there was a 13% increase in overcrowding on the footway. Also, the Red Man time had generally decreased and the weather was fine in both the Before and After 2 surveys. So, as other potential confounding factors would not have increased overcrowding, the observed increase could therefore be attributable to the introduction of PCaTS and the associated changes in pedestrian signal times.

Figure 76 shows the percentage of signal cycles for which the island was overcrowded (i.e. whether there was no room to stand on the island), or congested (i.e. not overcrowded, but very busy on the island).

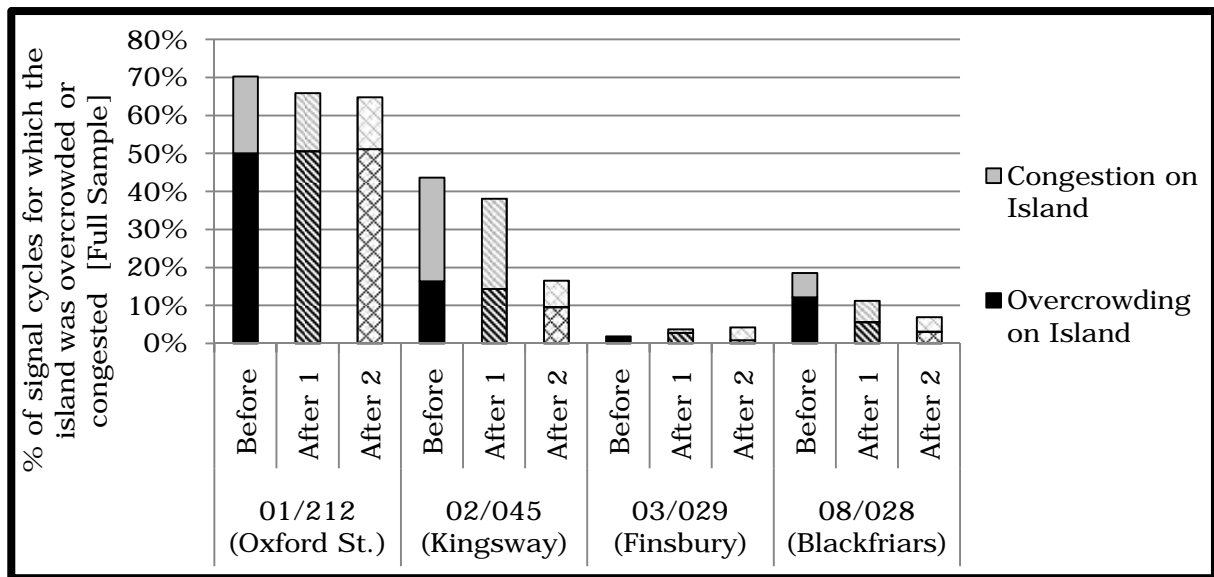


Figure 76 Percentage of signal cycles for which the island was overcrowded or congested

The high level of overcrowding on the highest pedestrian flows was not affected by the introduction of PCaTS, with the decrease on Kingsway probably resulting from the removal of the pedestrian guardrails on the site.

On the next highest flow site (Blackfriars), there was a small (9%) decrease in overcrowding on the island in the 'After 2' survey, but on the lower flow sites overcrowding was not an issue.

- The level of overcrowding and congestion on the island was zero for the four lower pedestrian flow sites
- On Oxford St, there were no significant changes in overcrowding or congestion on the island. Approximately 50% of all signal cycles were overcrowded and this was mainly after 13:00. As discussed in Section 6.1.2, there was a reduction in pedestrian flows on this site. However, this reduction in flows occurred after 14:00, by which point almost all signal cycles were already overcrowded (see Appendix C)
- On Kingsway, there were no significant changes in overcrowding on the island. However, in the 'After 2' survey there was a significant decrease (at the 95% Level) in congestion on the island from 27% to 7%
- On Blackfriars, there was a significant decrease (at the 90% Level) in overcrowding on the island in the 'After 1' survey from 12% to 6%. In the 'After 2' survey this trend went further, with a significant decrease (at the 95% Level) from 12% to 3%
- On Finsbury, the proportion of signal cycles for which there was overcrowding ranged from 1% to 3%, with no significant changes. In the 'After 2' survey, there was a significant increase (at the 90% Level) in congestion; however, this was a relatively small change, from 0% to 3%

On the highest flow sites (Oxford Street and Kingsway) there were high levels of overcrowding and congestion, and these were consistent through all surveys, except on

Kingsway. This anomaly was probably associated with the removal of a pedestrian rail between the 'After 1' and 'After 2' surveys, and was nothing to do with the introduction of PCaTS.

On the next highest pedestrian flow site, Blackfriars with approximately 100 pedestrians per hour, there was a decrease in overcrowding on the island. The proportion of pedestrians that waited at the island at Blackfriars decreased from 17% in the 'Before' survey to 12% in the 'After 2' survey, see Section 6.2.2. This may in part explain the decrease in overcrowding. The only other change was a weakly significant increase in the extent of overcrowding on Finsbury. Therefore, overall, PCaTS had little if any effect on the overcrowding of pedestrian islands.

6.2.5 Pedestrians who Crossed Elsewhere

Pedestrians crossing the road within the field of view of the cameras were partitioned into two separate groups:

1. Pedestrians who started to cross the road within the crossing area
2. Pedestrians who started or completed their crossing elsewhere (i.e. not on the crossing)- this includes a wide range of crossing lines, from those crossing mostly within the crossing but come off it before reaching the kerb, to those crossing up to 20m away from it, depending on the field of view of the video.

As discussed in Section 2, the first group were used for the main analysis in the Full Sample and the Detailed Sample. The second group are discussed here in Section 6.2.5.

Figure 77 shows the percentage of pedestrians who crossed elsewhere and Figure 78 shows the average number of pedestrians per hour who crossed elsewhere. As discussed in Section 6.1.2, due to the large range of flows across the sites, it is necessary to consider both the percentage and number of pedestrians.

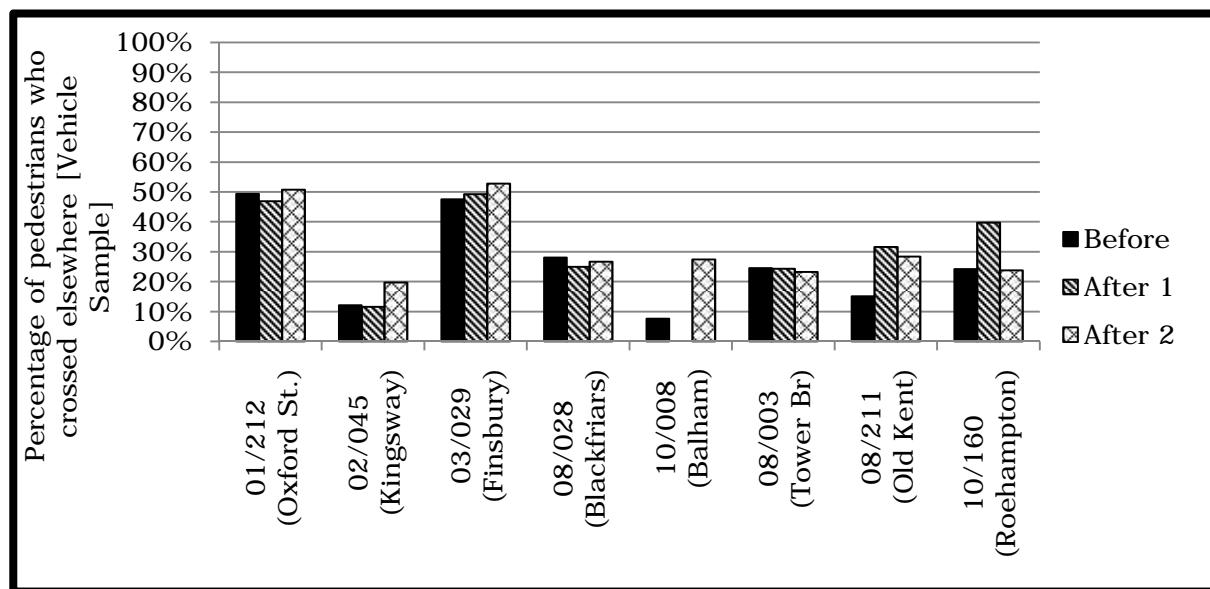


Figure 77 Percentage of pedestrians who crossed elsewhere

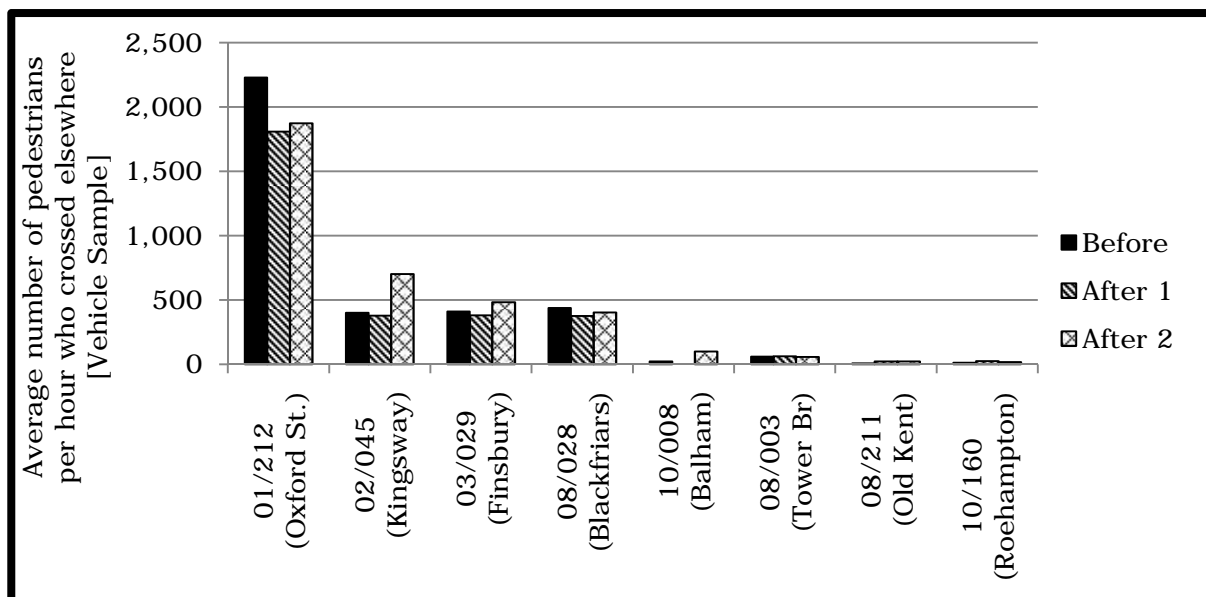


Figure 78 Average number of pedestrians per hour who crossed elsewhere

PCaTS had no discernable effect on the percentage of pedestrians crossing elsewhere on the highest flow sites (Oxford Street and Kingsway).

There was a small and significant increase (5%) on Finsbury, and an increase on Balham (the only site without a pedestrian island) after the scheme had settled in.

On the low flow sites, changes were only indicative, but the significant changes imply there may have been an increase in crossing elsewhere after the introduction of PCaTS on some of these sites.

Most pedestrians crossing elsewhere did so whilst the vehicle traffic signals were red and it appears that the schemes introduction did increase the percentage of pedestrians starting to cross whilst not on the crossing during this time.

- The site with the highest number of pedestrians who crossed elsewhere was Oxford Street. This is probably owing to it having high pedestrian flows.
- On Kingsway in the 'After 2' survey, there was a significant increase in the proportion of pedestrians who crossed elsewhere from 12% to 20%. This was almost certainly owing to the removal of a pedestrian railing between the 'After 1' and 'After 2' surveys, and any effects of PCaTS have been confounded by this change.
- In the 'After 2' survey, there were significant increases (at the 95% Level) on Balham (8% to 27%) and Finsbury (48% to 53%), and also (at the 90% Level) on Old Kent (15% to 28%)
- In the 'After 1' survey, there were significant decreases (at the 95% Level) on Oxford Street (49% to 47%) and Balham (8% to 0%), and also (at the 90% Level) on Blackfriars (28% to 25%).
- In the 'After 1' survey, there were also significant increases (at the 95% Level) on Old Kent (15% to 32%), and also (at the 90% Level) on Roehampton (24% to 40%)

Overall, on the high flow sites, PCaTS had little effect on the percentage of pedestrians crossing elsewhere, with the only significant change after a settling in period ('After 2' surveys) being a 5% increase.

The low numbers of pedestrians on Old Kent and Roehampton, makes trends on these sites only indicative. Therefore, overall, it appears that crossing elsewhere may have increased slightly on some of the lower flow sites. The largest increase occurring on the one site (Balham) without a pedestrian island.

Figure 79 and Figure 80 show the breakdown of whether the pedestrians who started crossing elsewhere did so when the vehicle traffic signal was red or green. The number of people who started crossing within the area are also included.

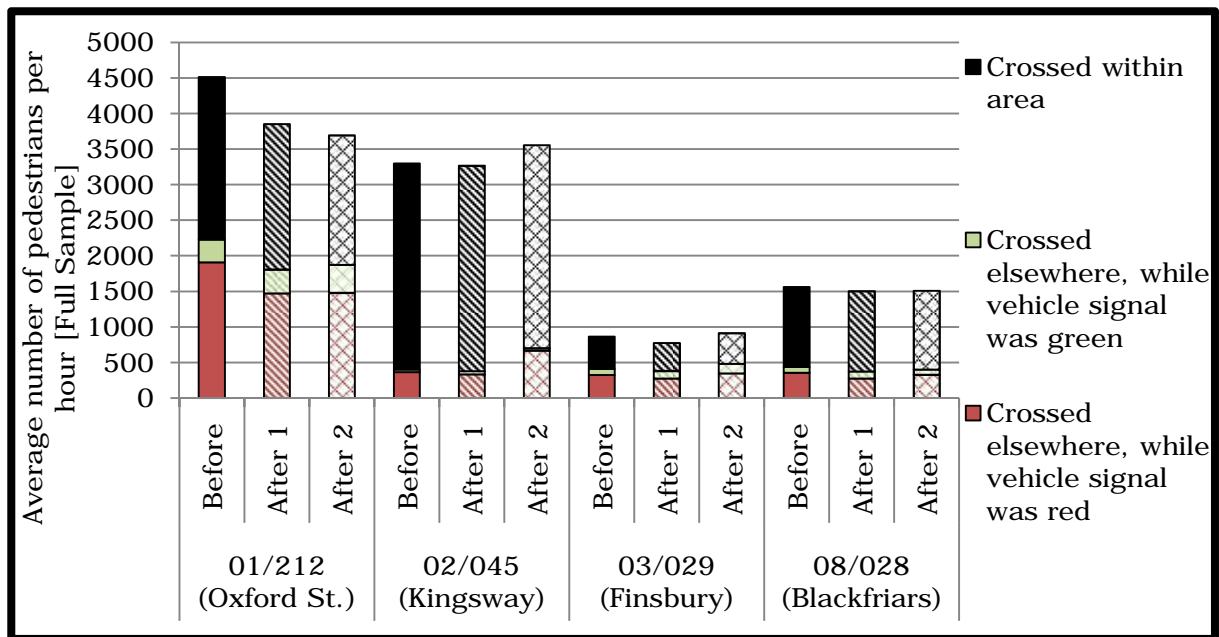


Figure 79 Average number of pedestrians per hour who crossed within the area or crossed elsewhere - Group 1

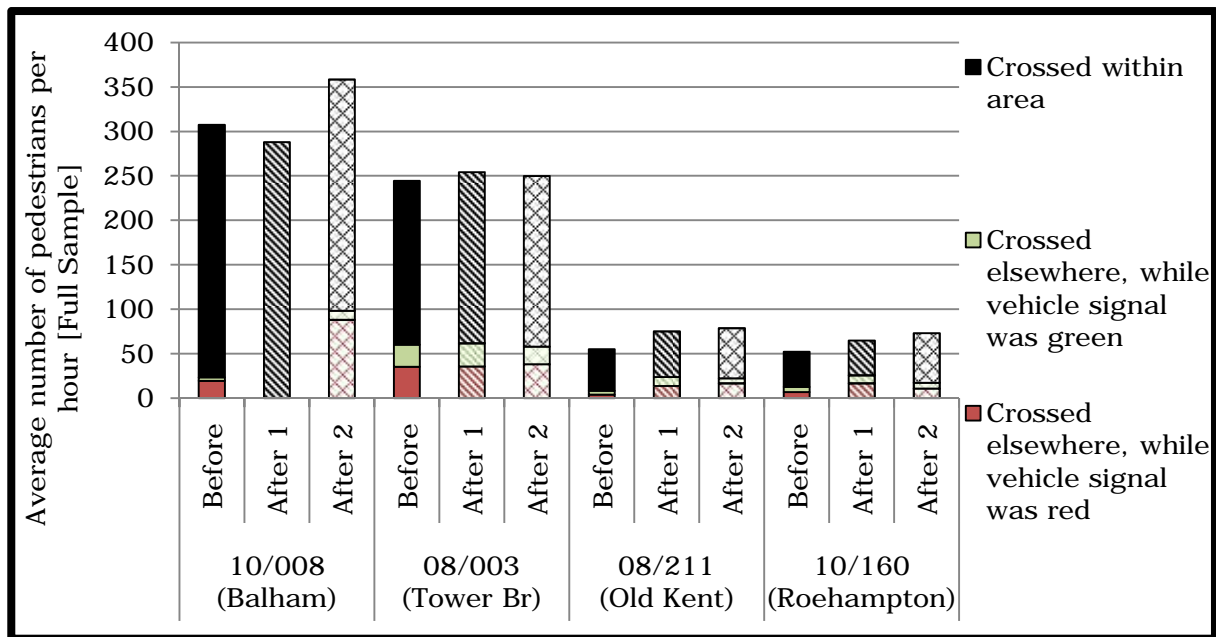


Figure 80 Average number of pedestrians per hour who crossed within the area or crossed elsewhere - Group 2

The majority of pedestrians who crossed elsewhere did so while the vehicle traffic signal on the arm surveyed was red (70%). In other words, this was either during the Green Man, Blackout or All Red phases, or when the vehicle traffic signal on the adjacent arm was green.

It is also during this time that there was an increase in pedestrians crossing on the lower pedestrian flow sites: the percentage crossing elsewhere whilst the vehicle signals were red increased from 63% in the 'Before' to 78% in the 'After 2' surveys. Although it is not possible to isolate the exact change in pedestrian behaviour that resulted in this, it would appear possible that the extra information provided by PCaTS, or the re-timings associated with it, resulted in more pedestrians starting to cross whilst not on the crossing.

6.2.6 Green Time Available and Distribution

The Green Man time available for pedestrians and its distribution provides an insight into the priority provided for pedestrians. However, it will also be affected by the number of calls made by pedestrians and therefore the pedestrian flow on the site. Figure 81 shows the average number of Green Man phases per hour.

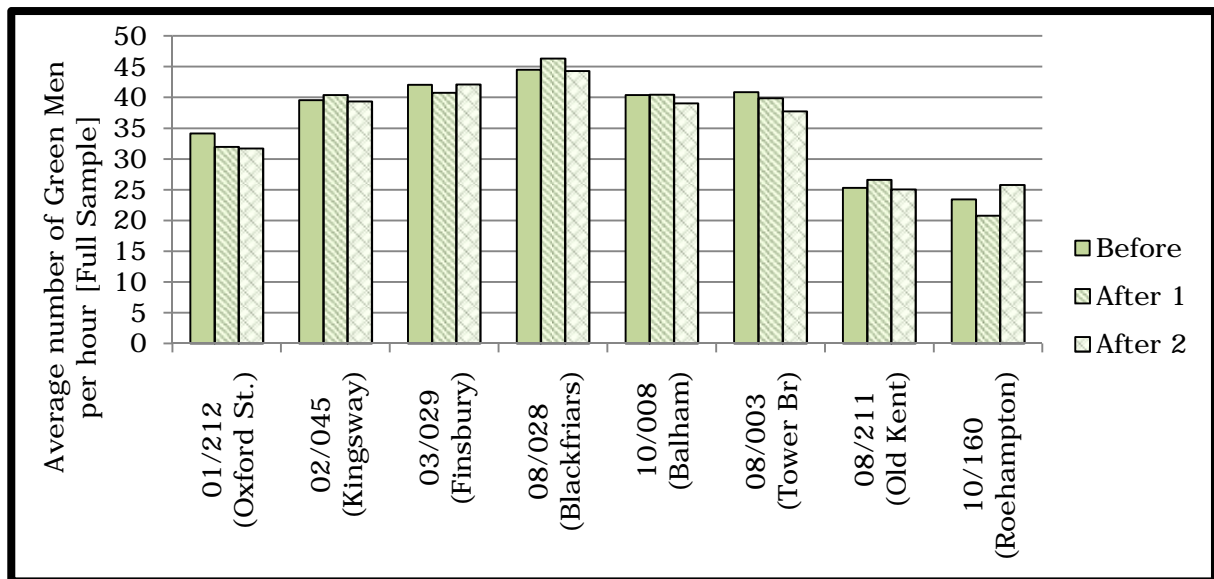


Figure 81 Average number of pedestrian phases per hour

The number of pedestrian phases (Green Mans) per hour varied between 20 (Roehampton) and 45 (Blackfriars).

The number of pedestrian phases were affected by pedestrian flows on individual sites (or requests to cross) and the cycle time at the junction.

The number of pedestrian phases did not alter greatly between the surveys, although the percentage of Green Man time was reduced in the 'After' surveys.

- Blackfriars had more pedestrian phases per hour than any other site. This was because the average cycle time at Blackfriars was 85 seconds in both the 'Before' and 'After' surveys, whereas the cycle time was over 90 seconds on all other sites
- Old Kent and Roehampton had the fewest pedestrian phases per hour owing to the low pedestrian flows and fewer pedestrian requests on these sites.
- The number of pedestrian phases per hour was lower on Oxford Street compared to the other sites with high pedestrian flows. This was because the junction's cycle time was longer, being 118 seconds in both the 'Before' and 'After' surveys.
- There were approximately 40 pedestrian phases per hour on the other four sites

The duration of the signal cycles (Section 6.1.3) didn't change, but the length of different phases did change. Therefore, as long as pedestrian flows were similar in both surveys, it would be expected that the number of pedestrian phases per hour would also remain comparable.

Figure 82 and Figure 83 show the percentage of Green Man time per hour, which includes the Red Man time for which there were no pedestrian requests.

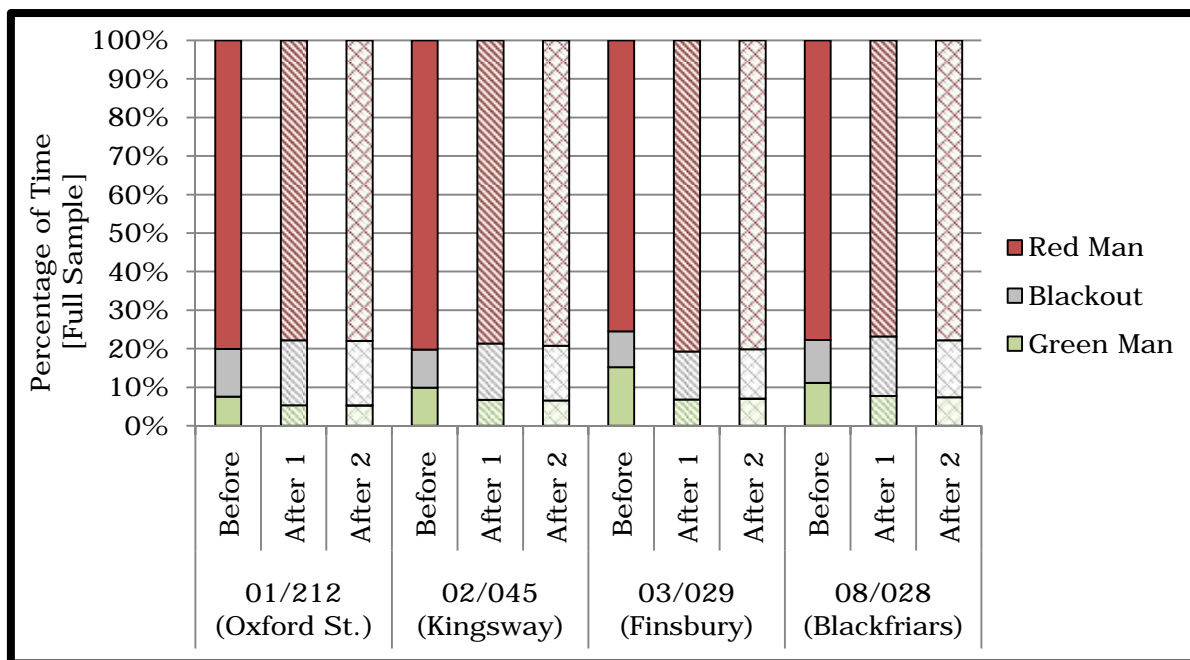


Figure 82 Percentage of time in each phase - Group 1

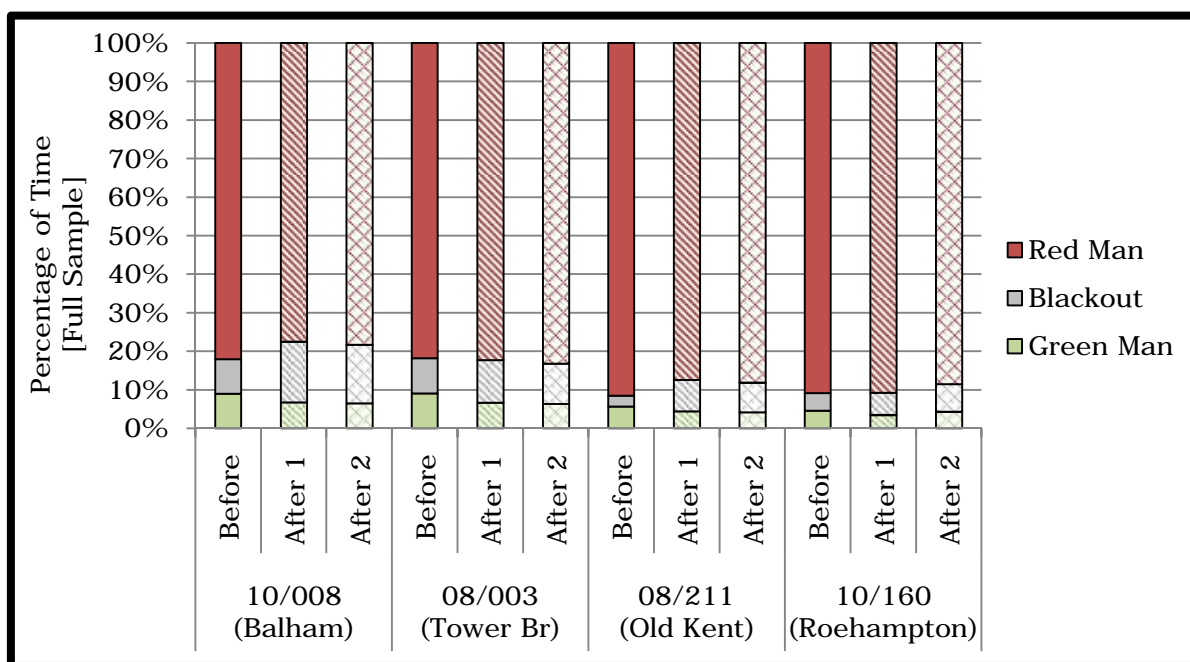


Figure 83 Percentage of time in each phase - Group 2

- On all sites, there was a reduction in the proportion of time that was Green Man. This was mainly because all Green Man times were reduced to 6 seconds, (as discussed in Section 6.1.3), while the number of pedestrian phases per hour didn't change.
- The proportions are similar (See Appendix C), which suggests that all the crossings were almost permanently in use (i.e. the pedestrian phase was constantly requested) on all sites, with the exception of Old Kent and Roehampton.

6.2.7 Walking Speed

Two measures of walking speed were taken. The first was a subjective measure of whether the pedestrians increased their speed (see Section 6.2.3). The other measured the walking speed of a sample of the pedestrians, and this is discussed in this section.

Figure 84 and Figure 85 show the average walking speed in metres per second. This is from the Detailed Sample, where the crossing time was recorded for up to 720 pedestrians in each site and survey. Specifically, any time spent on the island has been removed. The red line represents the 15th percentile for each survey; in other words, 85% of pedestrians were faster than this for that survey. The 1.2 m/s mark is highlighted, because a typical assumption is that usually more than 85% of the population walk faster than 1.2 m/s.

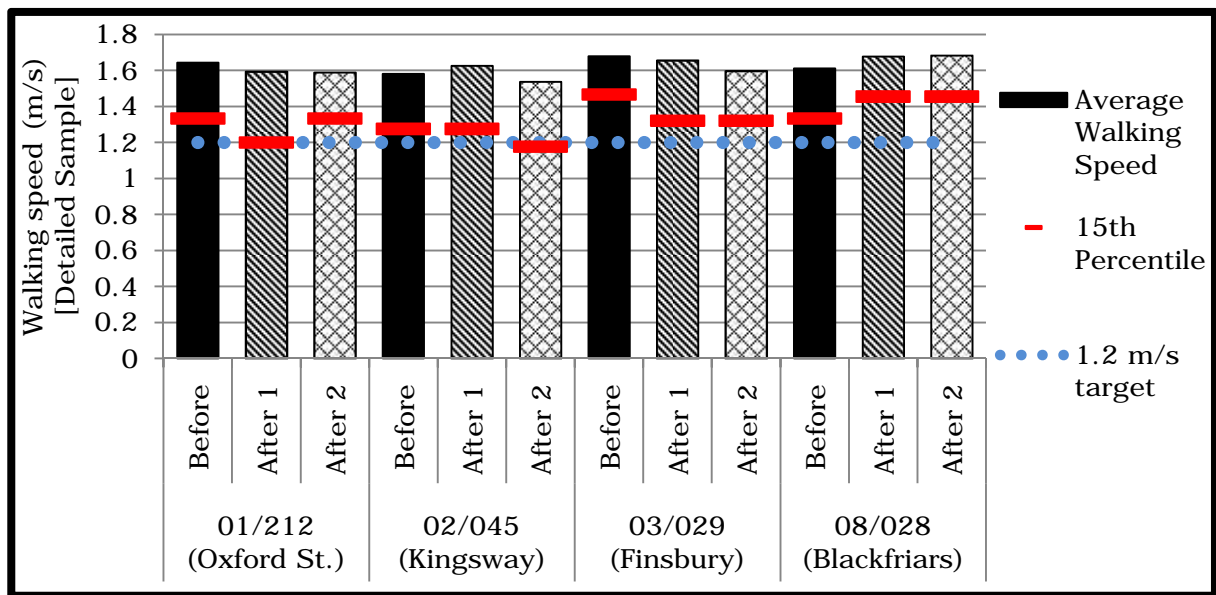


Figure 84 Average walking speed (m/s), with 15th Percentile - Group 1

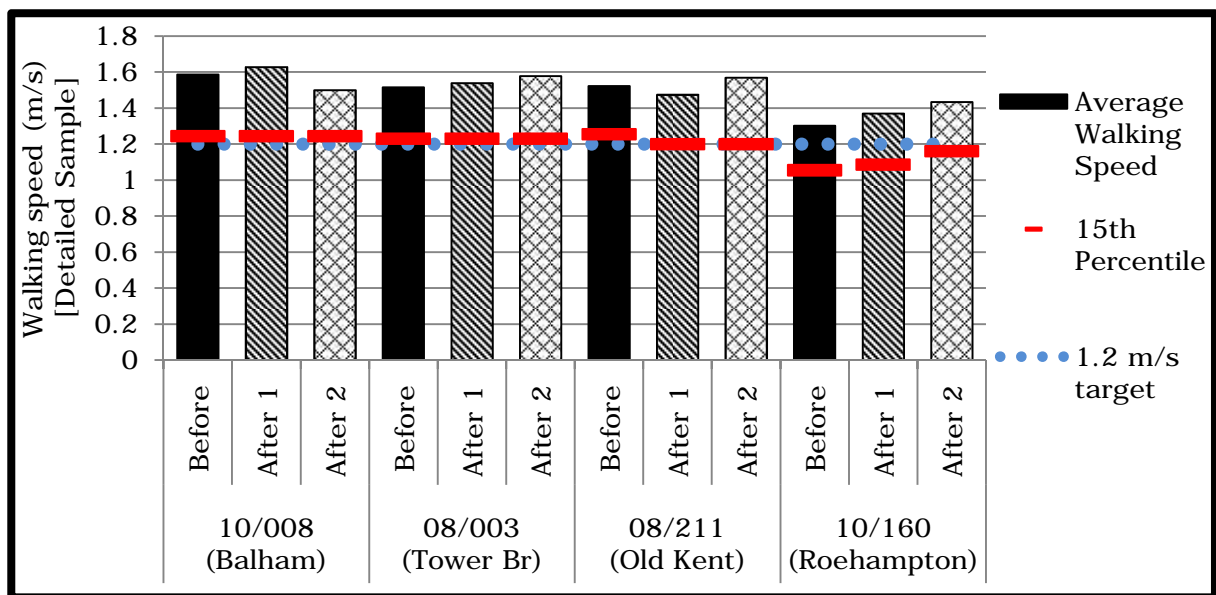


Figure 85 Average walking speed (m/s), with 15th Percentile - Group 2

The highest average walking speeds (approx 1.6m/s) were generally associated with the highest pedestrian flow sites, and the lowest average was on Roehampton which was near a hospital.

In the 'After 2' surveys there were increases at three, and decreases at four, sites.

Some of the average walking speed changes could potentially be accounted for by variations in the age and gender profiles of pedestrians on the sites.

The remaining changes in walking speeds were increases. Therefore, it does appear that PCaTS did increase average walking speed on some sites.

- The sites with highest average walking speeds of approximately 1.6 m/s were Oxford St, Kingsway, Finsbury, Blackfriars and Balham
- The site with the lowest average walking speed was Roehampton
- The 15th percentile speed was slightly higher than the typical value of 1.2 m/s in all surveys, with the exception of Roehampton
- In the 'After 2' survey compared to the 'Before' survey
 - There were significant increases (at the 95% Level) in average walking speed on three sites: Blackfriars, Tower Bridge and Roehampton. Of these sites, the 15th percentile increased on Blackfriars and Roehampton
 - There were significant decreases (at the 95% Level) in average walking speed on four sites: Oxford St, Kingsway, Finsbury and Balham. There were also decreases in the 15th percentile on Kingsway and Finsbury
- In the 'After 1' survey:
 - There were significant increases (at the 95% Level) in average walking speed on Blackfriars and Kingsway. There was also a notable increase in the 15th percentile speed on Blackfriars
 - There was a significant decrease (at the 95% Level) in average walking speed, as well as an associated decrease in the 15th percentile on Oxford St. Due to the diagonal crossing, this site had the longest Countdown period of all the sites (19 seconds). This combined with the small crossing width may in part explain the decrease in walking speed on this site
 - There was a decrease in the 15th percentile speed on Finsbury, but the change in average walking speed was not significant

The increase in speed on Blackfriars in both the 'After 1' and 'After 2' surveys was statistically significant. The frequency distribution of walking speed for Blackfriars is shown in Figure 86 in order to understand this trend further. The frequency distribution of walking speed for Oxford St, Kingsway and Finsbury are included in Appendix C.

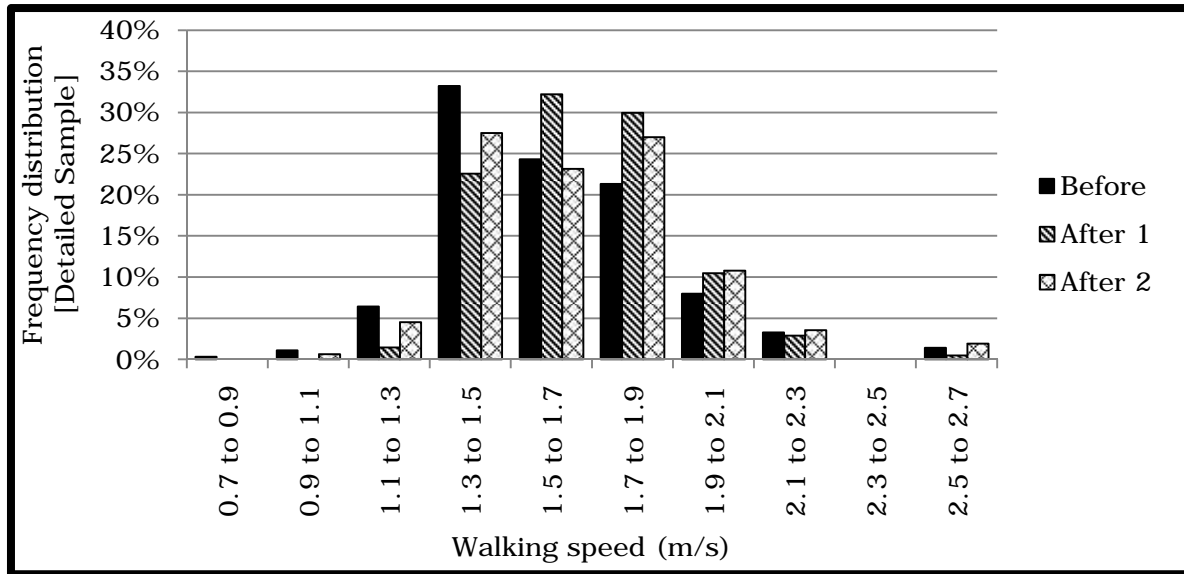


Figure 86 Frequency distribution of walking speed (m/s) at Blackfriars

- On Blackfriars, the proportion of pedestrians walking faster than 1.5 m/s increased from 59% in the 'Before' survey to 76% in the 'After 1' survey and 67% in the 'After 2' survey

The consequences of this are that the introduction of PCaTS and the signal timing modifications appear to have resulted in faster walking speeds, at some sites, and slower walking speeds at other sites.

It is possible that the changes in walking speed could be explained by changes in the gender and age of the samples. Figure 87 shows the average walking speed in metres per second, broken down by gender.

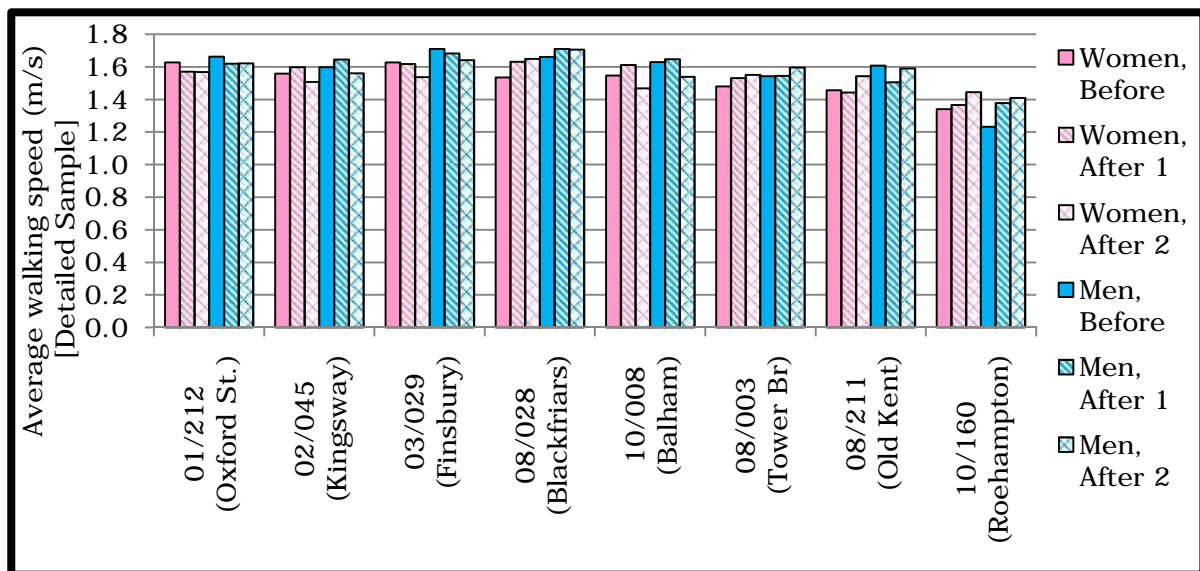


Figure 87 Average walking speed (m/s), by gender

- Men had a higher walking speed than women on all sites and surveys, with the exception of Roehampton

Section 6.1.1 showed that there were significant increases in the proportion of pedestrians that were women on Oxford Street and Balham in the 'After 2', and on

Finsbury in both the 'After 1' and 'After 2'. There was also a significant decrease in women on Old Kent in the 'After 2'.

Figure 88 and Figure 89 show the average walking speed in metres per second, broken down by the three age groups: Under 30; 30 to 60; Over 60 years old.

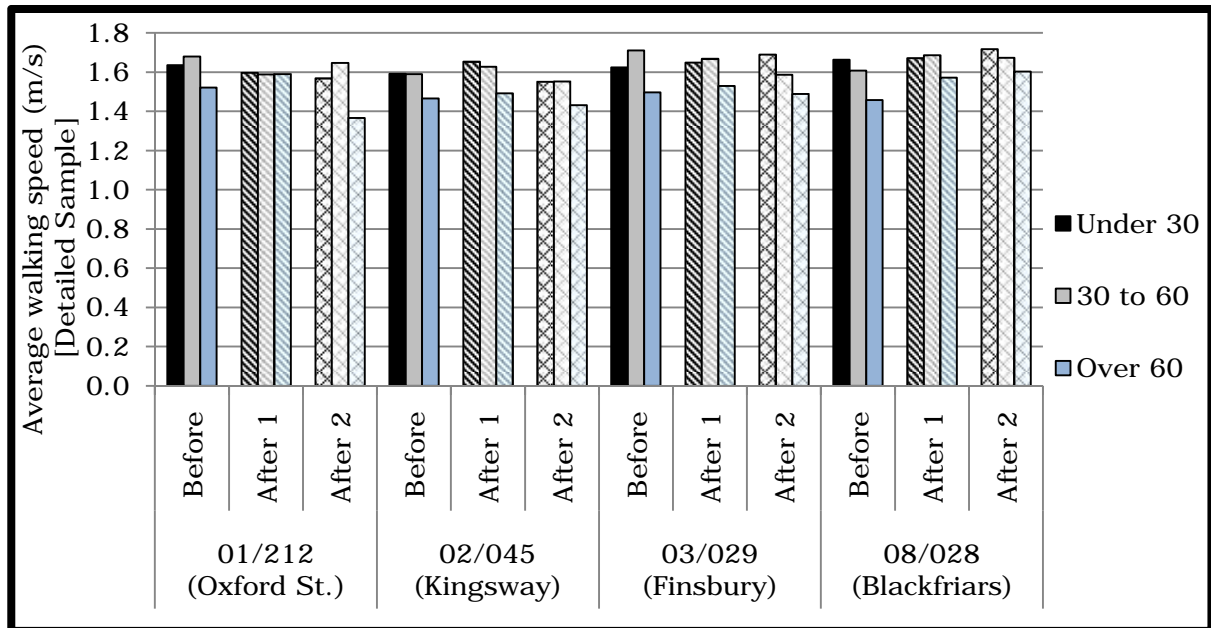


Figure 88 Average walking speed (m/s), by age - Group 1

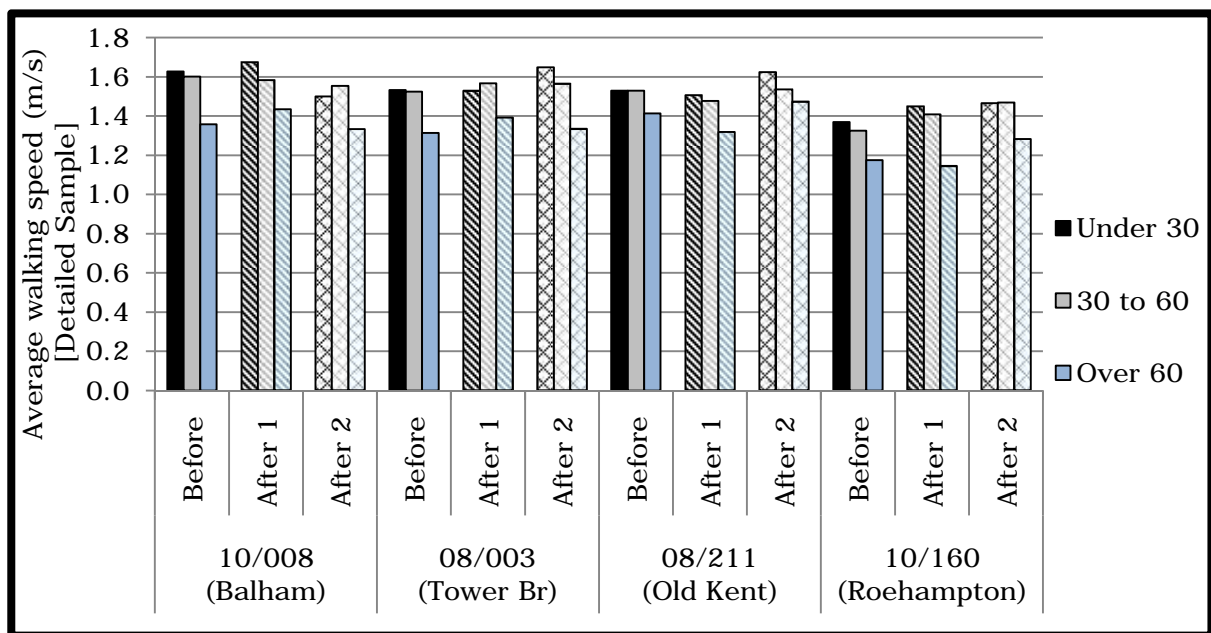


Figure 89 Average walking speed (m/s), by age - Group 2

- Pedestrians aged over 60 had the slowest walking speed of the three age categories on all sites and surveys
- There was only marginal difference in walking speed (approximately less than 0.1 m/s) between those pedestrians aged under 30 and those aged 30 to 60

On Roehampton over 20% of pedestrians were over 60 (Section 6.1.1), whereas the proportion was lower elsewhere. This may explain why the average walking speed at

Roehampton was lower than the other sites and the 15th percentile was below the 1.2 m/s threshold

Also, in the 'After 2' surveys there were significant increases in the proportion of pedestrians that were aged over 60 on Kingsway, Blackfriars and Tower Br, and a significant decrease on Oxford Street (Section 6.1.1).

There was also a significant increase in the proportion of pedestrians aged under 30, and a complementary significant decrease in the proportion of pedestrians aged 30 to 60 on several sites. However, the graphs above suggest that this change would be unlikely to influence the overall walking speed, because the average walking speed of these two age groups is very similar.

In summary contributing factors to observed changes in walking speed could be explained by, or partially explained by:

- Kingsway, 'After 2' - the increase in women over 60s
- Finsbury, 'After 2' –the increase in women
- Balham, 'After 2' – the increase in women

Whilst combined changes resulted in no conclusive reasons for:

- Oxford St, 'After 2' – as there was an increase in women and also a decrease in over 60s
- With the exception of the above, it doesn't appear that the remaining significant changes in walking speed were as a result of changes in age or gender, and so the increase in walking speed are more likely to be a result of the introduction of PCaTS on these sites:
 - In the 'After 2' survey, there were significant increases (at the 95% Level) in average walking speed on Blackfriars (1.61 to 1.68 m/s), Tower Bridge (1.51 to 1.58 m/s) and Roehampton (1.30 to 1.43 m/s)
 - In the 'After 1' survey, there were significant increases (at the 95% Level) in average walking speed on Blackfriars (1.61 to 1.68 m/s) and Kingsway (1.58 to 1.62 m/s) and there was a significant decrease (at the 95% Level) on Oxford Street (1.64 to 1.59 m/s)

Overall, this suggests that PCaTS has resulted in increased walking speeds on three sites in the 'After 2' survey (Blackfriars, Tower Bridge and Roehampton) and on two sites in the 'After 1' survey (Blackfriars, Kingsway). The decrease on Oxford Street in the 'After 1' survey may have been due to the signal timing changes, rather than PCaTS: as the Countdown duration was 19 seconds (to allow for the diagonal crossing), whilst it had a narrow crossing width. Also, walking speeds on Kingsway (increased in the 'After 1' survey and decreased in the 'After 2' survey) may have been affected by the removal of the pedestrian guardrails.

On other sites, the increased walking speeds do not appear to be associated with people speeding up whilst crossing, instead it appears they have altered their overall speed.

6.2.8 Delay

One measure of the effect of the introduction of the PCaTS package is delay to pedestrians. However, any observed changes need to be put into the context of the modifications to the signal timings. As discussed in Section 6.1.3, three sites had extra priority for pedestrians (Oxford St., Balham, Old Kent) and only one site had less priority for pedestrians (Finsbury).

Pedestrian delay will be affected by how pedestrians use the crossing. Some pedestrians cross as soon as they judge there is a suitable gap in the traffic regardless of the signal phase, and other pedestrians choose to wait until the start of the Green Man phase. The

analysis suggested that a majority of pedestrians fell into the first category, with over 50% crossing within 5 seconds of arrival.

Figure 90 shows the average wait time for pedestrians arriving at the crossing across all phases, from the Detailed Sample of up to 720 pedestrians per site and survey. For each pedestrian in the Detailed Sample, the delay was calculated by computing the difference between when they arrived at the crossing and when they started crossing.

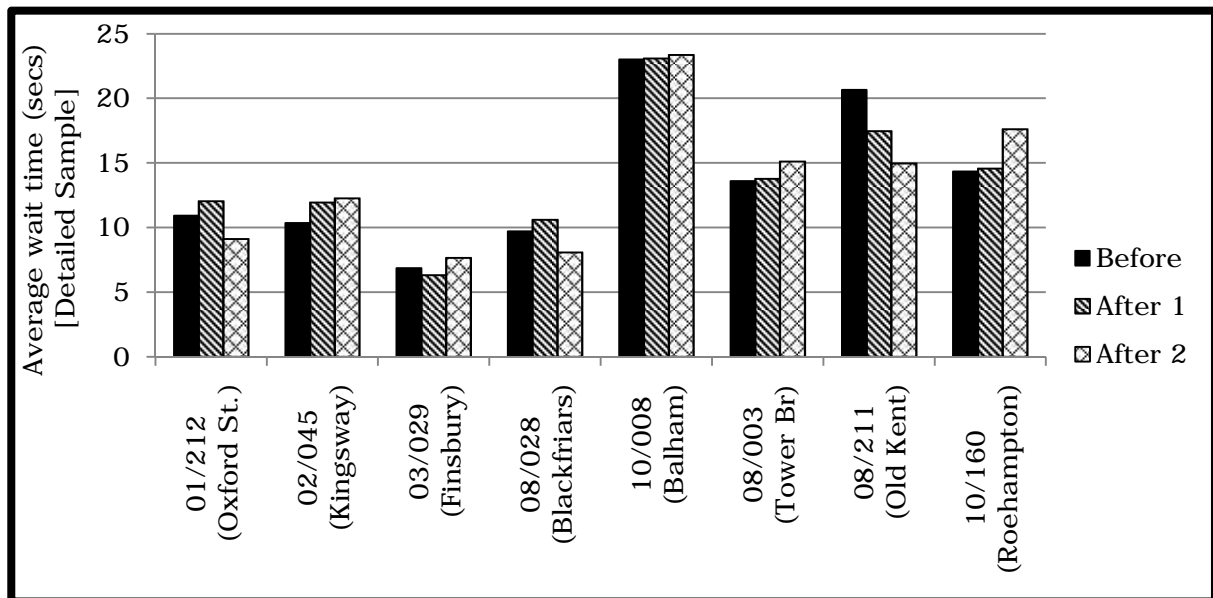


Figure 90 Average wait time (seconds) for pedestrians arriving at crossing

Average pedestrian delay varied between 6 and 23 seconds across the sites.

Once the schemes had settled in, any changes in average delay appeared to be correlated to changes in signal timings.

First person wait times (i.e. the first person to stop after the Red Man appears) increased on most sites in the 'After' surveys. These were partially explainable by the changes in signal times, but also seemed to be affected by the fact that pedestrians were less likely to start to cross after the end of the pedestrian phase with PCaTS, which will increase the first person delay.

- Finsbury had the lowest average delay of all the sites, with just over 5 seconds delay in all surveys
- Balham had the highest average delay of approximately 23 seconds in all surveys. As shown in Section 6.2.1, a smaller proportion of pedestrians crossed in the Red Man phase compared to other sites, most likely because it was the only site without an island
- In the 'After 2' survey, there appeared to be an increase in average pedestrian delay on Kingsway, Finsbury and Tower Br, and a decrease on Oxford Street and Blackfriars
- In the 'After 1' survey, there appeared to be a small increase in average pedestrian delay on Oxford St, Kingsway and Blackfriars
- The results for Old Kent and Roehampton should be treated with caution due to the small sample sizes

The changes in signal timings in isolation would imply an increase in pedestrian delay on Finsbury and a decrease in pedestrian delay on Oxford St., Balham and Old Kent. In the 'After 2' survey, once the schemes had settled in to a greater extent, this did occur on all these sites except Balham, and therefore it is potentially a contributing factor to the changes in delay.

The increase in average delay on Kingsway in both the 'After' surveys is investigated further in Figure 91 which shows the frequency distribution of wait times in the 'Before' and 'After' surveys for Kingsway.

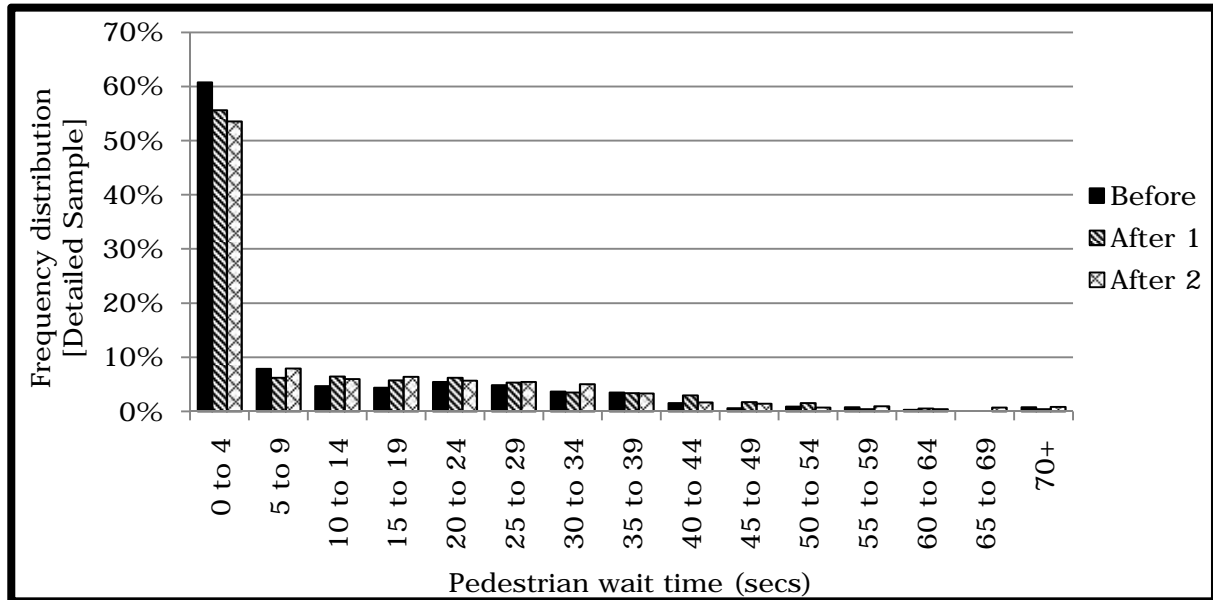


Figure 91 Frequency distribution of the wait time (seconds) for pedestrians arriving at crossing at Kingsway

- The modal average (the group with the largest number of observations) is the 0 to 4 seconds group. However, the average is 10 seconds in the 'Before' and 12 seconds in the 'After 1' survey
- There was a decrease in the proportion of pedestrians in the 0-4 and 5-9 seconds groups, and an increase in the proportion of pedestrians in most of the other groups with higher times

There was only a negligible increase in the Red Man timings on Kingsway (1 second per signal cycle). Overall, this suggests that on Kingsway a larger proportion of pedestrians waited for longer times.

An alternative measure of delay is the wait time of the first person to arrive at the crossing. The time was recorded that the first person who arrived in the Red Man phase then started waiting. This was then compared with the start time of the next Green Man phase. This was recorded in the Full Sample⁸. It was not possible to pool this data across sites, because it was dependent on the different signal timings. Figure 92 shows the average of this "first person wait time" for all sites and surveys.

⁸ This measure was recorded for approximately 150 to 200 signal cycles for all sites, with the exception of Old Kent and Roehampton, where there were only approximately 20 to 40 observations.

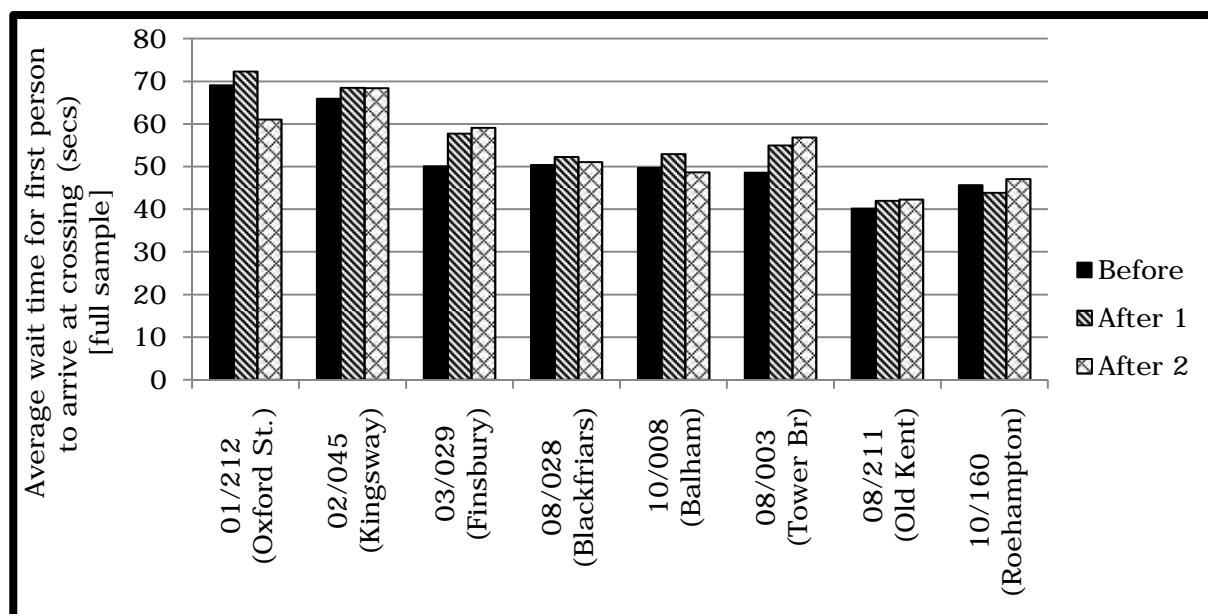


Figure 92 Average wait time for first person to arrive at crossing (seconds)

Delay changes experienced by pedestrians, measured as 'first person wait times' initially appear variable. At four of the sites the changes were too small to be statistically different. At the four sites where statistically significant changes in delay did occur, the delay had increased at three of these sites and reduced at one. The largest increase in delay was 9 seconds at Finsbury, the site that experienced the largest change in pedestrian green time.

There was an increase in Red Man time of 4 seconds all-day on Finsbury and also an 8-second increase on Tower Bridge for 10:00-16:00. There was also a 3-second decrease in Red Man time on Oxford St, a 4-second decrease on Balham, a 5-second decrease on Old Kent, and a negligible change in Red Man time on the other three sites. These signal timing changes partially explain some of the changes in average first person wait time.

Not all changes are explained by the signal time changes. Another influencing factor is the time that the first person stops after the end of the pedestrian phase. Pedestrians were less likely to decide to cross at the end of the pedestrian phase with PCaTS. Therefore the first person to stop (on average) did so earlier and experienced a longer delay at the crossing.

6.2.9 Unused Pedestrian Green Time

It is of interest from the point of view of the efficiency of the junction as to how much cycle time was wasted as Green Man time, when not in use by pedestrians. This has been calculated as the sum of the Green Man time: before the first pedestrians started to cross; after the final person has finished crossing; and for which no pedestrians crossed.

Figure 93 shows the percentage of Green Man time that was unused for all sites and surveys.

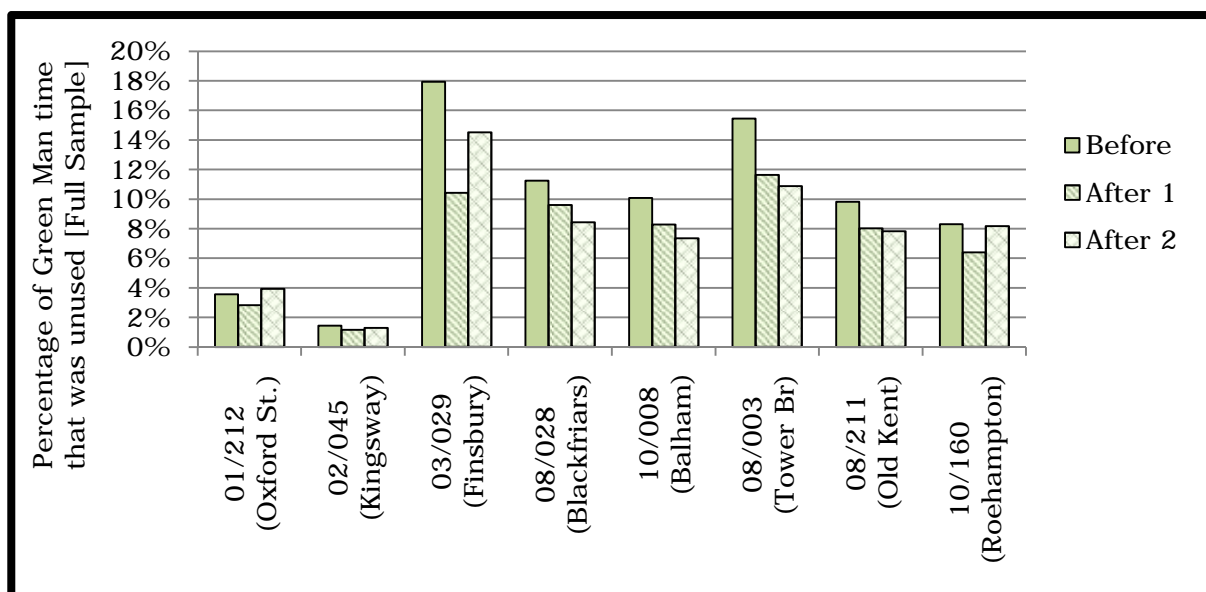


Figure 93 Percentage of Green Man time that was unused

The proportion of Green Man time unused was always low on the very high flow sites (less than 4%) and varied between 6 and 18% on the other sites.

There were decreases in the percentage of unused Green Man time in the 'After' surveys on all sites which will be (at least partially) related to the decrease in the duration of the Green Man on the sites.

- For most sites the proportion of Green Man time that was unused was approximately 10%
- The site with the lowest proportion of Green Man time that was unused was Kingsway, at approximately 1%
- There were decreases in the proportion of unused Green Man time in the 'After' surveys compared to the 'Before' survey on all sites. However, as discussed in Section 6.1.3, the fixed Green Man signal timings ranged from 7 to 13 seconds in the 'Before' survey and were all reduced to 6 seconds in the 'After' surveys. This may in part explain the decrease in unused Green Man time, although it may also be affected by pedestrian crossing behaviour with PCaTS

Because of the signal timing modifications, no conclusions can be drawn on the effect of PCaTS on unused Green Man time.

6.3 Effects of PCaTS on Pedestrian Behaviour (Mobility Impaired Participants and Child Accompanied Walks)

Sections 6.1 and 6.2 analysed pedestrian behaviour, based on three hours of video data from 07:00 to 19:00 in both the 'Before' and 'After 1' surveys. Section 6.3 analyses the pedestrian behaviour of the mobility impaired participants and children, taken from observations during the accompanied walks. Section 4 also contained analysis on the mobility impaired participants and children, but this was only the results of the questionnaire.

In the main surveys, pedestrians were observed when they crossed the road in relation to when they arrived at the crossing, and therefore according to the information that was displayed: e.g. Red Man, Green Man or Countdown. Observing a cross-section of the population with the Standard Crossing and with PCaTS provided an insight into how pedestrians' crossing behaviour was affected by the PCaTS (Countdown) display.

The effect on child and mobility impaired pedestrians was particularly sought owing to the relatively small numbers that could be observed using crossings, and also the potentially diverse interpretations these population sub-groups could have of the PCaTS information.

A separate survey was conducted to focus on these sub-groups' use of pedestrian crossings at junctions. The children were allocated to one of three groups of 9 children and the mobility impaired participants into one of 9 groups of two participants. Each child participant crossed the road using a Standard Crossing four times, and PCaTS four times. The mobility impaired participants performed half the number of crossings. The difference between each time they crossed was the simulated time of arrival at the crossing, simulated by asking participants to look at the appropriate time. They always saw the Green Man, i.e. "arrived" at the crossing during the invitation to cross period, but the time before the end of the Green Man varied from 2 to 10 seconds.

The decision to cross the road and whether they waited at the traffic island was recorded. It should be noted that there are two ways to explore this decision. Those using the crossing for the first time would be expected to base their decision on where they are at the end of the Green Man, however, after using the crossing (with experience) they would be expected to base it upon the time remaining until the Red Man is displayed.

The children's and mobility impaired participants decisions have been analysed, as have their feedback, directly after reaching the other side, as to whether they felt safe or rushed whilst using the crossing.

6.3.1 Child Observed Crossing Behaviour

The number (and percentage) of children deciding to completely cross the road has been analysed according to both the type of crossing they used and the simulated time of arrival at the crossing. Variation between the three groups' crossing decisions was high at individual arrival times, see Appendix C. However, the situation is clearer if each group's decisions are considered across all arrival times, see Figure 94.

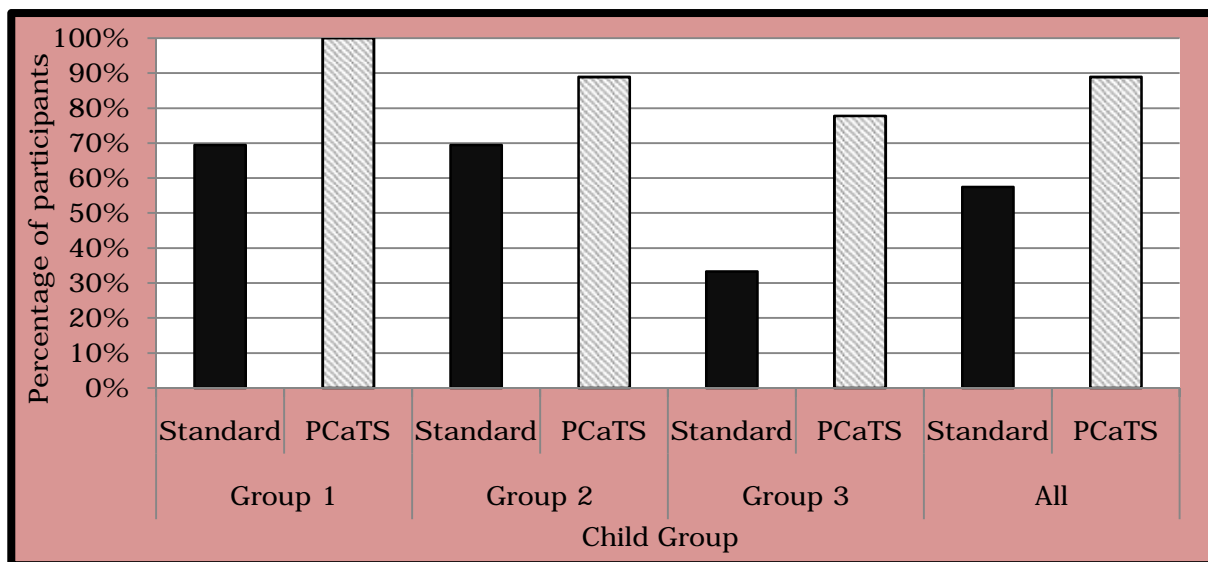


Figure 94 Percentage of children who crossed the road fully at each crossing type (all times)

The children were more likely, on average, to decide to complete crossing the road with PCaTS than with the current signals when arriving in the invitation to cross period: this was significant at the 95% confidence level. These decisions are comparable in that they are for the same numbers of observations for each of four times that are equivalent times before the end of the Blackout/Countdown period. It should be noted that 2 seconds before the end of the Green Man at the PCaTS crossing was the same as 4 seconds before the end of the Green Man at the Standard crossing, as the Countdown time was two seconds longer than the Blackout time.

Consequently, should their decisions have been based upon when the Green Man disappears, instead of the time remaining before the Red Man, then on average the decisions were made 2 seconds sooner (after starting to cross) with PCaTS. This implies the children were more likely to continue to cross the road at the PCaTS crossing if the same start times are analysed with respect to this decision point. This was found to be the case with the percentages of children completely crossing the road when arriving 4, 6 or 8 seconds before the end of the Green Man at the PCaTS and Standard crossings being 51% and 91% respectively.

The average differences for the arrival times across all child groups are shown in Figure 95.

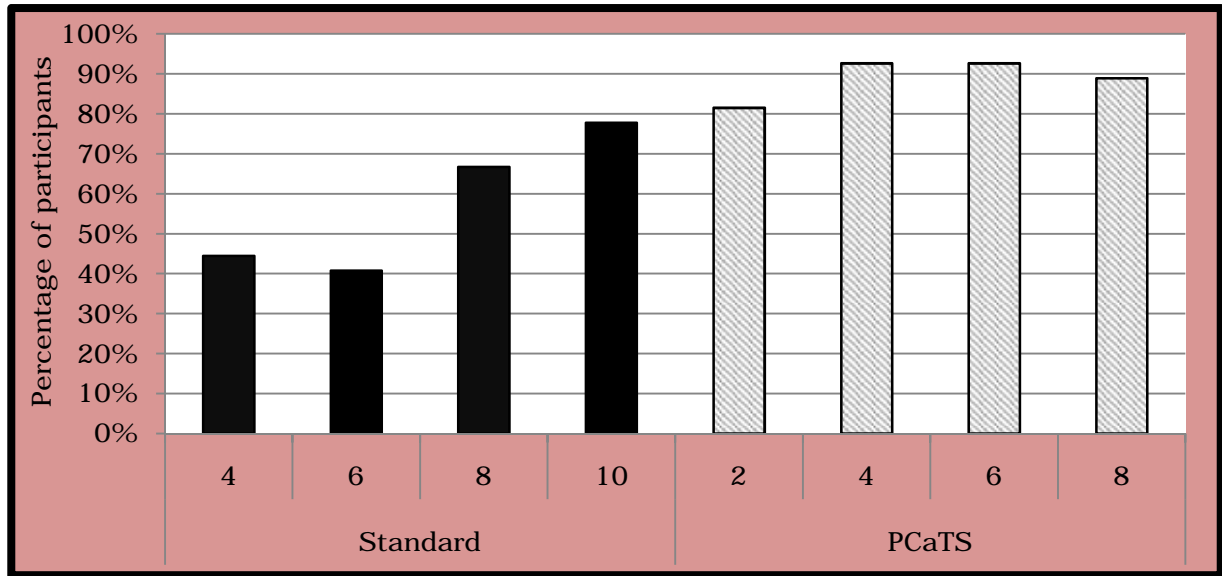


Figure 95 Percentage of children who crossed the road fully at each type of crossing for different arrival times

The percentage of children who crossed the road fully was up to 52% greater with PCaTS than on the Standard crossing, when compared with respect to the time remaining before the end of the Green Man. All these differences are statistically different (at the 95% confidence level), except for small difference in the number deciding to completely cross with 10 seconds of Green Man time at the Standard signals compared to 8 seconds at the PCaTS signals.

The decision on whether to start crossing is a simple binary choice (wait or cross) and in practice there would be an expected switching point: i.e. a time in the pedestrian phase where participants would change from crossing to waiting. In mathematical terms, there would be a time at which the probability of a person crossing increases from below, to above, 0.5 (i.e. there is a greater than 50% percentage chance of them crossing).

This implies that a suitable approach for analysing these decisions would be a LOGIT model (see Appendix D), that is one involving an S shaped curve. This captures the underlying decision process, see Figure 96



Figure 96 LOGIT models of the percentage of children who crossed the road fully at each type of crossing

This modelling implies that an average child would have a less than 10% chance of deciding to cross 3 seconds after the end of the Green Man. However, they will have a 75% chance of crossing at the same time at a PCaTS crossing, and a 60% chance of crossing at the end of the Countdown period, although some caution needs to be taken in extrapolating the observations this far after the end of the Green Man.

6.3.2 Mobility Impaired Participants Observed Crossing Behaviour

The mobility impaired participants could only cross each of the types of crossings twice, in order to limit the physical requirements placed upon them. The observations were consequently limited to two times before end of the Green Man, that were the same time before the start of the Red Man at the two crossings: i.e. 12 and 16 seconds. The number, out of 18, participants who decided to cross completely are shown in Table 12.

Time to end of Green Man (seconds)	PCATS		Standard	
	Number	%	Number	%
3	14	78%		
5			8	44%
7	14	78%		
9			13	72%

Table 12 Number of participants who crossed the road fully

As with the Children a high percentage (over 70%) of the Mobility Impaired participants crossed completely when there was a large time available before the end of the Green Man at both crossings. However, again a higher percentage crossed completely with PCaTS than with the Standard signals, and this difference was 34% at times close to the end of the Green Man. Overall, the Mobility Impaired participants:

- crossing decisions appeared consistent with the Children’s decisions at the Standard crossing

- were more likely to cross completely with PCaTS than at the Standard crossing, but
- were less likely to cross completely with PCaTS than Children

6.3.3 Extent of feeling Rushed and Safe: Mobility Impaired Participants and Children

Once the participants had crossed the road (whether in one go or two) they were asked firstly, had they felt rushed, and secondly, had they felt safe. As with the decisions to cross, there was a high degree of variation between the Children’s sub-groups at different observation times, their overall assessment of being rushed and safe across all observation times is shown in Figure 97, and is shown for the mobility impaired in Figure 98.

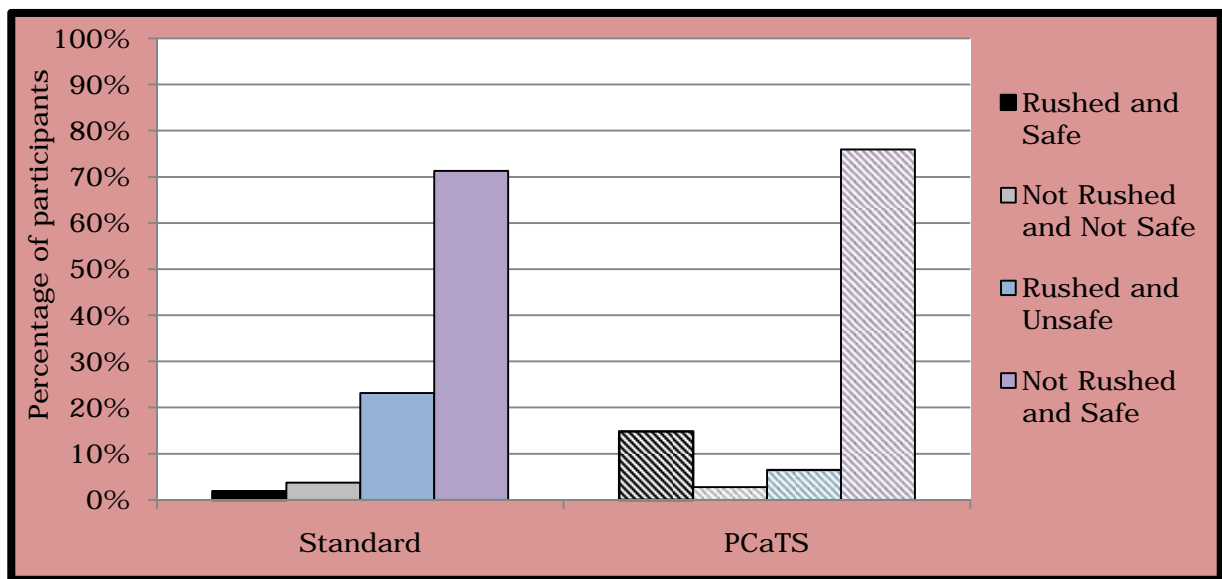


Figure 97 Percentage of children who felt rushed and safe

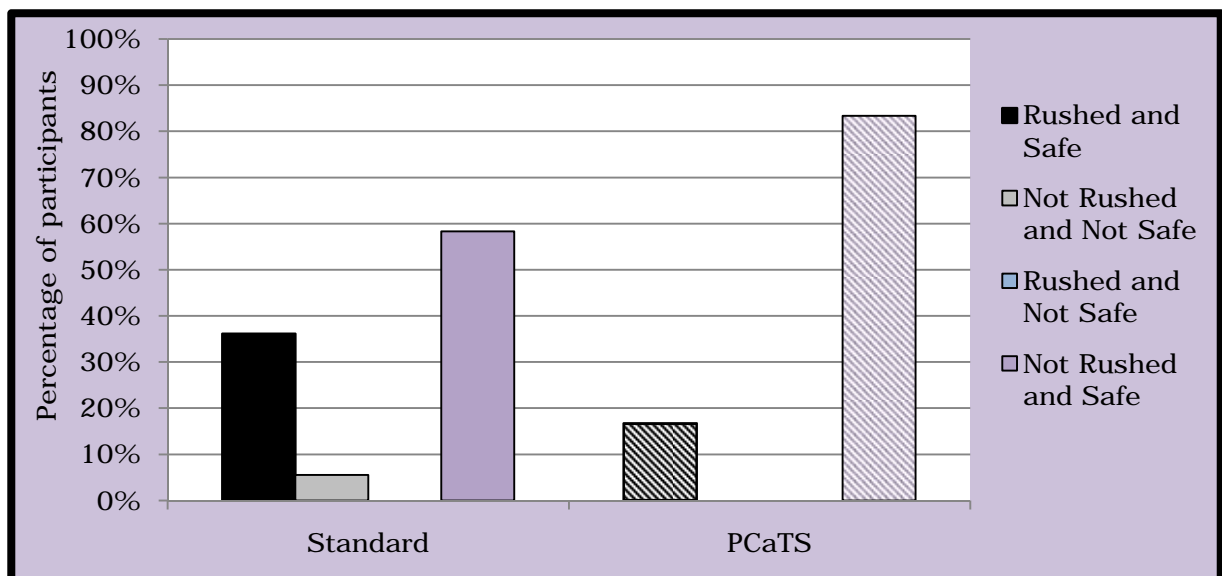


Figure 98 Percentage of mobility impaired participants who felt rushed and safe
 Most (over 55%) of the Children and Mobility Impaired participants did not feel rushed and felt safe when using both the Standard and the PCaTS crossings. The children were

more likely to feel rushed and safe at the PCaTS crossing, but were less likely to feel rushed and unsafe, which was significant at the 95% confidence level.

The difference with the mobility impaired participants was that very few of them felt unsafe at either of the crossings. However, fewer felt not rushed (although safe) at the Standard crossing compared to the PCaTS crossing: significant at the 95% confidence level.

It was also possible to consider the percentage of children who felt rushed according to the time they were simulated to arrive at the crossing, see Figure 99

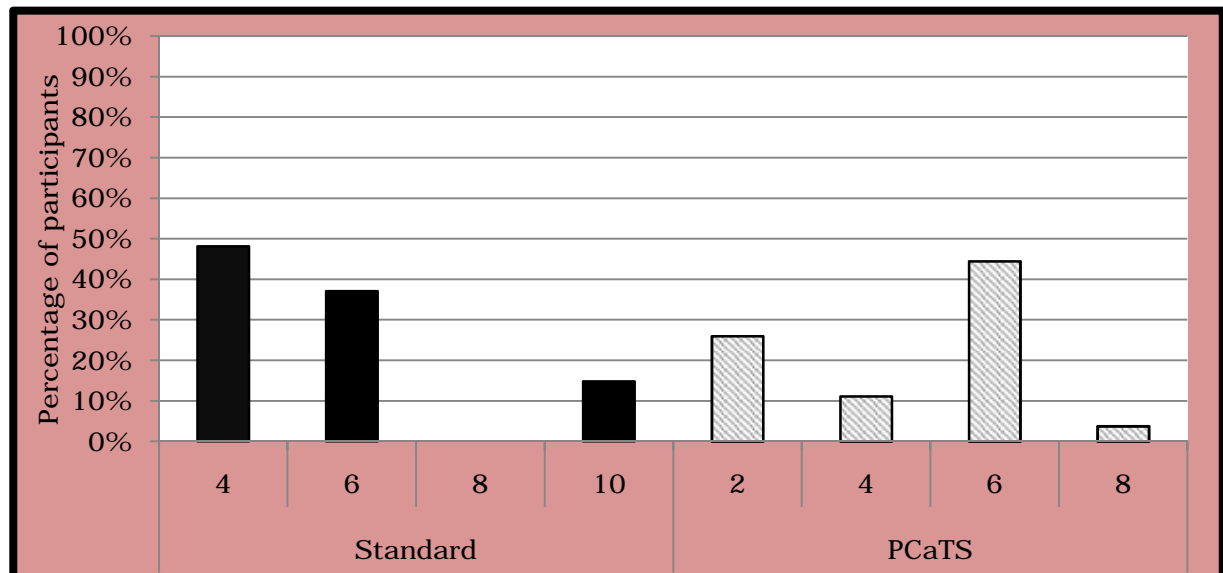


Figure 99 Percentage of children who felt rushed according to “arrival” time

The main difference, as would be expected, is that they were less likely to feel rushed if they “arrived” close to the end of the Green Man at the PCaTS, than at the Standard, crossing.

6.4 Summary of Findings

6.4.1 Site and Sample Characteristics

1. At all sites video observations confirm that the Green Man time was reduced to a standard 6 seconds; the “All Red” time (after the end of the Blackout phase when both the pedestrian and vehicle signal are red) was reduced to 3 seconds; the Blackout time was increased in the ‘After’ surveys compared to the ‘Before’ survey. This represented a 19% decrease in total available time to cross the road on Finsbury, and increases of 19%, 25% and 42% on Oxford St, Balham and Old Kent, respectively. The average Red Man time changed on four sites: a 4-second increase on Finsbury, a 3 to 5 second decrease on Oxford St, Balham and Old Kent. The cycle times remained generally unchanged and ranged from 85 to 118 seconds.
2. In the ‘After 2’ survey, the gender composition of the sample was reasonably consistent with the ‘Before’ survey, changing by at most 10%. There were significant increases in the proportion of pedestrians that were women on Oxford St, Balham and Finsbury, and a decrease on Old Kent. There was also a significant increase in women in the ‘After 1’ survey on Finsbury.

3. In the 'After 2' survey there were generally small but often significant changes in the age composition of the sample. There were increases in the proportion of pedestrians that were aged over 60 on Kingsway, Blackfriars and Tower Bridge, and a significant decrease on Oxford Street. There was also a significant increase in the proportion of pedestrians aged under 30, and a complementary significant decrease in the proportion of pedestrians aged 30 to 60 on several sites.
4. Pedestrian flows were consistent on seven of the eight sites. The only significant change in pedestrian flows was a decrease on Oxford Street of approximately 10% from the 'Before' to the 'After 1' surveys, and also a decrease of approximately 20% from the 'Before' to the 'After 2' surveys. The sites surveyed gave a very wide range of pedestrian flows, from around 1 pedestrian per minute up to around 50 per minute.

6.4.2 Pedestrian Behaviour

1. In all surveys, both before and after the installation of PCaTS, a large proportion of pedestrians chose to cross as soon as possible after they arrived, regardless of the traffic signal. Within 5 seconds of arriving at the crossing, 56%, 54% and 57% of pedestrians had started crossing in the 'Before', 'After 1' and 'After 2' surveys respectively, and approximately 70% of pedestrians had started crossing within 15 seconds in all three surveys.
2. On the highest flow sites, Oxford Street and Kingsway, PCaTS had little effect on pedestrians' crossing decisions with over 75% deciding to cross within 3 seconds of arrival during the final ten seconds of both the Blackout and Countdown periods. However, at lower flow sites with reasonable sample sizes, there was an increase in the proportion of pedestrians choosing to cross within 3 seconds throughout the Blackout period, apart from the final few seconds.
3. At all sites, with PCaTS fewer pedestrians chose to cross just before the end of the Blackout/Countdown phase, suggesting that even when they are making more use of the earlier part of the Blackout phase they are avoiding the last few seconds before the Red Man. It should also be noted that the "All Red phase" after the end of the Blackout phase (when both the pedestrian and vehicle signals are red) was reduced on all sites from between 5 and 9 seconds to 3 seconds. Relative to the end of the All Red phase, there was generally either no difference between the 'After' and 'Before' surveys, or slightly fewer pedestrians starting to cross in the 'After' surveys.
4. On most sites the majority of pedestrians crossed during the Red Man phase both before and after PCaTS was installed. In line with the timing changes there was generally an increase in the percentage of pedestrians crossing in the Countdown period (compared to the Blackout) and a decrease in the number crossing during the Green Man. There were small increases in the proportion of pedestrians crossing during the Red Man on Oxford Street in the 'After 2' survey (6%), and also on Blackfriars, Tower Bridge and Old Kent in the 'After 1' survey. The increase on Oxford Street was of particular note, given that there was a decrease in Red Man time on that site. There was a 5% decrease in the proportion of pedestrians crossing in the Red Man on Kingsway in the 'After 2' survey. There were also increases on Tower Bridge in the 'After 2' and on Finsbury in both 'After' surveys, but this was inconclusive due to the increase in Red Man time on these surveys.
5. It was observed that a higher proportion of pedestrians sped up during the Countdown phase in comparison with Blackout; and that a greater proportion of those that sped up during the Countdown did so in the second half of the phase,

which was not the case during the Blackout phase. The measured differences were as follows:

- With the Standard crossing, 14% of pedestrians who sped up, did so during the Blackout: 7% did so in the first half of the Blackout and 7% in the second half.
 - With PCaTS, 33% of the pedestrians who sped up did so during the countdown: 12% did so in the first half of the Countdown and 21% in the second half.
6. There were increased walking speeds on three sites in the 'After 2' survey (Blackfriars, Tower Br, Roehampton) and reduction on four sites. The decrease on Oxford Street was possibly a result of the long Countdown time (19 seconds) implemented because of the diagonal crossing. Some of the other changes may have been a result of changes in age and gender profiles on the sites. In the remaining cases the walking speed increased, so possibly implying that PCaTS did result in increased walking speeds.
 7. There was a mixture of increases and decreases in average pedestrian delay that were possibly related to the changes in signal timings. There was also an increase in the first person wait time at three of the four sites where statistically significant changes were observed, with the exception of those with reduced Red Man times (Oxford St, Balham). This may be a result of fewer pedestrians starting to cross immediately after the start of the Red Man with PCaTS.
 8. PCaTS had no discernable effect on the proportion of pedestrians crossing elsewhere on Oxford Street and Kingsway. There was a small but significant increase on Finsbury in the 'After 2' surveys and an increase on Balham (8% to 27%) which was the only site that had no island. Across other lower pedestrian flow sites there was weak evidence that crossing elsewhere tended to increase. The majority of pedestrians who started crossing elsewhere did so while the vehicle traffic light was red.
 9. The 'After 2' results suggested that there was a slight decrease (significant changes varied from 3 to 12%) in the percentage of pedestrians that waited on the island, on the four sites (including Kingsway, Oxford St, Blackfriars). This was a change from the 'After 1' results, which suggested no overall consistent effect, with a mixture of increases and decreases.
 10. In the 'After 2' surveys there were significant reductions in overcrowding on the footway on Blackfriars and Kingsway that were at least partially attributable to changes in pedestrian flows and the removal pedestrian guardrails on Kingsway. However, there was a statistically significant (13%) increase in overcrowding on Oxford Street that appeared to be attributable to introduction of PCaTS and the changes in pedestrian signal timings.
 11. The high level of overcrowding on the islands on the highest pedestrian flow sites was unaffected by the introduction of PCaTS. There was a 9% (significant) reduction in overcrowding on Blackfriars, but overcrowding was not an issue in any of the surveys on the lower pedestrian flow sites.
 12. PCaTS had no consistent effect on the proportion of pedestrians that returned to the kerb.
 13. Alongside greater use of the Blackout phase for crossing was an observed reduction in the amount of unused green time, i.e. green time during which no-one crossed. However, as changes to the signal timing were made alongside the introduction of PCaTS it is not possible to draw conclusions on the extent to which this is caused by PCaTS or is simply a consequence of there being less green time available.

6.4.3 Mobility Impaired Participants and Children (Accompanied Walks)

14. Accompanied walks surveys were conducted on 10/160 (Roehampton) on a loop of a PCaTS crossing and a Standard crossing.
15. The children were more likely to complete crossing the road with PCaTS than with the Standard signals when arriving in the invitation to cross period. This was significant at the 95% confidence level.
16. A high percentage (over 70%) of the mobility impaired participants crossed completely when there was a large time available before the end of the Green Man at both crossings. However, a higher percentage crossed completely with PCaTS than with the Standard signals, and this difference was 34% at times close to the end of the Green Man.
17. Most (over 55%) of the children and mobility impaired participants felt both safe and not rushed when using both the Standard and the PCaTS crossings. The children were less likely to feel both unsafe and rushed at the PCaTS crossing (7%) compared to the Standard crossing (23%), which was significant at the 95% confidence level. The children were also more likely to feel safe but rushed at the PCaTS crossing (15%) compared to the Standard crossing (4%).
18. Very few of the mobility impaired participants felt unsafe at either of the crossings. However, more felt not rushed (and safe) at the PCaTS crossing compared to the Standard crossing: significant at the 95% confidence level.

7 Results: Conflicts (Video Data)

Conflict analysis indicates situations where different road users vie for the same space at the same time. Whilst it does not necessarily indicate a collision, it can often imply a higher probability of collisions occurring, i.e. it is to an extent a pre-cursor of a collision. Therefore situations that generate higher numbers of conflicts are considered to be inherently less safe than those with lower conflict rates.

A conflict is indicated by one or both of the road users involved modifying their behaviour in response to the other road user. This can be:

- a change in direction, for example swerving, or
- a change in speed, for example speeding up, stopping or reversing direction

In addition, to recording to the event of a conflict they have also been rated by the video analyst, and therefore the conflict level is subjective. However, the number of video analysts were minimised for this element of the analysis to ensure comparability. The conflict levels recorded were:

- Level 0: Inconvenience – for example a stationary vehicle in a pedestrian's path
- Level 1: Precautionary - for example stopping to allow the other road user to pass
- Level 2: Controlled – minor deviation from initial route, or controlled braking
- Level 3: Near Miss – rapid deceleration, lane change or stopping
- Level 4: Very Near Miss – emergency braking or violent swerve
- Level 5: Collision – actual contact between road users (none observed during the trial)

Examples of Conflict levels 1 to 4 are shown in Section 7 of the main report.

Initial analysis was conducted on the data, and indicated a high number of Level 1 conflicts: this especially occurred on Tower Bridge. The Level 1 conflicts were therefore re-assessed and one of the underlying causal effects was vehicles inappropriately stopping on the pedestrian crossing, causing the pedestrians to deviate their planned course around them. Such behaviour, whilst in the strict definitions was a conflict, was not helpful in assessing safety as they involved a stationary vehicle. Therefore these occurrences were re-classified as Level 0 conflicts:

- Level 0 – Inconvenience – for example where one road user is stationary but in the path of the other road user

It should be noted that it rained on Kingsway for two hours in the 'After 1' survey. Therefore, this data was affected by abnormal pedestrian behaviour. To ensure this did not affect the study, this data and the equivalent data (same time of day) were removed from the 'Before' and 'After 1' time periods affected: 08:00 to 08:15 and 12:00 to 12:15.

There was also some light rain on Oxford Street between 9:00 and 9:05 in the 'Before' period and also between 14:00 and 14:15 in the 'After 1' period. This rain was only light and did not appear to affect the pedestrian behaviour.

Analysis of the data also indicated an inconsistency in the data collection. This only occurred when one vehicle was involved in a conflict with more than one pedestrian. On some occasions these conflicts had been grouped as one conflict, whilst on other occasions they had been counted as different incidents.

The approach used to remove these anomalies was to re-classify any single conflicts into grouped conflicts depending on the time they occurred. That is, if two conflicts occurred close together then they were grouped into one multiple conflict. A sensitivity analysis

was conducted to assess the correct time to allow between conflicts before classifying them as a different conflict. This showed that allowing times between conflicts of 1 to 4 seconds had little effect on the results: it was therefore decided to use a 2 seconds gap. Such conflicts were removed from the analysis to ensure consistent comparisons between the datasets. Furthermore, information on the age, gender and movements observed of pedestrians involved in multiple conflicts was unavailable.

7.1 Overall number of conflicts

The overall number of conflicts that occurred on each site during the three surveys is shown in Figure 100 and Figure 101. The total numbers of conflicts have also been divided by the number of observed pedestrians in the same time periods to form a conflict rate for each site and this is shown in Figure 102.

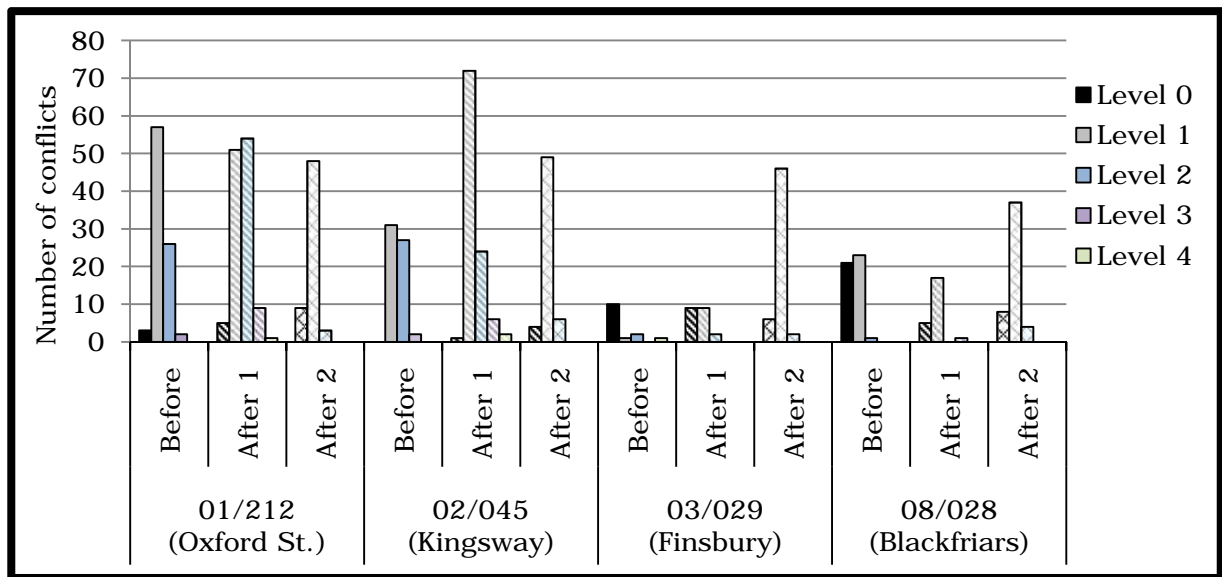


Figure 100 Number of each level of Conflict – Group 1

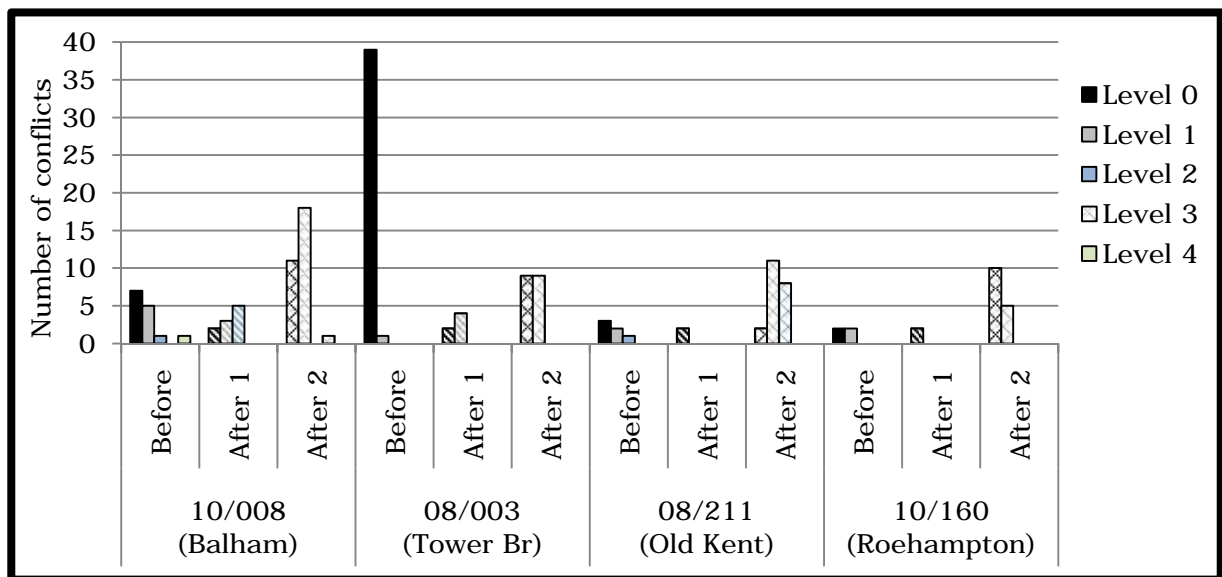


Figure 101 Number of each level of Conflict – Group 2

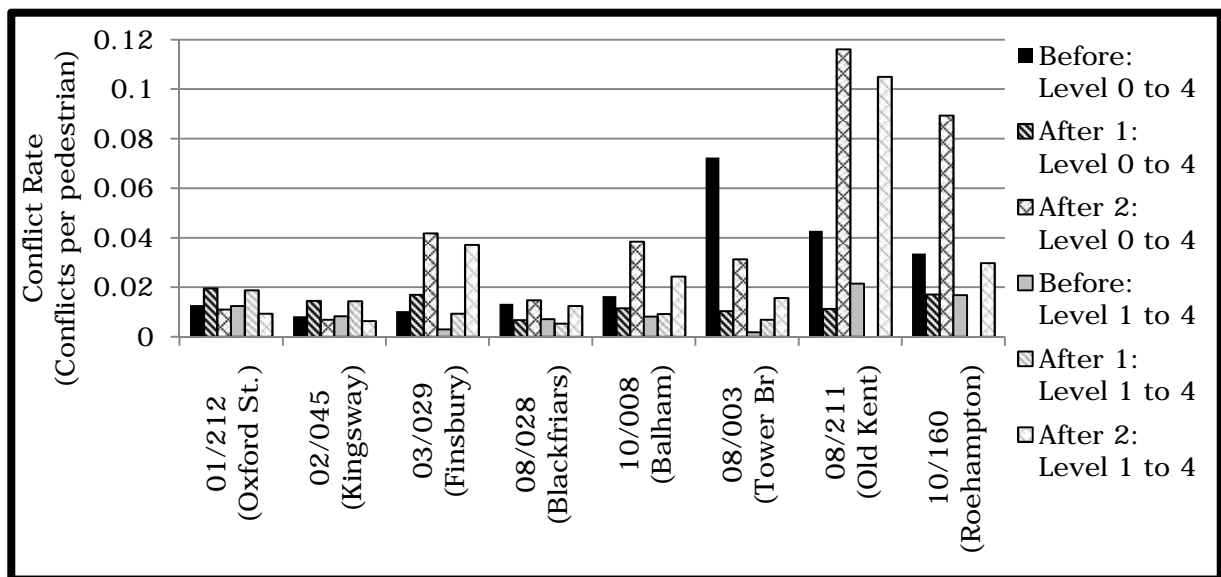


Figure 102 Conflict rates

Overall, the increases in Levels 2 to 5 conflicts observed in the 'After 1' surveys on the high flow sites were no longer present in the 'After 2' surveys: no Level 5 (collisions) were observed in any survey. There were significant decreases on Oxford Street and Kingsway, although a significant increase on the Old Kent Road site.

Level 1 conflict rates were approximately the same in the 'Before' and 'After 2' surveys on Oxford Street and Kingsway. However, the rates on the other six sites increased and the change was significant on four of the sites.

Consequently, after settling in, increases were observed in minor Level 1, precautionary conflicts on all but the highest flow sites: an increase from 122 to 223 across all sites. Overall, there was a decrease in Level 2, controlled conflicts, from 58 to 23, although on two sites there appears to have been an increase.

On all sites except Oxford Street and Kingsway there were few conflicts of Level 1 or above observed in both the 'Before' and 'After 1' surveys, although there were higher numbers observed on Finsbury and Blackfriars in the 'After 2' survey.

Examination of the conflict rates emphasises the distorting effect of including Level 0 conflicts in the analysis, as the trends can be different to considering the Level 1 and above conflicts. As Level 0 conflicts are only generally with stationary vehicles, so are not an indicator of a potential collision, Level 0 conflicts were therefore excluded from the analysis provided in the main report.

Excluding Level 0 conflicts, there were indications of increases in conflict rates on Finsbury, Kingsway and Oxford Street, and weak indication (given the small sample sizes of approx 100 pedestrians in the 3-hour period) of a decrease on Old Kent in the 'After 1' survey. However, there were significant increases in such conflict rates on all but the highest pedestrian flow sites (Oxford Street and Kingsway), except Roehampton, between the 'Before' and the 'After 2' surveys.

There were increases in the 'After 1' surveys, significant at the 95% level, on Oxford Street from 1.2% to 1.9% (85 to 114) and Kingsway from 0.7% to 1.2% (60 to 104). There was also a significant increase on Finsbury from 0.3% to 0.9% (4 to 11) and a

significant decrease on Old Kent from 2.1% to 0% (3 to 0); however, these two results should be treated with caution due to the low sample size in the 'Before' to 'After 1' surveys.

The conflict rates (Level 1 and above) reduced back to the 'Before' levels on Oxford Street and Kingsway in the 'After 2' survey (0.9% and 0.6% respectively), whilst they increased to 3.7% Finsbury. On the other five sites the conflict rate increased from within the range 0.2% to 2.1% in the 'Before' survey to within the range 3.0% to 10.5% in the 'After 2' survey.

However, unlike the 'After 1' survey, the increases appeared to be associated with Level 1 conflicts (i.e. precautionary) and not conflicts of higher severity. In the 'After 1' surveys there were increases on Oxford Street in Level 2 (26 to 54) and Level 3 (2 to 9) conflicts, which were significant at the 95% confidence level. On Kingsway, there were increases in Level 3 (2 to 6) and Level 4 (0 to 2) conflicts however these were not statistically significant. However, there did not appear to be any obvious reason for the increase and it occurred throughout the day, see Figure 103. These increases were no longer present in the 'After 2' surveys with three Level 2 and no Level 3 conflicts on Oxford Street and no Level 3 or 4 conflicts on Kingsway.

Overall, in terms of all the higher level conflicts (Level 2 to 5), there were significant decreases on Oxford Street and Kingsway, but a significant increase on Old Kent between the 'Before' and the 'After 2' surveys.

Across all sites between the 'Before' and the 'After 1' surveys:

- For Severity 0, significant decrease (95% Level), from 0.4% to 0.1% (85 to 28)
- For Severity 1, significant increase (95% Level), from 0.6% to 0.8% (122 to 156)
- For Severity 2, significant increase (95% Level), from 0.3% to 0.4% (58 to 85)
- For Severity 3, significant increase (95% Level), from 0.0% to 0.1% (4 to 16)
- For Severity 4, no significant change

Also, across all sites between the 'Before' and the 'After 2' surveys:

- For Severity 0, significant decrease (95% Level) from 0.4% to 0.3% (85 to 59)
- For Severity 1, significant increase (95% Level), from 0.6% to 1.1% (122 to 223)
- For Severity 2, significant decrease (95% Level), from 0.3% to 0.1% (58 to 23)
- For Severity 3, no significant change
- For Severity 4, no significant change

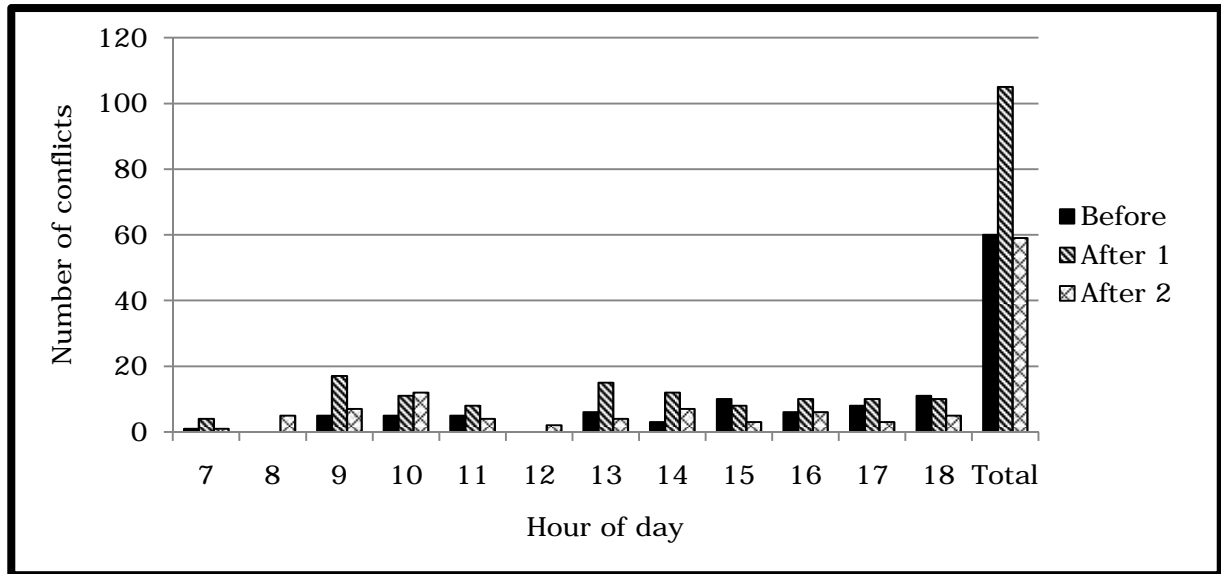


Figure 103 Conflicts at Kingsway by time of day (excluding rain 8-8:15 and 12-12:15)

Overall, direction of travel across the pedestrian crossing did not affect the probability of being involved in a conflict.

A further test was performed on whether any changes in conflicts were associated with the direction in which the pedestrian used the crossing. There were no consistently different trends between the conflicts associated with pedestrians crossing in the two directions in any of the three surveys, so the pedestrians' direction of travel does not appear to affect conflicts.

The remainder of this section examines the following type of conflicts:

- Those involving one pedestrian only
- Those of Level 1 and above; i.e. not with a stationary vehicle
- Those not affected by adverse weather

7.1.1 Pedestrians involved in conflicts

Pedestrian behaviour is dependent on the type of pedestrian. Those of different ages and genders are likely to differ in their crossing decision and assessing circumstances that constitute a safe situation. The conflict analysis therefore collected information on the gender of the pedestrians involved in observed conflicts. Also, where possible an estimate of the pedestrian's age in three wide age bands: less than 30, 30 to 60, and over 60 years old was collected.

The types of pedestrians involved in the conflicts are shown in Figure 104, Figure 105, Figure 106 and Figure 107. It should be noted that these are conflicts involving only one pedestrian, as where groups were involved no gender or age was recorded for the individuals in the group.

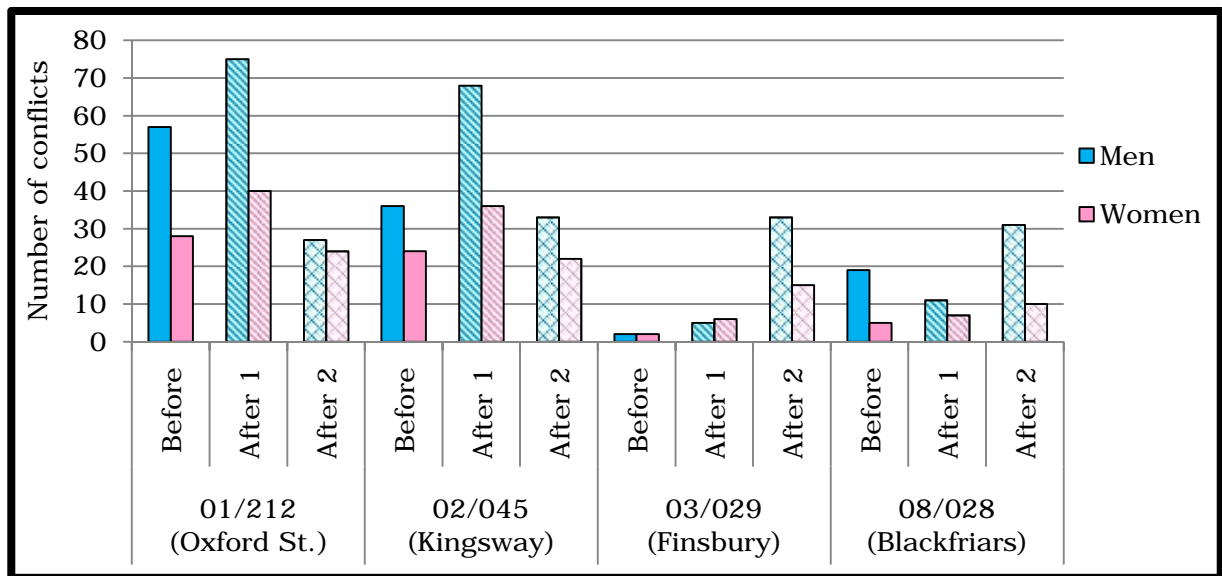


Figure 104 Gender of pedestrians involved in conflicts – Group 1

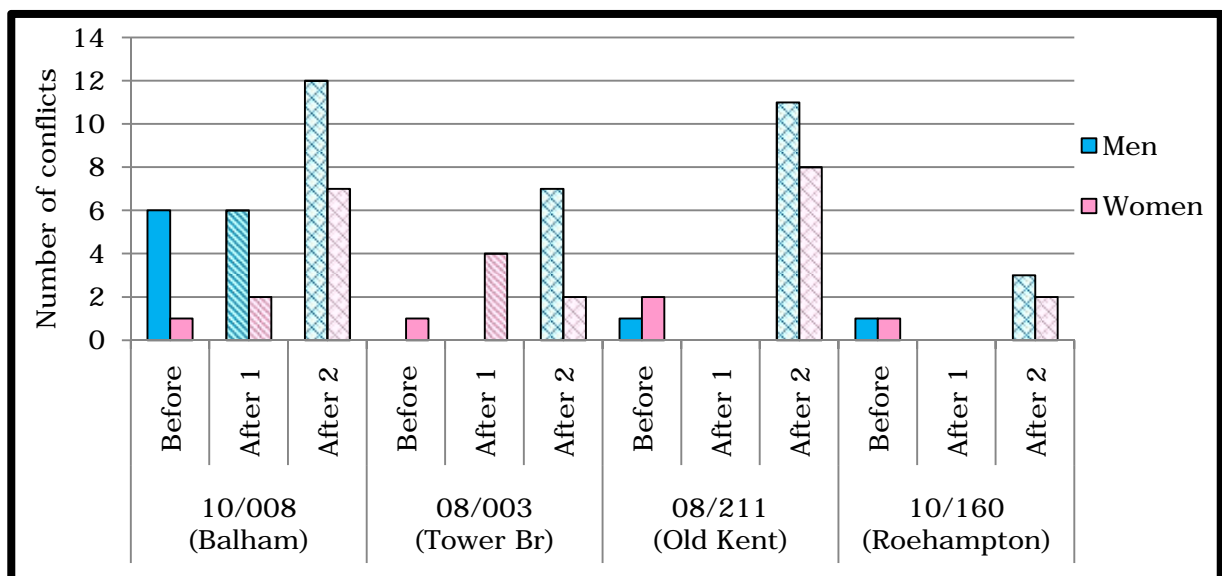


Figure 105 Gender of pedestrians involved in conflicts – Group 2

Overall, men were more likely to be involved in conflicts than women. On seven of the eight sites the proportion remained constant across all the surveys.

In line with expectation, on most sites with a reasonable number of conflicts, more men were involved in conflicts. The main exception was Tower Bridge (in the first two surveys), although there were very few conflicts on this site.

At seven of the eight sites there were no significant changes in the proportion of men and women involved in the conflicts. At Tower Bridge there was a significant increase in the proportion of men involved in the conflicts from the 'After 1' survey to the 'After 2' survey, with the number of conflicts rising in general.

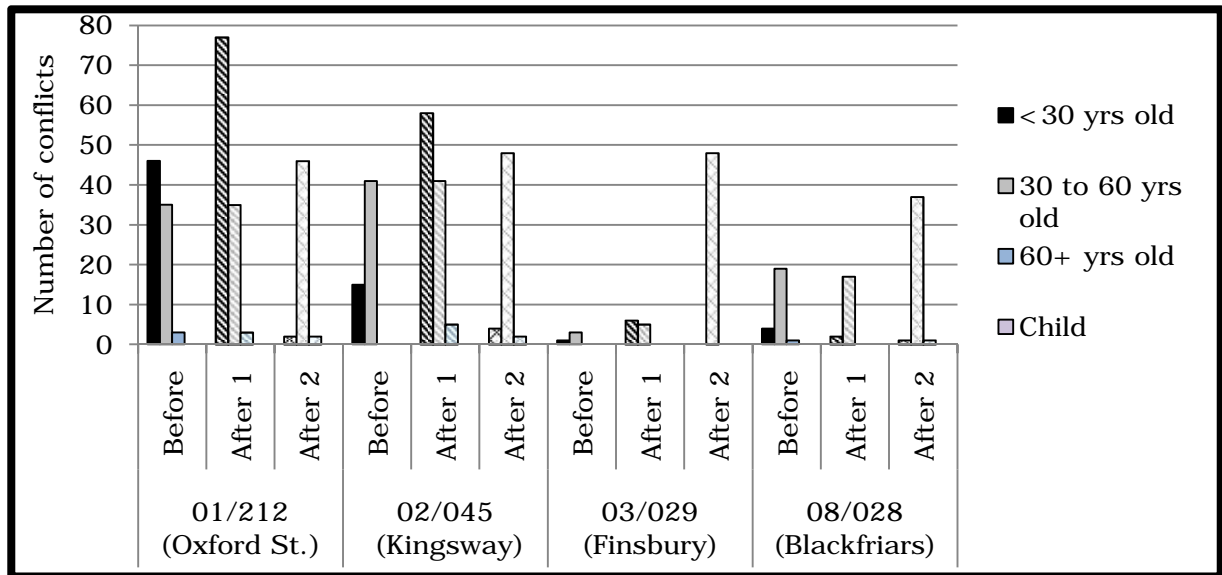


Figure 106 Age of pedestrians involved in conflicts – Group 1

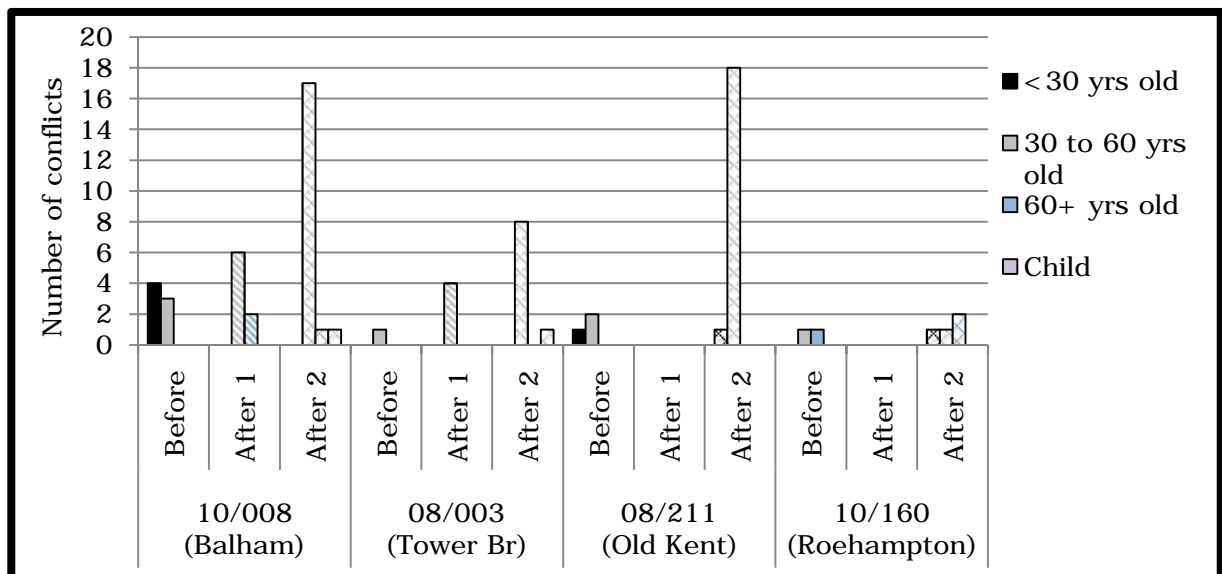


Figure 107 Age of pedestrians involved in conflicts – Group 2

Overall, in the 'After 2' survey there were increases in the percentage of 30 to 60 year olds involved in conflicts on six out of the eight sites, of which four were statistically significant and one was weakly statistically significant.

With regards to the age of the pedestrians, there were no totally consistent patterns in the conflict data between the 'Before' and 'After 1' surveys: 58% of conflicts involved 30 to 60 year olds in the 'Before' survey, and 55% of conflicts involved under 30 year olds

in the 'After 1' survey. However, the main increases on the high pedestrian flow sites (Oxford street and Kingsway) were among the under 30's.

These trends were no longer present in the 'After 2' survey. There was a more consistent trend of the proportion of 30 to 60 year olds involved in conflicts increasing between the 'Before' and the 'After 2' survey: this was significant on Oxford street, Kingsway, Finsbury and Balham, and weakly significant on Blackfriars. Furthermore, the percentage of 30 to 60 year olds involved in conflicts ranged from 42 to 79% in the 'Before', 30 to 89% in the 'After 1' and 89% to 100% in the 'After 2' at sites with 5 or more conflicts.

There were fewer than 6 conflicts at each site in each survey involving people over 60 years old or children.

7.1.2 Vehicles involved

The vehicles involved in the conflicts are of interest as each has its own behaviour. For example, cyclists in London have a tendency to move forward before the start of the Green traffic signals, motorcycles have high acceleration and cars together with light goods vehicles represent the majority of the traffic flow. The actual vehicles involved in conflicts of Level 1 and above with pedestrians are shown in Figure 108 and Figure 109.

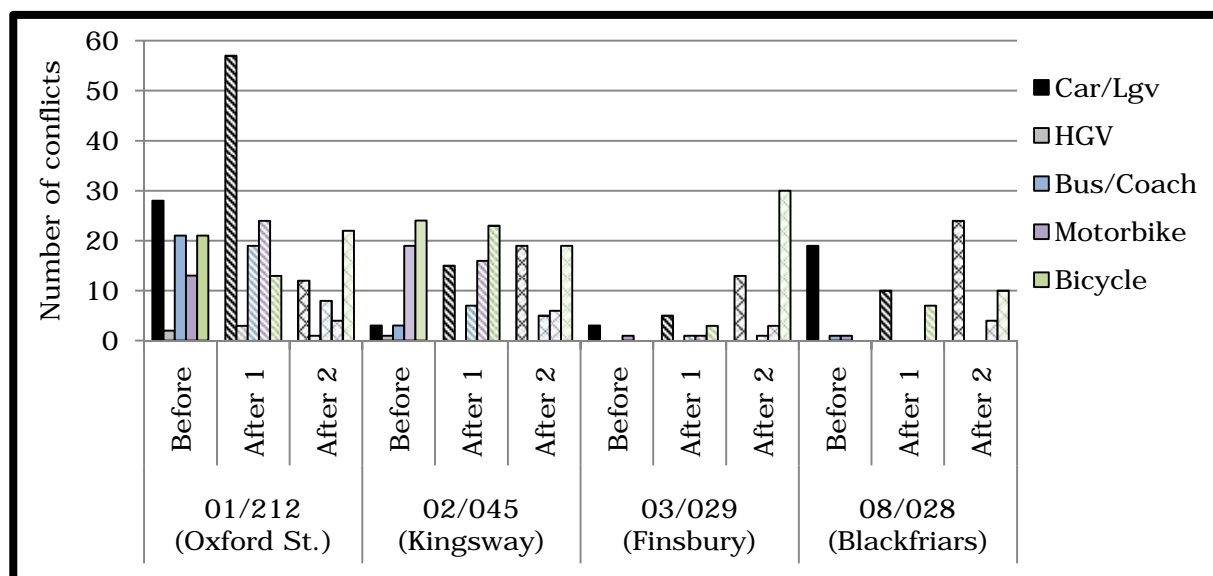


Figure 108 Vehicles involved in conflicts – Group 1

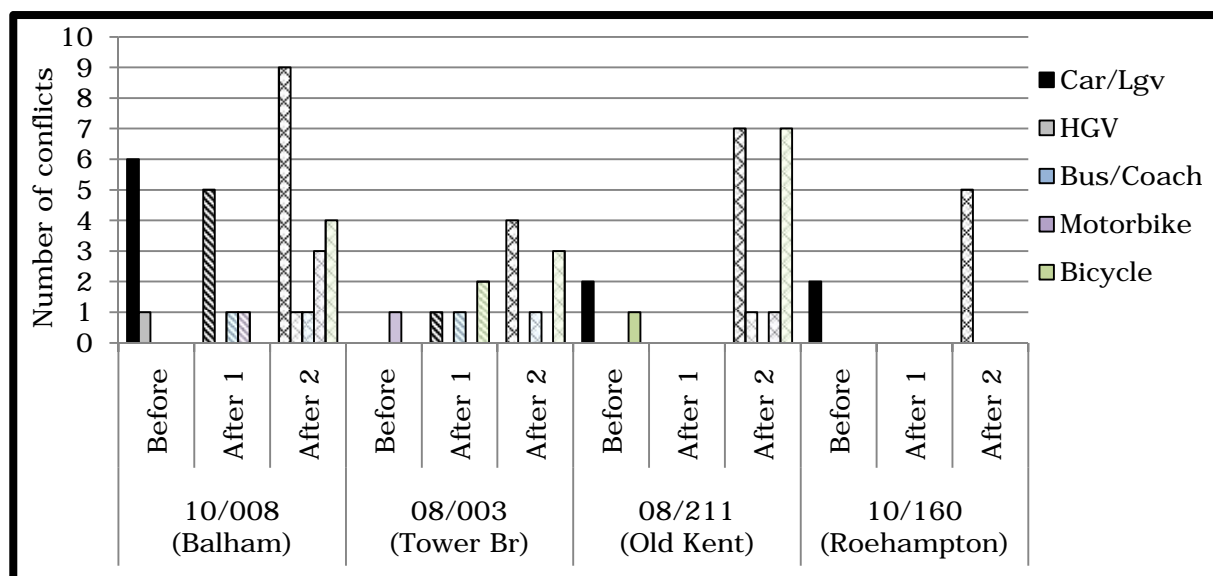


Figure 109 Vehicles involved in conflicts – Group 2

Overall, in the 'After 2' survey there were increases in the percentage of conflicts involving cycles on six of the eight sites (statistically significant on three sites), and the percentage was greater than the percentage of the traffic flow they represent: i.e. 22% to 64% of the conflicts and less than 18% of the traffic flow on high flow sites.

On low flow sites the majority of conflicts involved car and light goods vehicles. This is as expected given that they account for approximately 80% of the traffic flow on these sites. In contrast, although the numbers are small, the percentages of conflicts involving motorcycles were greater on some of these sites than would be expected given the proportion of them in the traffic flow.

The change in conflicts on Kingsway between the 'Before' survey to the 'After 1' survey, was an increase associated with car, light goods and buses. The main increase is amongst cars and light goods which accounted for 5% in the 'Before' and 25% in the 'After 1' survey. In contrast, the percentage of cycles involved in the conflicts decreased from 48% to 38%. However, the percentage of cycles involved in conflicts in the both surveys was much greater than the percentage of flow they represented (approximately 10%). A similar trend and high conflict rate with motorcycles was also evident on Kingsway.

On Oxford St, there was a large increase in the number of conflicts involving cars or LGVs from the 'Before' survey to the 'After 1' survey, and the percentage of conflicts involving these vehicles slightly increased (by 16%) owing to large increases in conflicts involving other modes. There was a larger number of conflicts with buses than on any other site; this may have been as expected due to the high frequency of buses on this site. The number of conflicts involving cycles or buses on Oxford Street slightly decreased.

The increase in the percentage of conflicts involving cars and LGVs was maintained on Kingsway, but disappeared on Oxford Street in the 'After 2' survey. The main consistent trend was an increase in the percentage of conflicts involving cycles, which was significant at Oxford Street, Finsbury and Blackfriars. The percentage of conflicts involving cycles (on high flow sites with greater than 10 conflicts) ranged from 0 to 48% in the 'Before' survey and 22% to 64% in the 'After 2' survey. This percentage is greater than the percentage of traffic flow they represent, which was less than 18% on all sites and in all surveys.

7.1.3 Turning movements of vehicles

Information was collected during the survey as to the direction of travel of the vehicle involved in a conflict. This could be either exiting the junction, or entering the junction. This is of relevance as those exiting the junction are waiting at the stop line near to the crossing during the pedestrian phase, whilst those entering the junction have travelled from another of the junction’s arms. The direction of the vehicles involved in the conflicts are shown in Figure 110 and Figure 111.

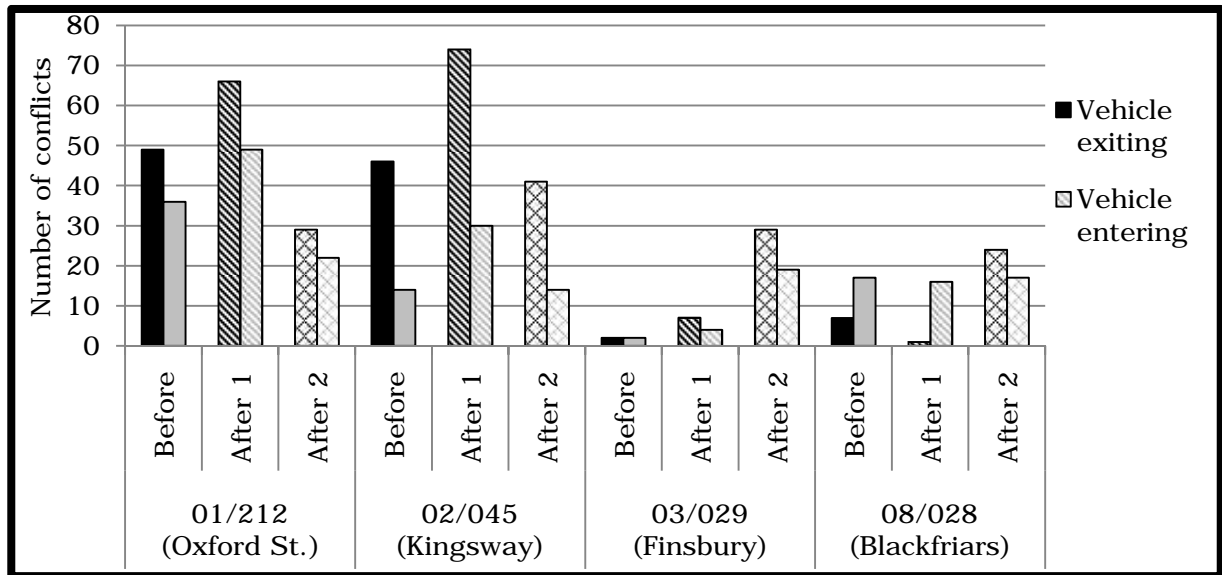


Figure 110 Turning movements of vehicles in conflicts – Group 1

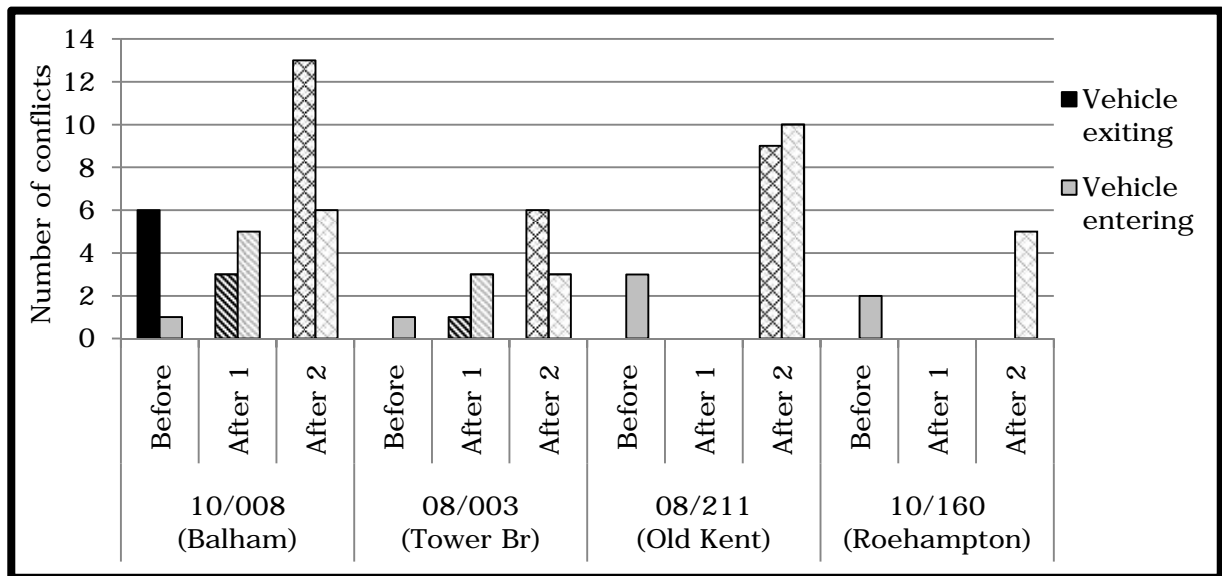


Figure 111 Turning movements of vehicles in conflicts – Group 2

Overall, no change was found in the percentage of conflicts occurring in each direction of travel: into and out of the junction. Overall averaging across all sites between 59 and 61% of conflicts occurred with vehicles exiting the junction in the three surveys.

As a general rule, there were more conflicts involving cars exiting rather than the entering the junction. However, this was not true of Old Kent and Roehampton.

The numbers at the low pedestrian flow sites are quite small, however it would appear that there has been an increase in the number of conflicts involving vehicles entering the junction at Balham from the 'Before' survey to the 'After 2' but the increase was not significant.

At both Oxford Street and Kingsway, the number of conflicts increased both for vehicles exiting and entering the junction in the 'After 1' survey, with a 37% and 114% increase in those entering the junction and a 33% and 61% in those exiting, respectively. At Blackfriars there was a slight reduction in conflicts both directions of vehicles. It would therefore appear that the increase, or decrease, in conflicts at a site is independent of the direction of travel of the vehicles involved.

The only significant changes when compared to the 'After 2' survey was at Blackfriars with a significant increase in the proportion of conflicts involving vehicles exiting the junction from both the 'Before' and the 'After 1' surveys.

A further test was performed to assess whether there was any difference in the number of conflicts when taking into account both the direction of travel of the vehicle and the direction in which the pedestrian(s) involved crossed the crossing. No consistent trends could be seen and it would therefore appear that any changes in conflicts are not associated with the direction of travel of vehicles or pedestrians.

7.1.4 Pedestrian phase at time of conflict

It may be expected that the time that a pedestrian decides to cross, or when the conflict occurs, could have a direct relevance to the conflict happening. If a pedestrian starts to cross in the Green Man then they should be able to reach the other side of the carriageway before any change in priority and therefore not come into conflict with the traffic. If they cross during the Red Man then they are crossing without priority and therefore between moving vehicles which could increase the likelihood of a conflict. If crossing in the Clearance period then they will start with priority, but may not have sufficient time to reach the other side of the carriageway before the change in priority.

The time that the pedestrian started to cross was recorded together with the pedestrian phase, referred to as:

- 'Red Man 1',
- 'Green Man 1'
- 'Blackout 1' (before)
- 'Countdown 1' (after)

The pedestrian phase at the time of the conflict was referred to as:

- 'Red Man 2',
- 'Green Man 2'
- 'Blackout 2' (before)
- 'Countdown 2' (after)

There was virtually no difference observed between using the phase when they started to cross and the phase at the time of the conflict in the analysis, so this section only considers the phase at the time of the conflict. The phases at the time of the conflicts are shown in Figure 112 and Figure 113.

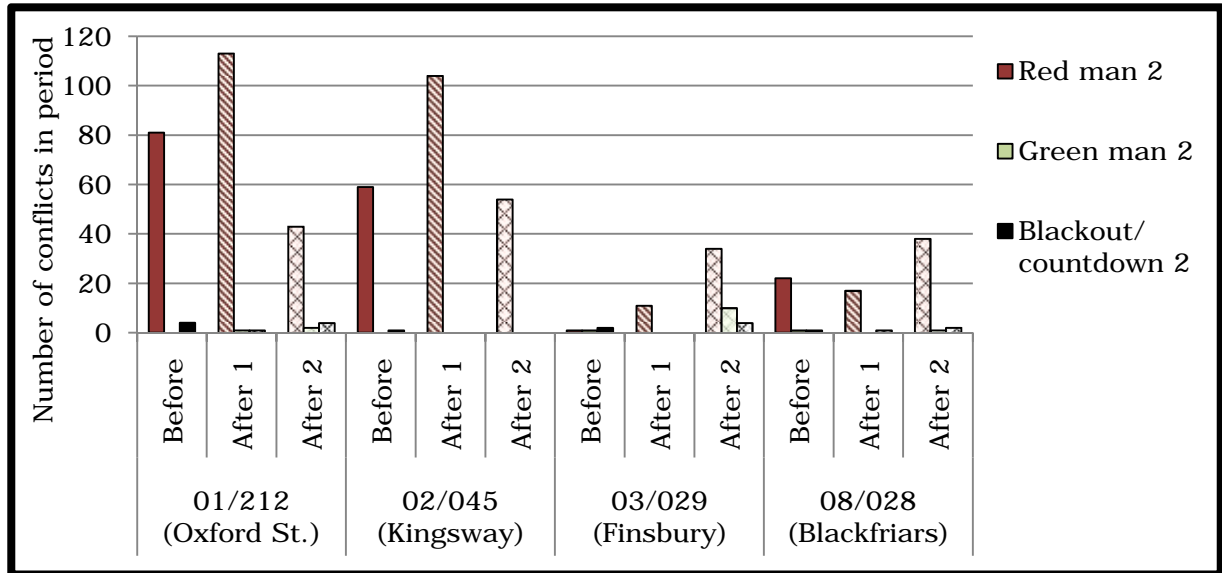


Figure 112 Phase showing to pedestrian at conflict – Group 1

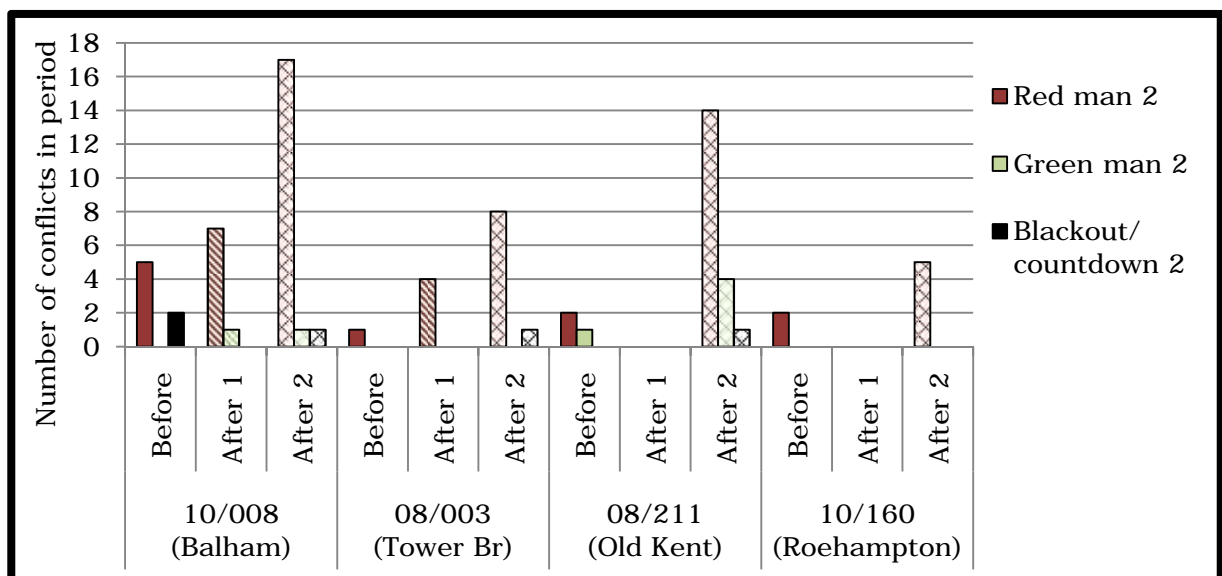


Figure 113 Phase showing to pedestrian at conflict – Group 2

Overall, across all surveys, most conflicts occurred in the Red Man: 84% on low, and 94% on high, pedestrian flow sites.

There was weak evidence from the high pedestrian flow sites that increases in conflicts did occur shortly after the start of the Red Man.

On all sites, most of the conflicts occurred during the Red Man; on average 94% occurred during the Red Man on the high pedestrian flow sites (Group 1) and 84% on the low flow pedestrian sites (Group 2), averaged across all surveys.

Considering Oxford Street in detail, as this accounted for the most conflicts, nearly all occurred during the Red Man (95% 'Before', 98% 'After 1' and 88% 'After 2'). This change was a significant reduction between the 'After 1' and the 'After 2' survey.

On Finsbury there was a significant increase in conflicts during the Red Man between the 'Before' and the 'After 1' surveys, but a significant decrease between the 'After 1' and 'After 2' surveys.

An investigation was made into the time after the start of the Red Man when the conflict occurred. The emphasis of the analysis was to ascertain whether the conflict occurred directly after the start of the Red Man indicating that the pedestrian started to cross near the end of the pedestrian phase, or whether they were further after the start of the Red Man, indicating the pedestrian had made a conscious decision to cross in the Red.

The analysis was conducted for pedestrians crossing A to B for conflicts of Level 1 or above; that is they started on the side of the crossing where the traffic was waiting at the stop line. The number of conflicts were banded into those occurring 0 to 4 seconds, 5 to 9 seconds and 10 to 14 seconds after the start of the Red Man, see Figure 114 and Figure 115.

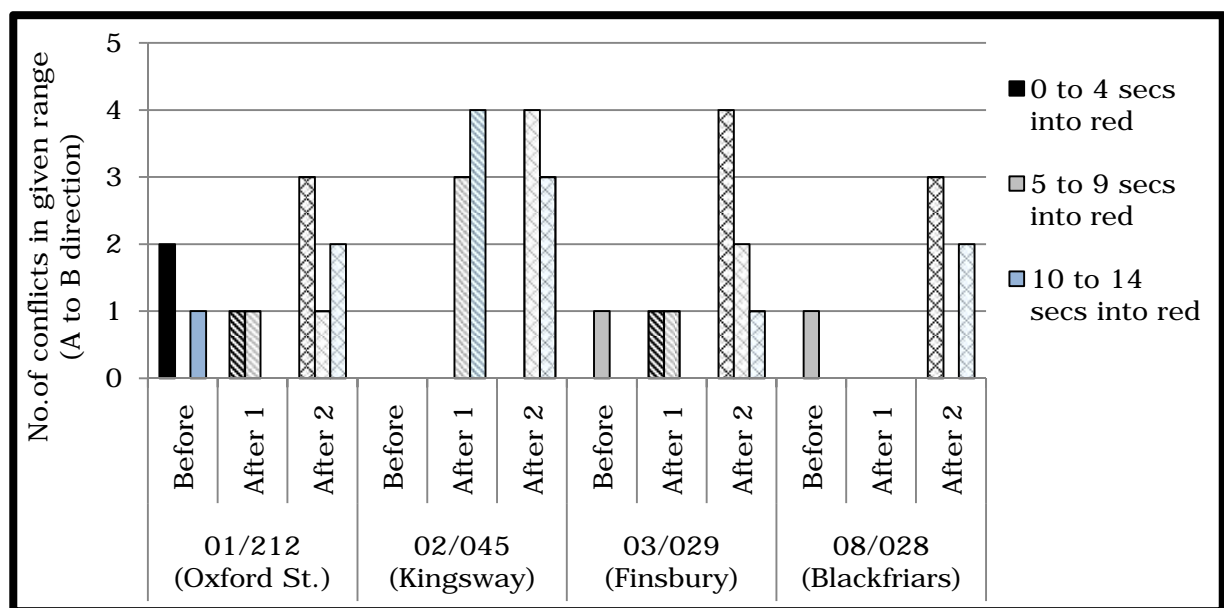


Figure 114 Time into Red Man at conflict for pedestrians crossing A to B – Group 1

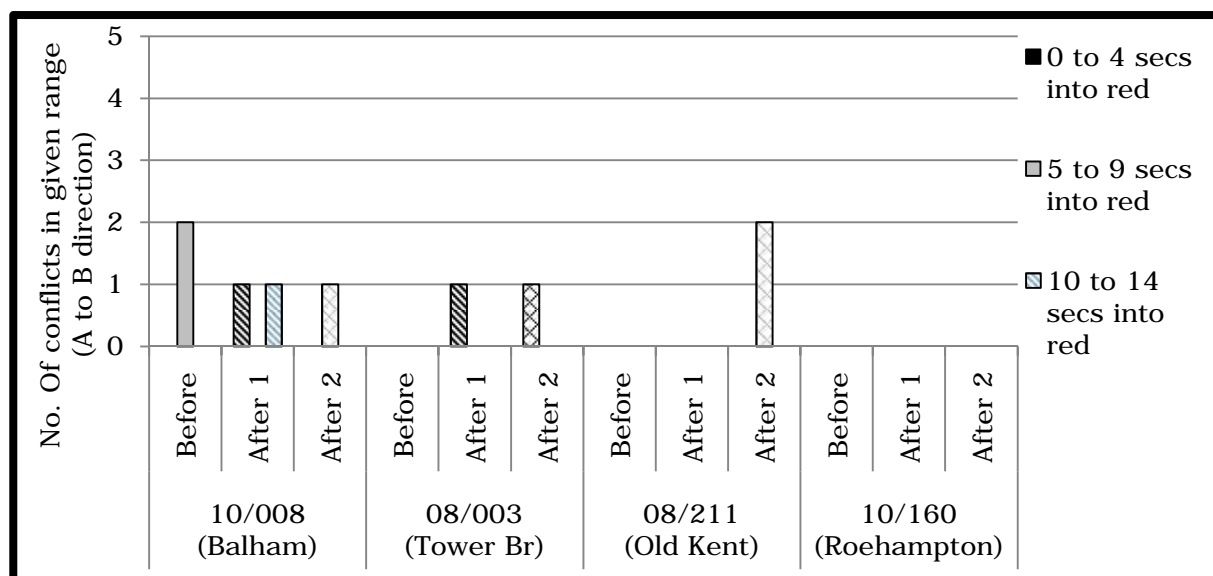


Figure 115 Time into Red Man at conflict for pedestrians crossing A to B – Group 2

The sample sizes in this section of the analysis are small, and should only be considered indicative of possible trends. On the higher flow sites, there were some increases in conflicts shortly after the start of the Red Man, and it is therefore likely that some of these pedestrians involved in these conflicts had made the decision to cross within the end of the Countdown period. It should be noted that on the other sites, the numbers were very small and so no conclusions can be drawn. A further investigation into the number of pedestrians on the crossing up to 6 seconds before the change to traffic green is performed in Section 9.

There were no significant changes between the 'After 1' survey and the 'After 2' survey.

7.2 Multiple pedestrian conflicts

Single conflicts were examined in the previous section and considered situations where one pedestrian conflicted with the movements of vehicles, i.e. they vied for the same road space. However, there are situations where more than one individual is affected by the same vehicle(s), that is, they can be considered as a single event. Two types of event have been considered to be multiple conflicts. The first is where more than one individual is involved in a conflict, and the time between the conflicts was less than two seconds. The other is where a group of pedestrians are all involved in a conflict at the same time.

In the first type of multiple conflicts all the information collected for a single conflict was available. However, the second type of conflict can involve very large numbers of pedestrians. Therefore, where possible, the exact number of pedestrians were recorded, but in other cases a minimum number of pedestrians involved was collected (e.g. at least 20). Consequently, it was not possible to collect detailed information about the pedestrians (for example age and gender) that were involved in this type of conflict.

The reduced information available, combined with the approximate nature of the number of pedestrian affected, resulted in this sub-dataset being analysed separately to the single conflicts.

7.2.1 Number of multiple conflicts

The total number of multiple conflicts that occurred of both types and of all conflict severity levels (Level 0 to 4) are shown in Figure 116 and Figure 117.

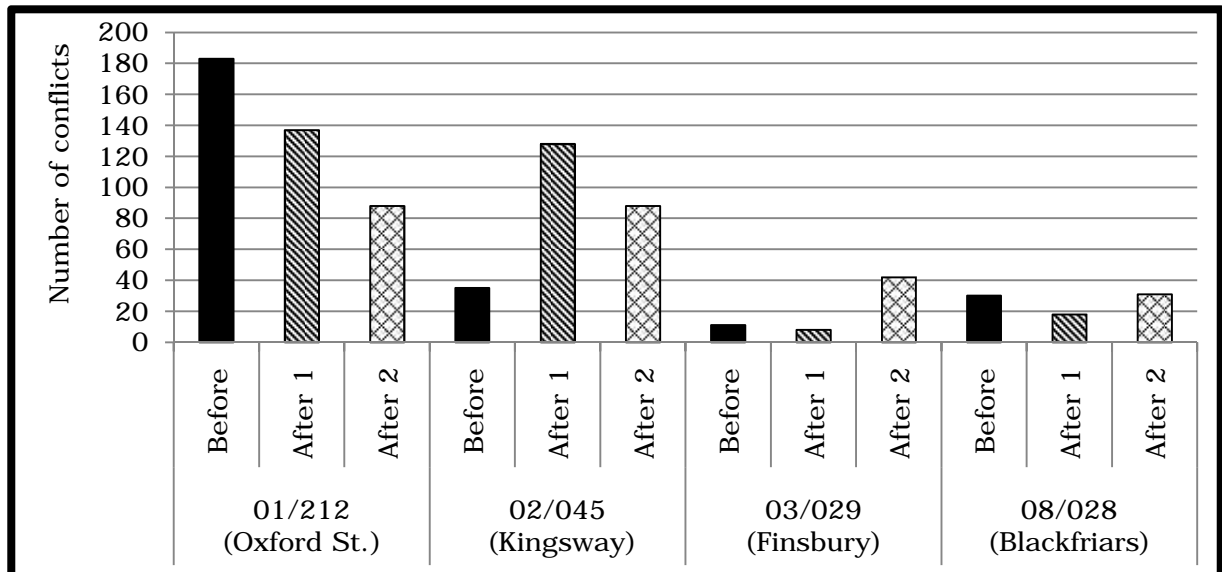


Figure 116 Number of multiple conflicts – Group 1

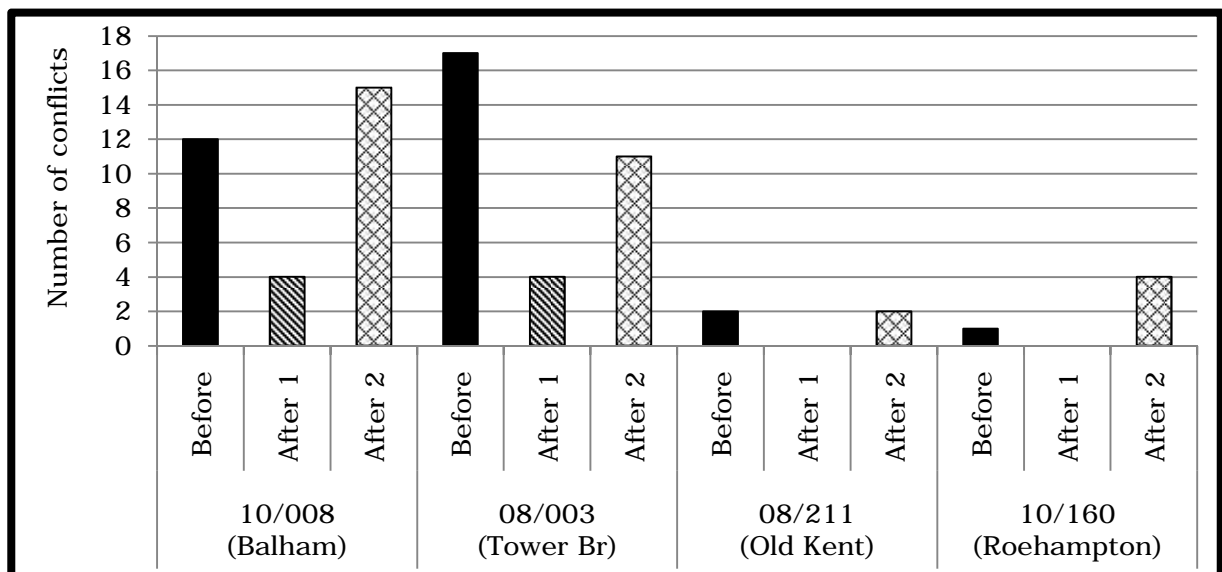


Figure 117 Number of multiple conflicts – Group 2

On Oxford Street and Tower Bridge the number of multiple conflicts reduced in the 'After' surveys, but there were increases on four of the sites in the 'After 2' survey

The number of conflicts on each site was in line with the relative pedestrian flows on each site.

On Oxford Street the number of multiple conflicts reduced with each survey. However, the number of multiple conflicts increased on four of the other sites in the 'After 2'

survey compared to the 'Before' survey, remained at the 'Before' levels on two sites and reduced on Tower Bridge. Also, on all but the two highest flow sites the number of multiple conflicts decreased in the 'After 1' survey, whilst pedestrians became accustomed to the PCaTS.

7.2.2 Conflict levels

Multiple conflicts that affected more one pedestrian at the same time were evaluated as a whole, and allocated to a single conflict level, which were measured on the same scale as the single conflicts. This provided an overall assessment of the severity of the action taken by the pedestrians involved and the vehicle(s) that conflicted with them.

However, multiple conflicts that consisted of individual pedestrians affected by the same event (i.e. occurred within 2 seconds of each other) had their level of conflict assessed individually. The approach taken was to allocate the conflict level of the first person to be affected to the whole multiple conflict. This was considered to be a reasonable approach as the first person affected is the initial part of the event and would be expected to be representative of its severity. Further, it is most likely that any subsequent pedestrians affected in the same multiple conflict would have encountered a conflict level of the same or less severity: tests showed that a higher conflict level was only encountered by subsequent pedestrians in nine multiple conflicts across all sites and surveys.

The level of severity of the multiple conflicts is shown in Figure 118 and Figure 119

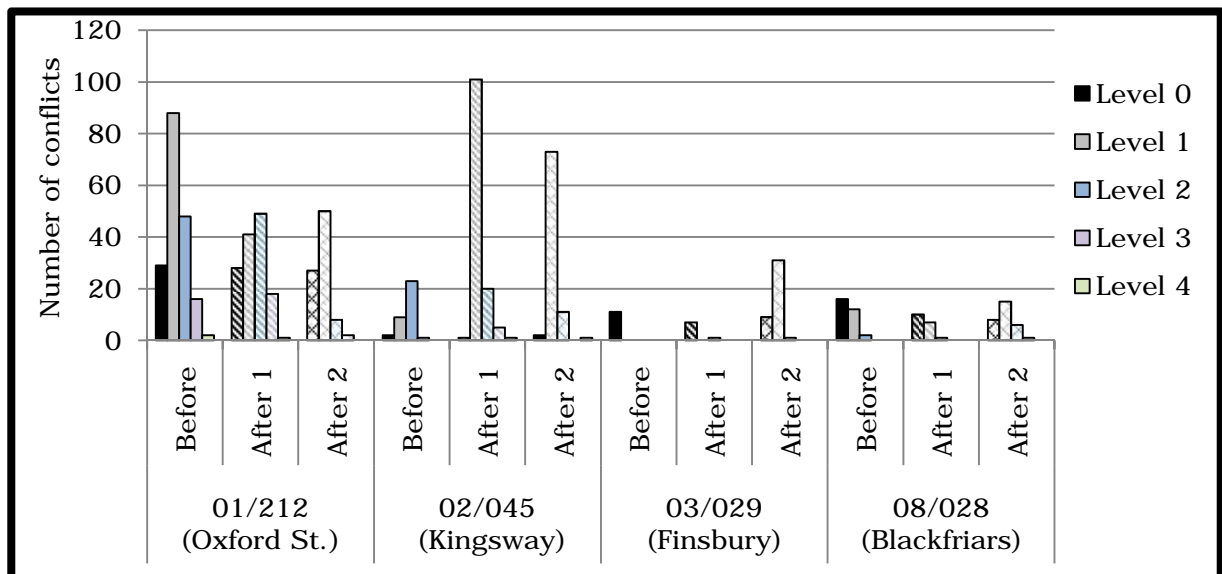


Figure 118 Number of conflicts at each level – Group 1

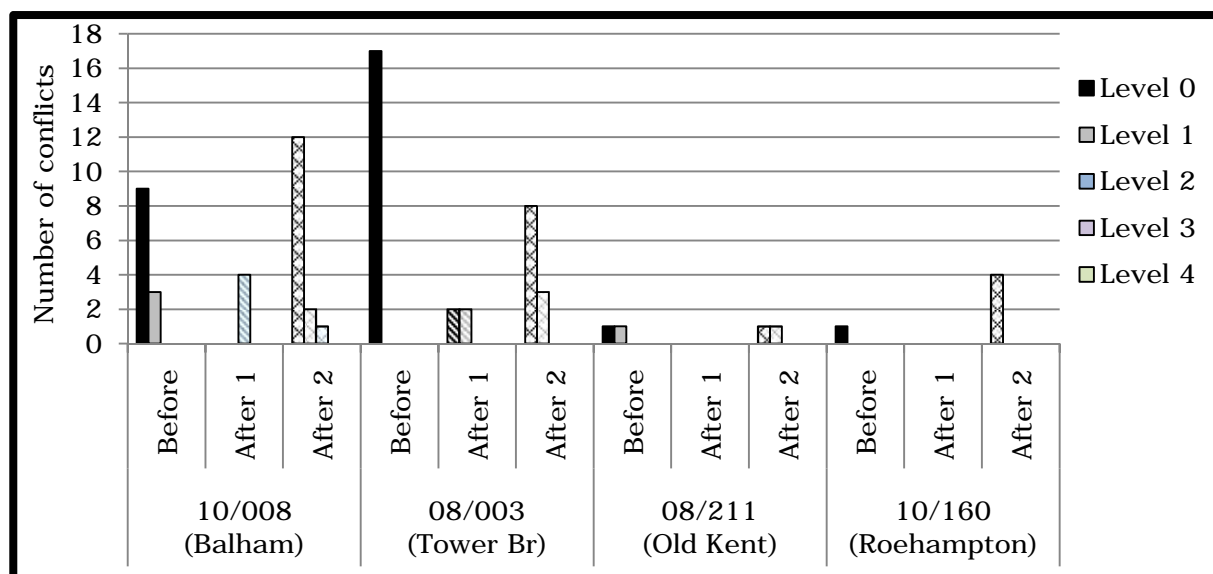


Figure 119 Number of conflicts at each level – Group 2

Just over half of all observed multiple conflicts were precautionary (Level 1).

On Oxford Street there was a decrease in multiple conflicts of all severities and an associated decrease in conflict rates.

On Kingsway, Finsbury and Blackfriars there were increases in multiple conflicts and conflicts rates, although those on Kingsway were associated with precautionary (Level 1) in the 'After 2', whilst the others occurred in conflicts of all severities.

The most prevalent level of conflict was Level 1, which accounted for 51% of all multiple conflicts across all sites and surveys. Level 2 conflicts accounted for 20% of all multiple conflicts, whilst Levels 3 and 4 combined accounted for only 6%. It is therefore not possible to isolate trends in the higher level conflicts at the lower flow sites, and Levels 2 to 4 are assessed together on the higher pedestrian flow sites.

Excluding the Level 0 conflicts, as with the single pedestrian conflicts, there was a decrease in the number of conflicts of all severity levels on Oxford Street in the 'After 2' survey, whilst there had been a decrease in Level 1 conflicts only in the 'After 1' survey. On Kingsway, the number of Level 1 conflicts rose in both 'After' surveys, but the number of Level 2 to 4 conflicts decreased in the 'After 2' survey after an initial increase in the 'After 1' survey. On Finsbury, and Blackfriars, there was an increase in Level 1 to 4 conflicts in the 'After 2' survey, although this increase was not evident in the 'After 1' survey. On the lower pedestrian flow sites, the number of Level 1 to 4 conflicts remained approximately the same on three sites and increased slightly on one site.

The examination of numbers of conflicts does not take into account variations in the number of pedestrians using the crossings. This is achieved by examining the conflict rates, or number of conflicts per pedestrian, see Figure 120 and Figure 121.

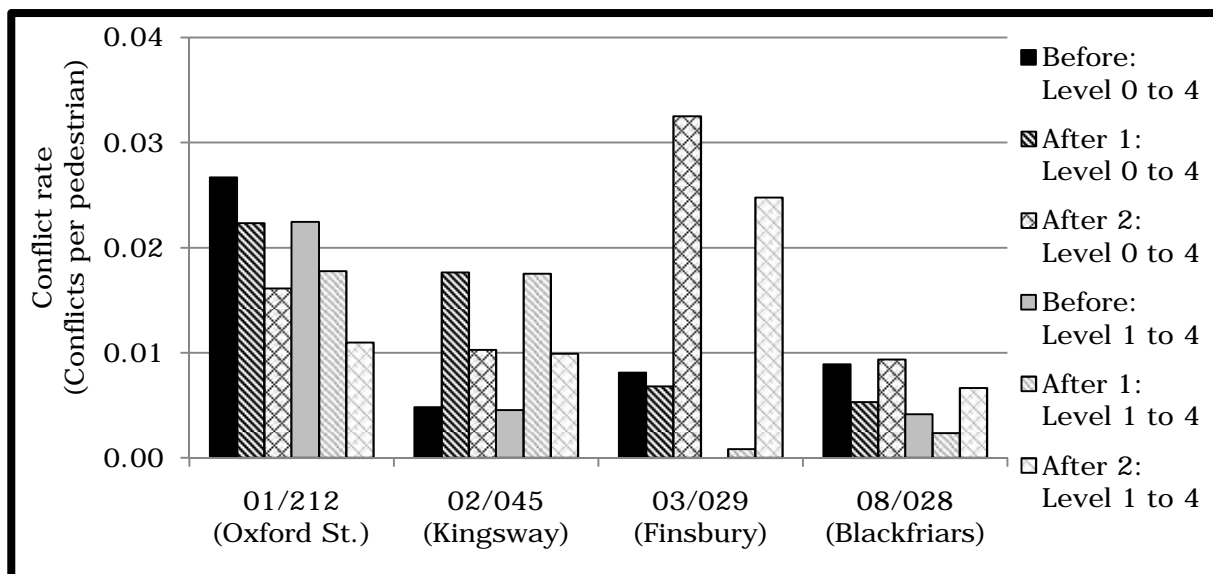


Figure 120 Conflict rate (per pedestrian) at each site – Group 1

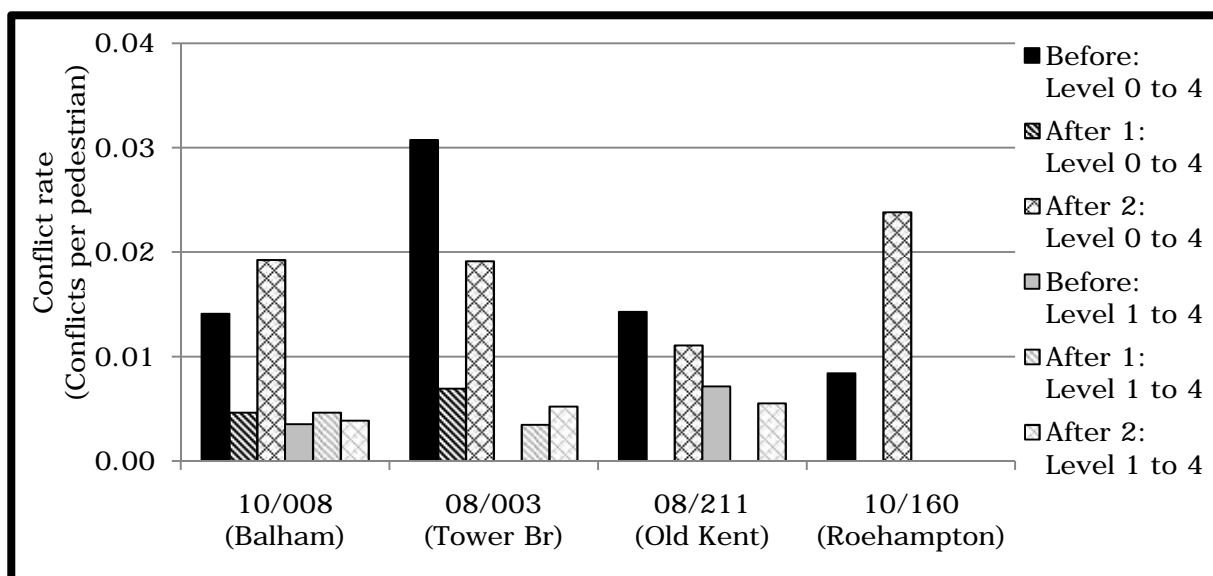


Figure 121 Conflict rate (per pedestrian) at each site – Group 2

In the 'After 1' survey, the only significant increase in Level 1 to 4 conflict rates was an increase on Kingsway. Also, although the conflict rate decreased in the 'After 2' survey, after pedestrians had become accustomed to PCaTS, it still represented a significant increase in the conflict rate compared to the 'Before' survey. There was also a significant increase in conflict rate in the 'After 2' survey on Finsbury, and a non-significant increase on Blackfriars. Although, in contrast, the conflict rate on Oxford Street significantly decreased in the 'After 2' survey. Owing to the small sample sizes the variations in conflict rates on the low flow pedestrian sites were not significant.

The greater pedestrian flows on the two highest flow sites (Oxford Street and Kingsway) also permit the examination in trends of Level 2 to 4 conflicts. On both sites the conflict rates associated with these more severe occurrences significantly decreased in the 'After 2' survey.

7.2.3 Number of people involved in the conflicts

Previous sections have considered the number of conflicts occurring on sites, as these can be accurately assessed. However, it is also possible to estimate the number of people involved in conflicts (Level 1 to 4). These are approximations because of difficulties obtaining an exact count of those affected when a large group is involved. The estimated number of pedestrians involved in such multiple conflicts are shown in Figure 122 and Figure 123.

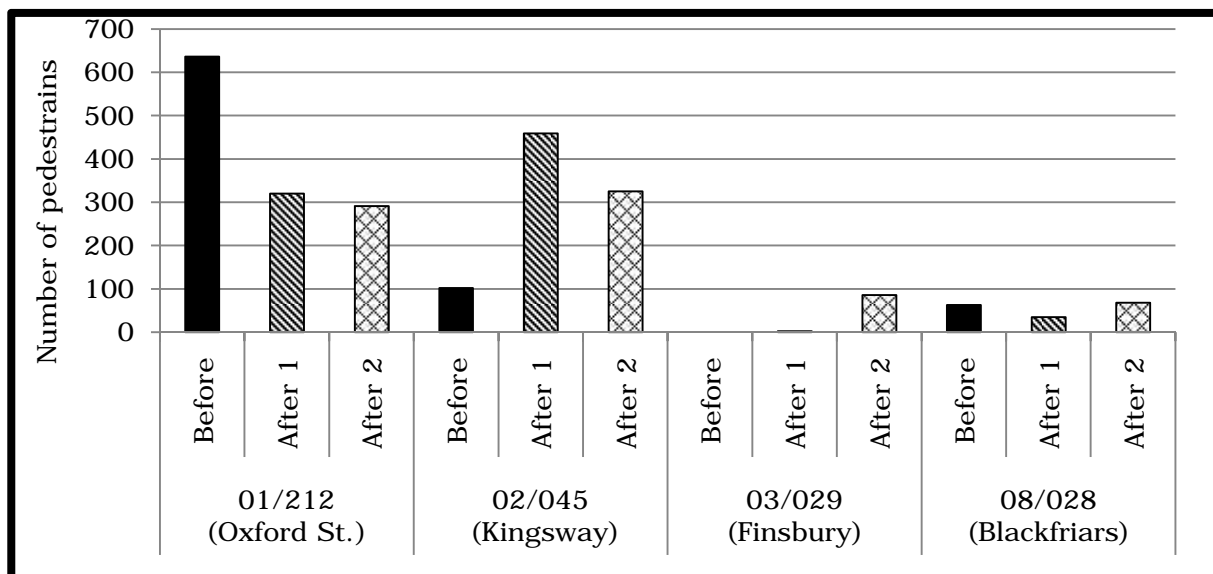


Figure 122 Number of pedestrians involved in multiple conflicts – Group 1

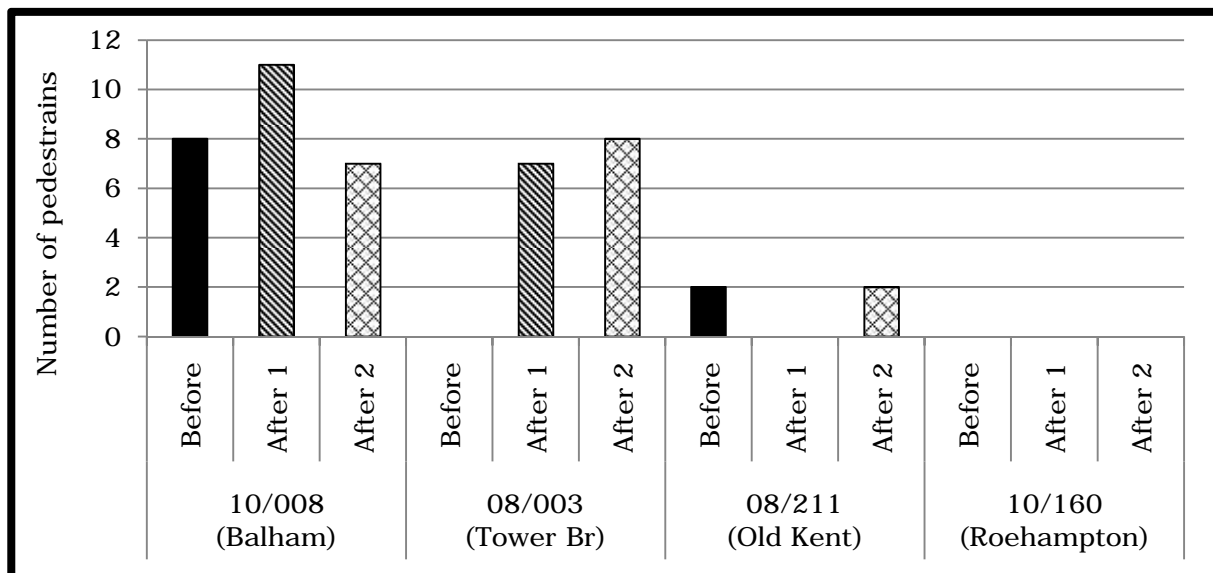


Figure 123 Number of pedestrians involved in multiple conflicts – Group 2

Trends in the number of pedestrians involved in multiple conflicts mirrored the trends in the number of conflicts.

There was a decrease in the number of pedestrians involved on Oxford Street and an associated significant decrease in the percentage of involved in such a conflict.

However, there were increases in the numbers involved on the other higher flow sites, with significant increases in the percentage of pedestrians involved on Kingsway, and on Finsbury in the 'After 2' survey.

There were no consistent trends on the lower pedestrian flow sites.

The same trends as in the number of conflicts are seen in the number of people involved in conflicts. That is, there was a decrease on Oxford Street, and increase on Kingsway and Finsbury and a small increase in the 'After 2' survey on Blackfriars. There were no consistent trends on the four lower pedestrian flow sites, probably because of the low numbers affected.

The conflict numbers have been standardised according to the pedestrian flows observed, to obtain the percentage of pedestrians involved in a conflict, these are shown in Figure 124 and Figure 125.

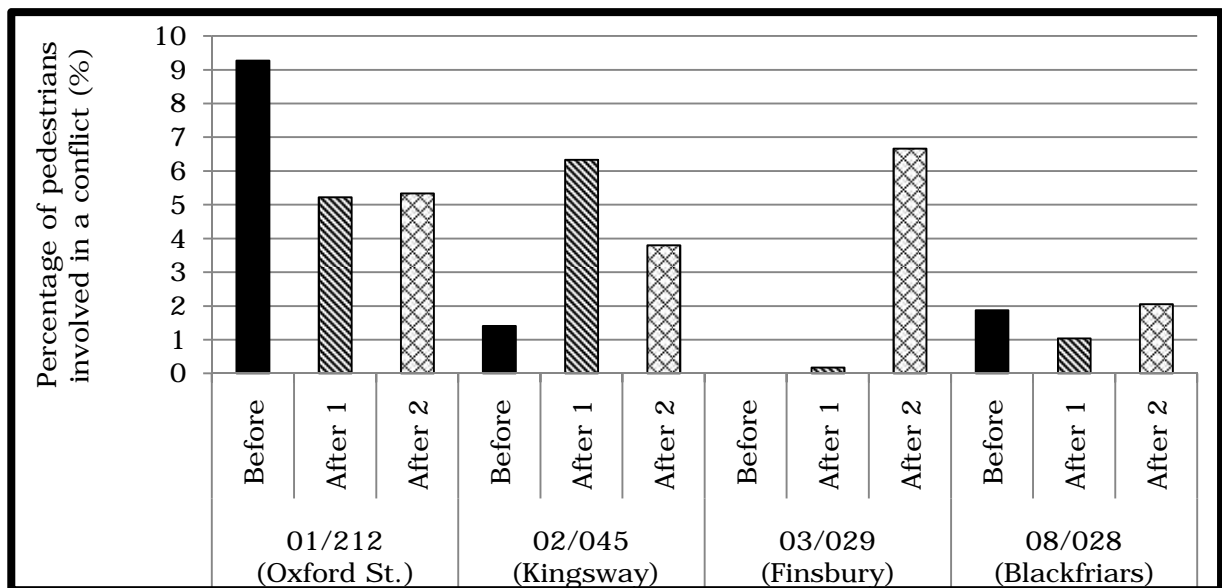


Figure 124 Percentage of pedestrians at each site involved in a conflict – Group 1

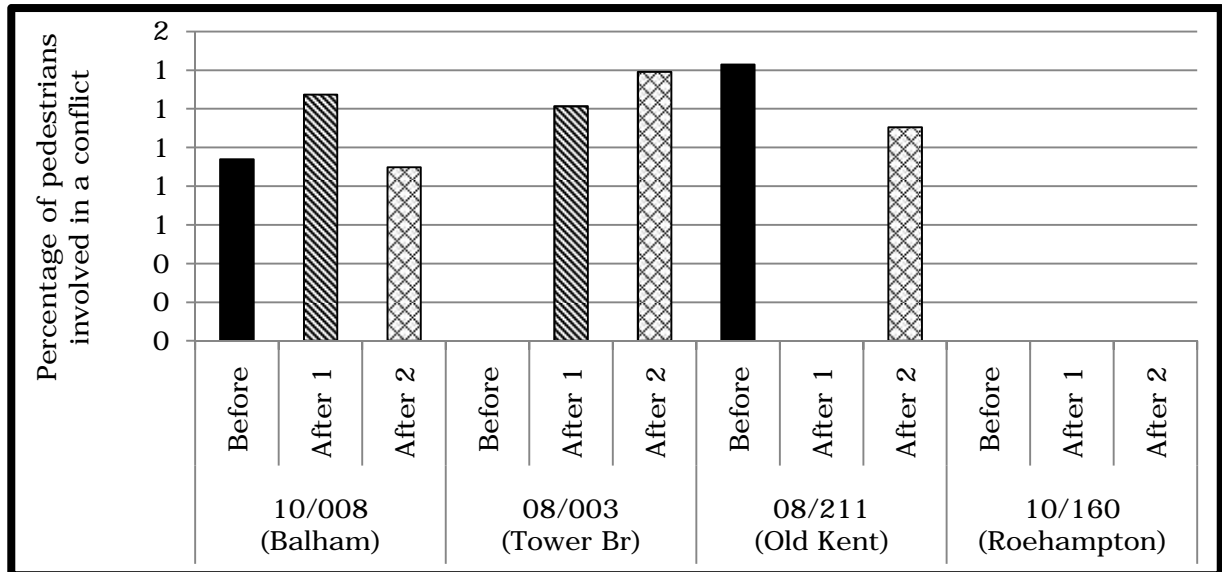


Figure 125 Percentage of pedestrians at each site involved in a conflict – Group 2

The conflict rates were the same order of magnitude on the high, and low, flow sites (see Section 7.2.2). However, the percentage of pedestrians involved in conflicts was generally higher on the high flow sites: this is almost certainly a result of multiple conflicts being with larger groups of pedestrians when they occur on the high flow sites.

The same variations between surveys were evident within both the percentage of people involved in multiple conflicts and the multiple conflict rates. There was a significant decrease (at the 95% confidence level) on Oxford Street, and significant increase on Kingsway, a significant increase in the ‘After 2’ surveys in Finsbury. The percentage of pedestrians involved in multiple conflicts was approximately the same after pedestrians had become accustomed to PCaTS on the other sites, except for Tower Bridge where there was a significant increase in conflicts.

7.2.4 Vehicles involved in conflicts

The other aspect to a conflict is to examine the other parties involved, i.e. the vehicles that were in conflict with the pedestrians. The vehicle type (for example, car/light goods vehicle or cycle) was recorded for the multiple conflicts. However, it should be noted that the vehicle type involved could not be ascertained for 32 (5%) of the multiple conflicts, and these were on the highest pedestrian flow sites (Oxford Street, Kingsway and Blackfriars). For this reason, the values in this analysis are slightly different to those in the previous analysis of the number of conflicts.

Further, on some conflicts more than one vehicle was involved. This was re-coded for consistency to be a conflict with the vehicle expected to result in the highest level of conflict. The vehicles involved in the conflicts of Level 1 and above are shown in Figure 126 and Figure 127.

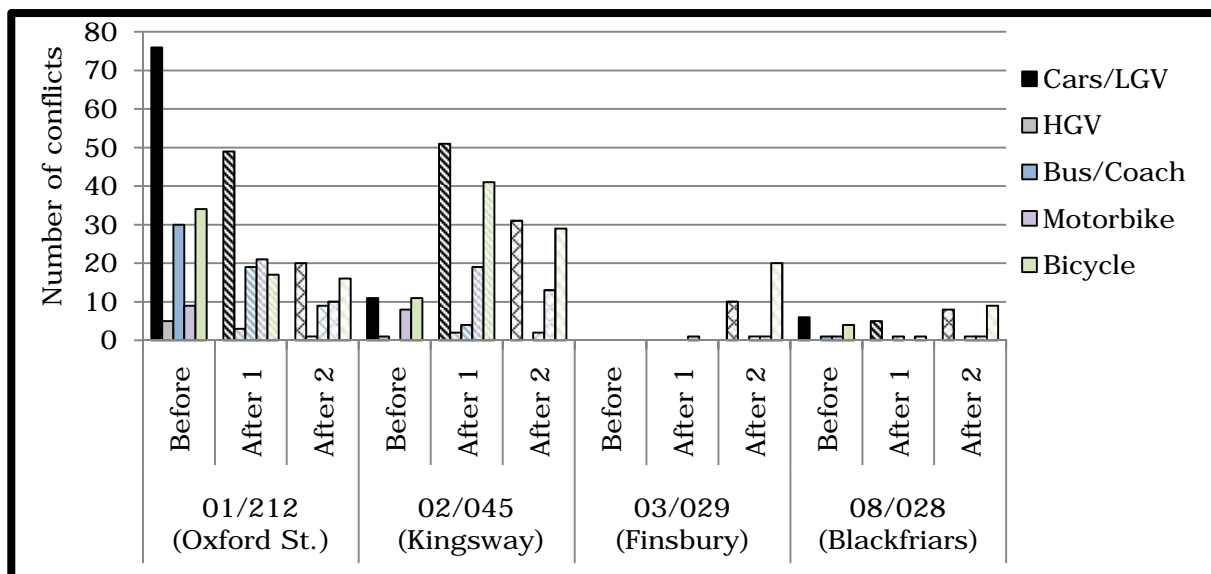


Figure 126 Vehicles involved in the conflicts – Group 1

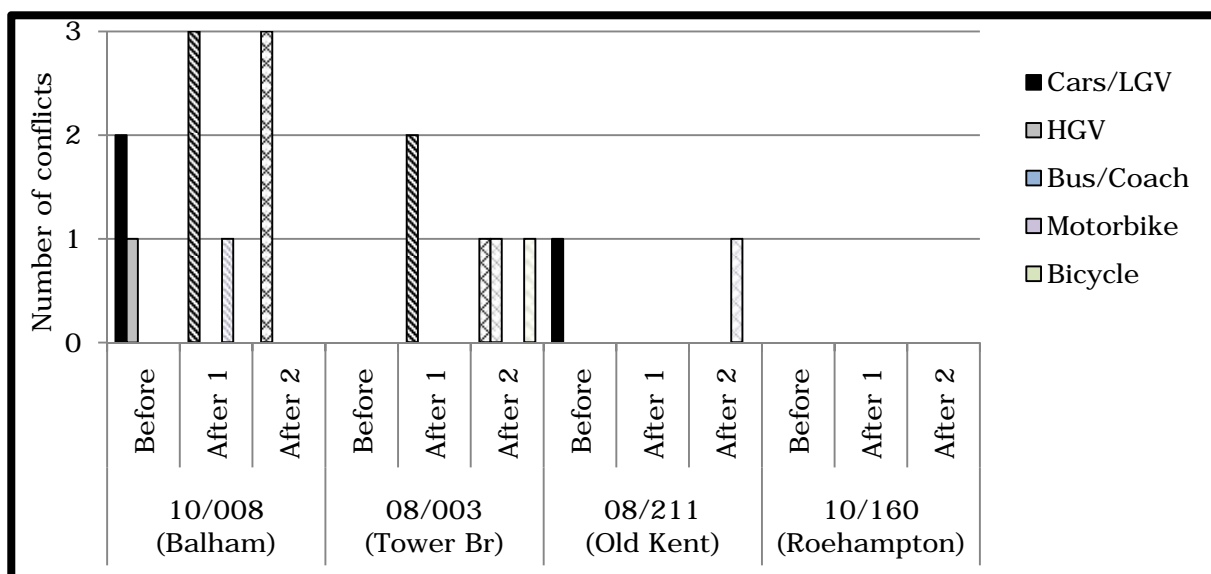


Figure 127 Vehicles involved in the conflicts – Group 2

On the high flow sites there was a significant decrease in the percentage of multiple conflicts involving buses and coaches.

The most significant percentage increase in multiple conflicts occurred amongst cycles, with increases on five sites and an increase from 25% of all multiple conflicts on high pedestrian flow sites in the 'Before' survey to 40% in the 'After 2' survey. There was also a (non-significant) increase on the low pedestrian flow sites from 0% to 14%

On the low-flow sites there were few multiple conflicts, with cars and light goods vehicles accounting for approximately 80% of them in the 'Before' and 'After 1' surveys, but only 57% in the 'After 2' survey. In contrast there were increases in the percentage of multiple conflicts involving cycles and motorcycles, especially in the 'After 2' survey, but the changes were not statistically significant.

On high flow sites cars and light goods vehicles accounted for 31 to 71% of the multiple conflicts. Over all the high flow sites (i.e. amalgamated data) there was a significant decrease in multiple conflicts involving buses. Whilst on Oxford Street there was a significant increase in the percentage of multiple conflicts involving motorcycles.

Examining the cycle and motorcycles in more detail, the percentage of multiple conflicts involving motorcycles had increased on two sites and was significant on one. However, the percentage involving cycles had increased on five sites with the change over all high flow sites being from 25% in the 'Before' to 40% in the 'After 2' survey (a significant change), and the change on the low flow sites being from 0% in the 'Before' to 14% in the 'After 2' survey (a non-significant change). So, as with single conflicts, the percentage of involving cycles was greater than the percentage of the flow they represent on high pedestrian flow sites.

7.2.5 Vehicle Manoeuvres

Information was collected during the survey on the direction of a vehicle was travelling in when it was involved in a conflict: either exiting, or entering, the junction. As with the single pedestrian conflicts, this is of relevance as those exiting the junction are waiting at the stop line near to the crossing during the pedestrian phase, whilst those entering the junction have travelled from another of the junction's arms. The directions of the vehicles involved in the conflicts are shown in Figure 128 and Figure 129.

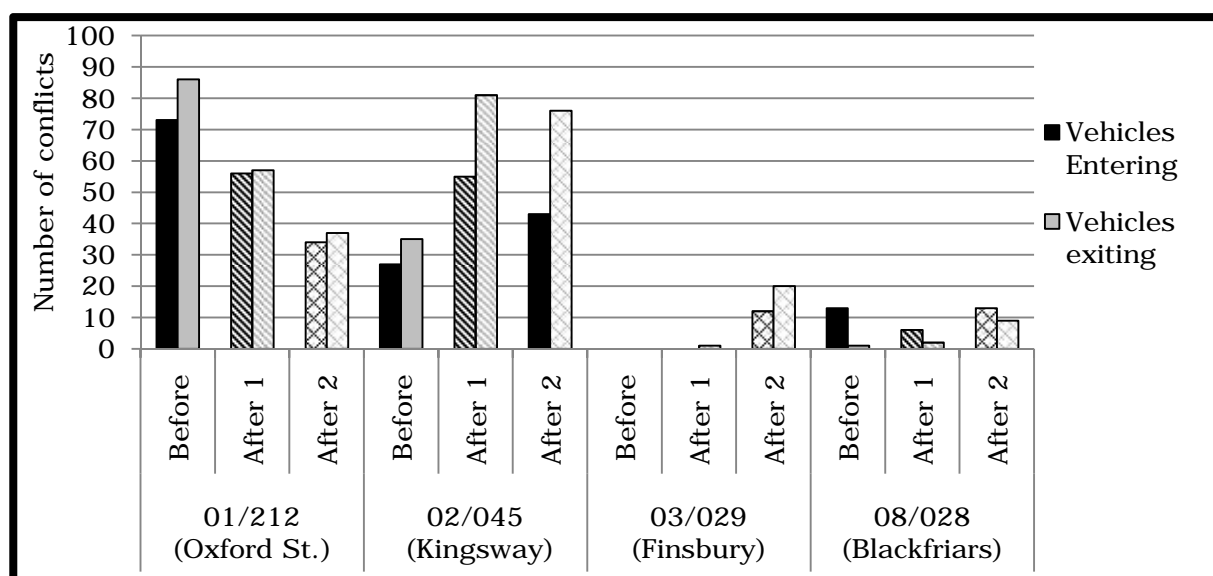


Figure 128 Direction of vehicles involved in conflicts – Group 1

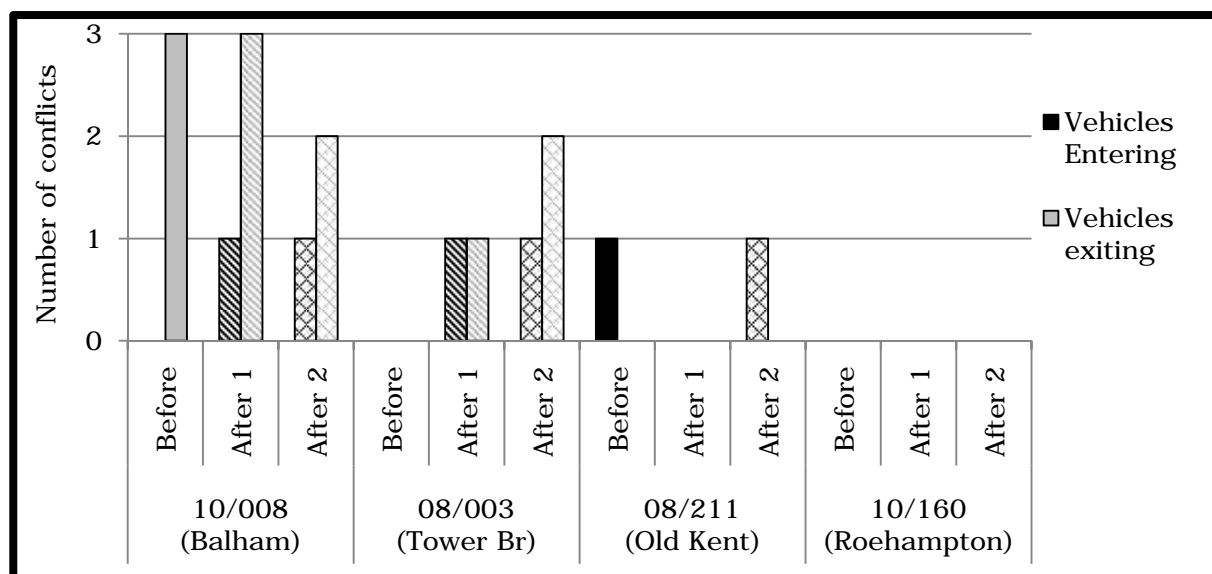


Figure 129 Direction of vehicles involved in conflicts – Group 2

Most multiple conflicts involved vehicles exiting the junction. However, there was little evidence of any changes between the surveys.

On high flow site the percentage of multiple conflicts involving vehicles exiting the junction varied from 50 to 64% across all sites and surveys where at least 30 multiple conflicts occurred. The average percentages ranged from 52% in the 'Before' to 58% in the 'After 2' survey.

On low flow sites the average percentage of multiple conflicts involving vehicles exiting the junction varied from 75% in the 'Before' to 57% in the 'After 2' survey.

Overall, the sample sizes or the changes, were small and there was little evidence of any observed changes in conflicts being associated with vehicles making a particular manoeuvre.

7.2.6 Pedestrian Phase

The time a pedestrian crosses could be a causal effect to a conflict occurring. For example, if crossing in the Green Man they should have total priority and not be involved in a conflict, whilst in contrast if crossing during the Red Man they could be in conflict with moving vehicles. The time that pedestrians started to cross and the time of the conflict were classified in the same manner as the single person conflicts, that is:

The time that the pedestrian started to cross was recorded together with the pedestrian phase, referred to as:

- 'Red Man 1',
- 'Green Man 1'
- 'Blackout 1' (before)
- 'Countdown 1' (after)

The pedestrian phase at the time of the conflict was referred to as:

- 'Red Man 2',

- 'Green Man 2'
- 'Blackout 2' (before)
- 'Countdown 2' (after)

The phases at the time of the conflicts are shown in Figure 130 and Figure 131.

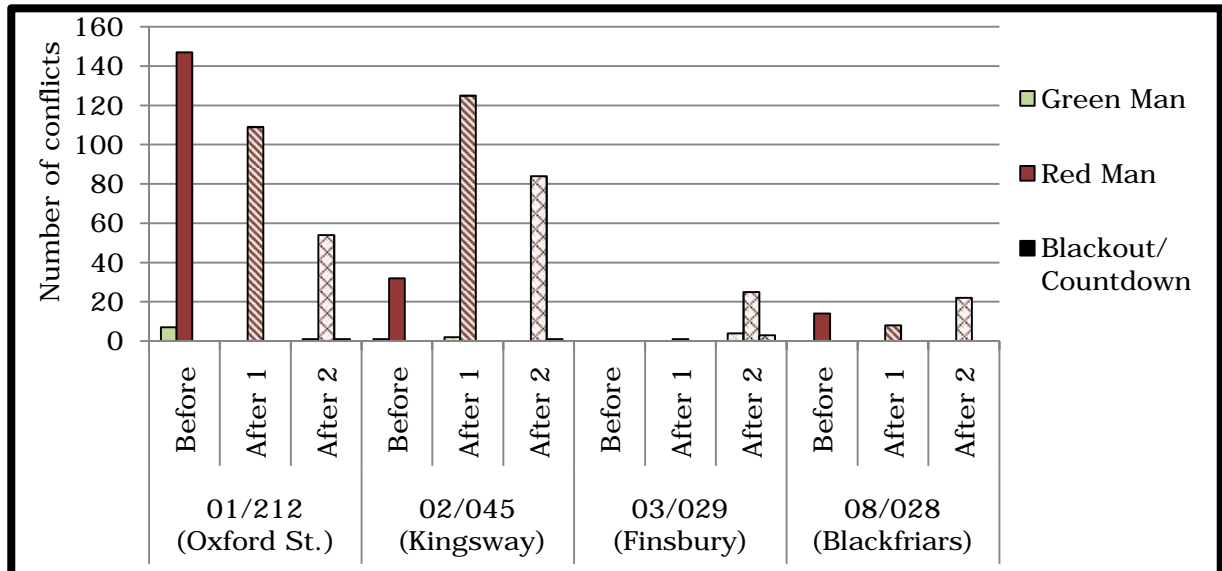


Figure 130 Phase during which the conflict occurred – Group 1

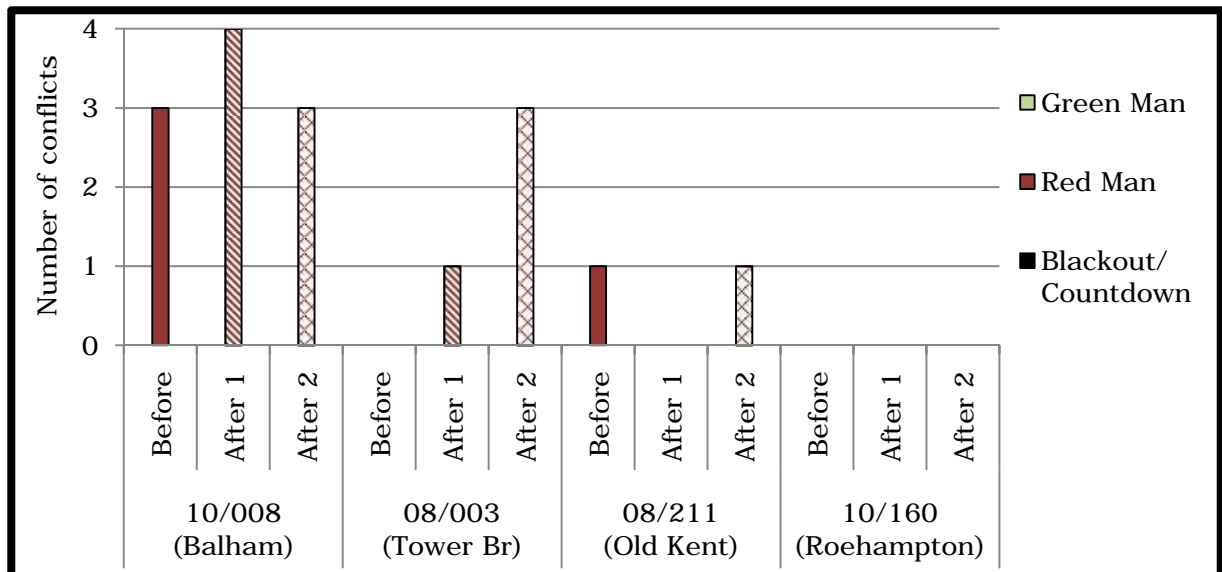


Figure 131 Phase during which the conflict occurred – Group 2

Nearly all multiple conflicts occurred in the Red Man phase.

There were no common trends for when in the Red Man phase the conflicts occurred on the higher flow sites. On the two highest pedestrian flow sites (Oxford Street and Kingsway) they generally appeared to occur more than four seconds after the start of the Red Man, whilst they appeared to occur earlier on the other two high flow sites.

Nearly all multiple conflicts occurred during the Red Man: 97% across all surveys on high flow site and 100% across all surveys on low flow sites.

It is therefore clear that conflicts are associated with pedestrians crossing during the Red Man. This has therefore been investigated further. In particular, the time after the start of the Red Man when the conflict occurred has been considered. As with the single pedestrian conflicts this analysis aimed to determine whether conflicts occurred directly after the start of the Red Man indicating that the pedestrian started to cross near the end of the pedestrian phase, or after this time when the pedestrian had made a conscious decision to cross in the Red.

The analysis was conducted for pedestrians crossing A to B for conflicts of Level 1 or above; that is they started on the side of the crossing where the traffic was waiting at the stop line. The number of conflicts were banded into those occurring 0 to 4 seconds, 5 to 9 seconds and 10 to 14 seconds after the start of the Red Man, see Figure 132.

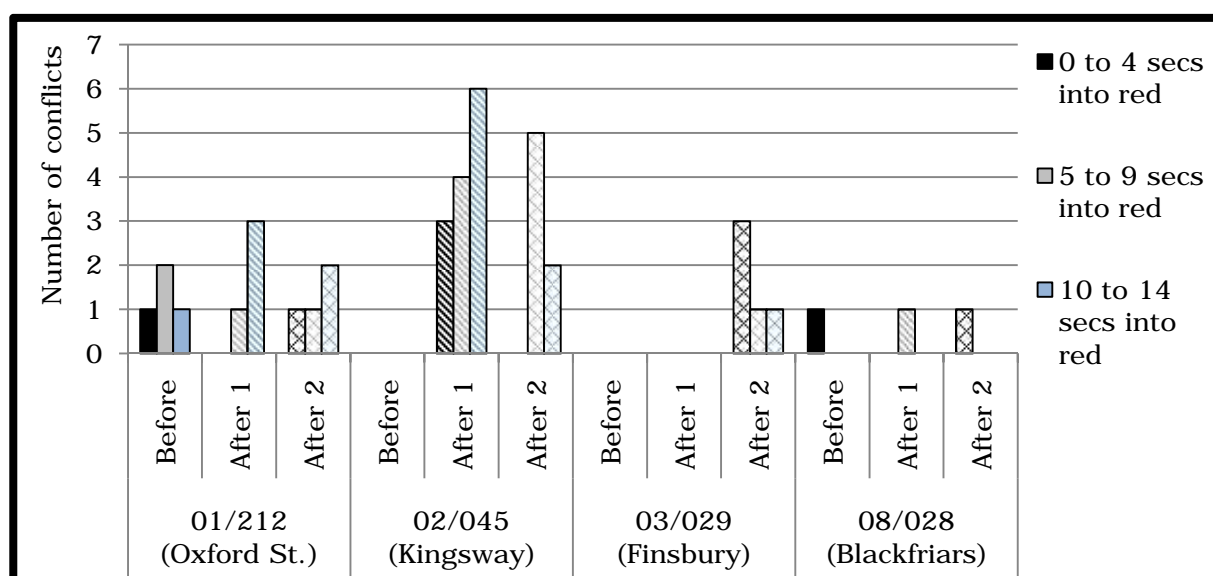


Figure 132 Time into the red man at which the conflict occurred – Group 1

This data was only available for a limited number of conflicts so the results should be treated with caution, and none occurred on the lower pedestrian flow sites.

There were no common trends for when the conflicts occurred on the higher flow sites. At the highest flow sites (Oxford Street and Kingsway) most multiple conflicts occurred more than 4 seconds after the start of the red man phase. At Finsbury and Blackfriars the conflicts tended to occur earlier on in the Red man phase.

7.3 Overall effect on conflicts

The previous sections have examined two slightly different types of conflicts in isolation, those involving a single pedestrian and a vehicle, and those that affected a group of pedestrians. This section draws together the findings from this analysis to consider the overall effect of the PCaTS schemes on conflicts on the eight pedestrian crossings studied.

7.3.1 Number of all types of conflict

The total number of all conflicts that occurred and of conflict severity levels 1 to 4 are shown in Figure 133 and Figure 134.

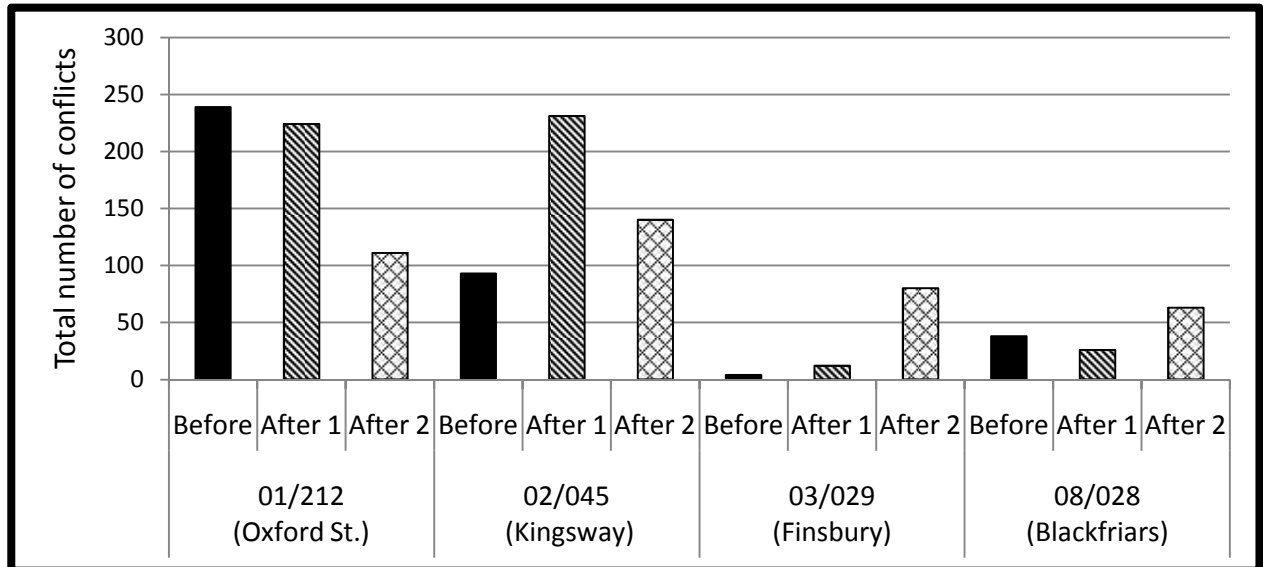


Figure 133 Number of all conflicts – Group 1

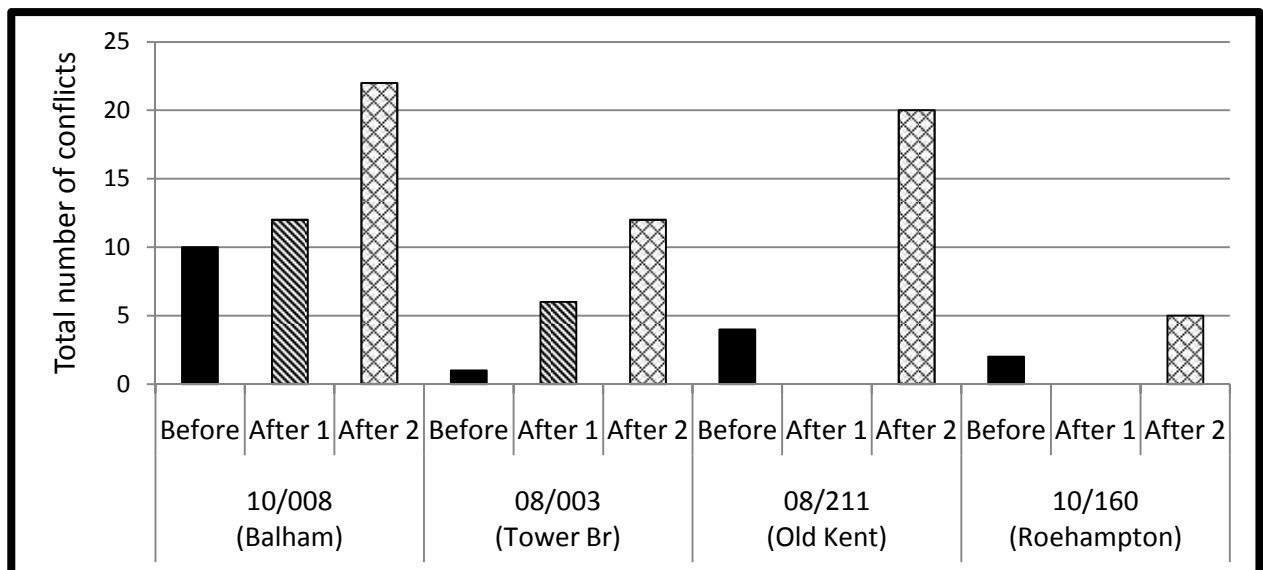


Figure 134 Number of all conflicts – Group 2

The number of conflicts decreased on Oxford Street, but increased on all other sites, though mostly Level 1, and the increase was significant on five of the sites.

On Oxford Street there was a decrease in the total number of conflicts during the ‘After’ surveys, but increases were evident on the other sites especially in the ‘After 2’ survey.

However, this analysis does not take account of the variation in number of pedestrians using the crossing and therefore the relative risk to pedestrians. The conflict rate, that is

the number of conflicts per person using the crossing is summarised in Figure 135 and Figure 136.

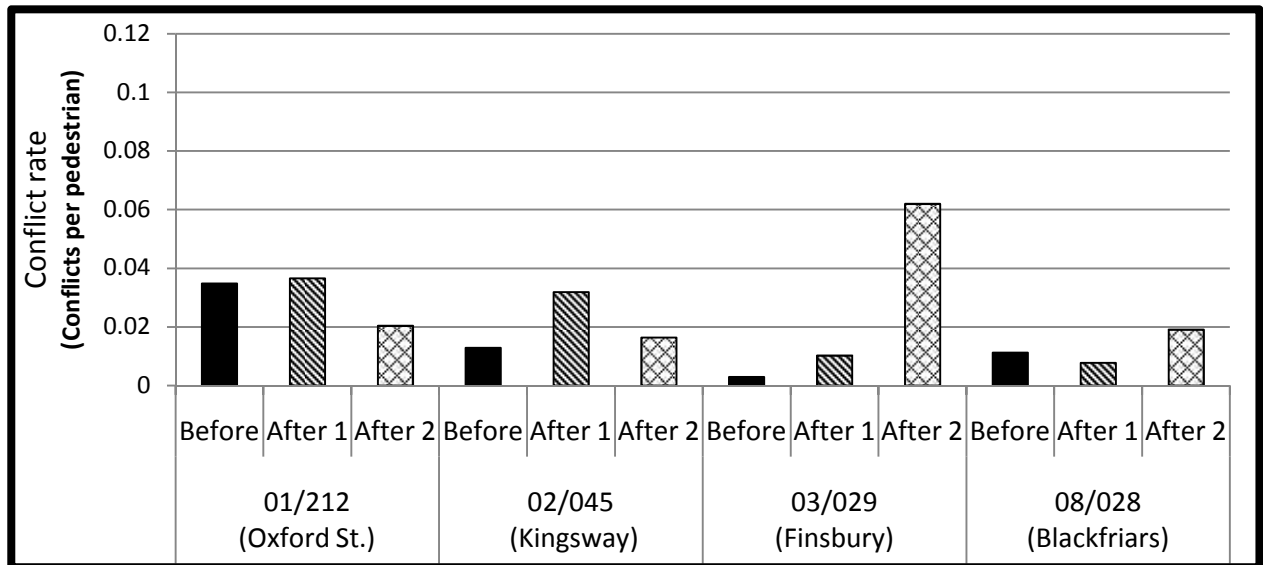


Figure 135 Conflict rate (per pedestrian) at each site – Group 1

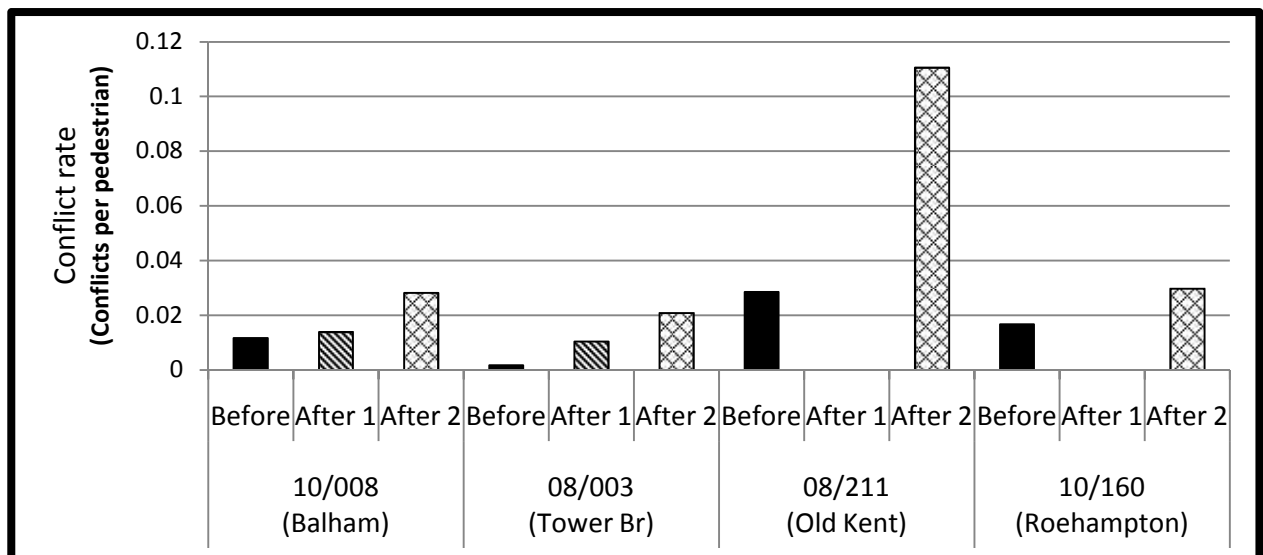


Figure 136 Conflict rate (per pedestrian) at each site – Group 2

Overall the same patterns of a reduction in conflict rate on Oxford Street and an increase on the other sites, particularly in the 'After 2' survey is seen. A statistical test of the relative probability of a conflict affecting a pedestrian showed that the decrease on Oxford Street was significant in the 'After 2' survey, and that the increases on five of the other sites were also significant (with the changes in Kingsway and Roehampton not being significant).

7.3.2 Conflict Levels

The previous section considered the effect of the schemes on the total number of conflicts of Level 1 up to Level 5, although no Level 5 conflicts were observed. These

show overall trends but not the severity of the conflicts. The number of conflicts observed according to their severity are summarised in Figure 137 and Figure 138.

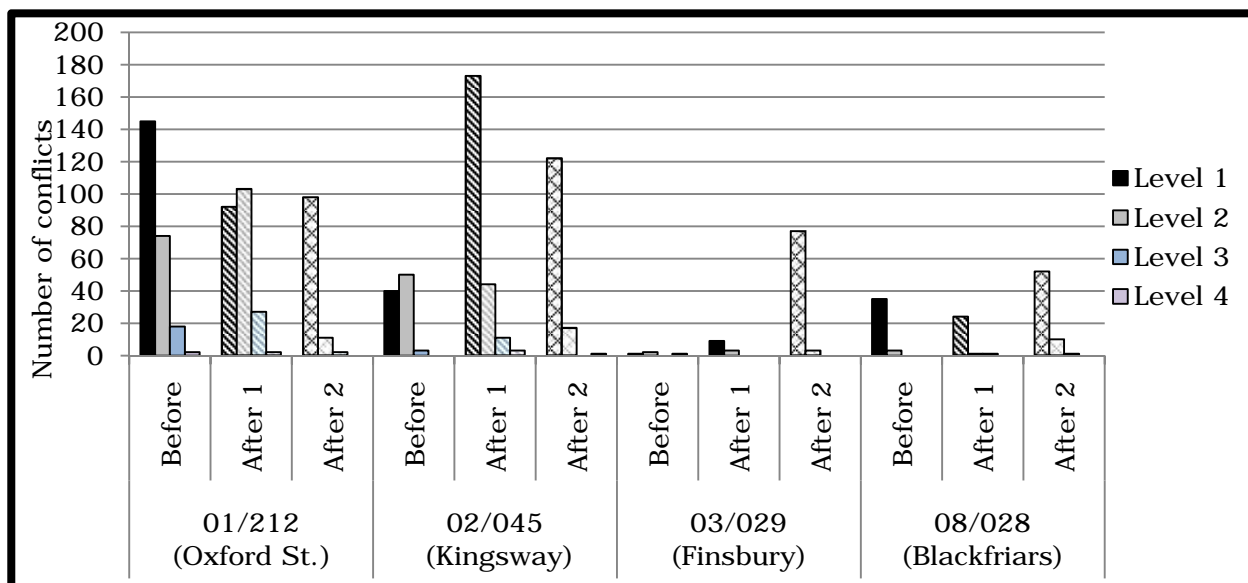


Figure 137 Conflict levels at each site – Group 1

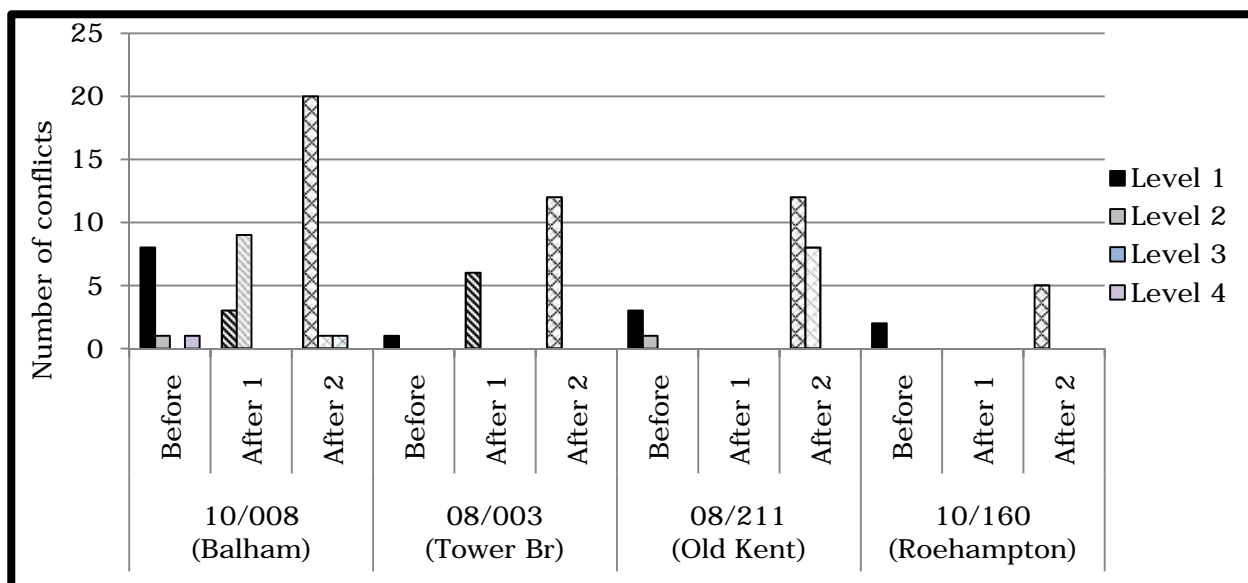


Figure 138 Conflict levels at each site – Group 2

On Oxford Street there was a reduction in the number of conflicts of all severities, however, the reduction was greater amongst those of higher severity and the reduction amongst the percentage of conflicts of Level 2 to 4 was significant.

Previous analysis showed there were increases in the number of conflicts on the other sites. However, the number of Level 2 to 4 conflicts on five of these sites either remained the same, or decreased, and the increase in conflicts were amongst the precautionary (Level 1) conflicts in the 'After 2' survey compared with the 'Before' survey. On the remaining two sites (Blackfriars and Old Kent) there were increases in both the number of Level 1 and 2 conflicts.

7.3.3 Number of people involved in the conflicts

Previous sections have considered the number of conflicts occurring on sites, as these can be accurately assessed. However, as with the multiple conflict analysis, it is also possible to estimate the number of people involved in all conflicts (Level 1 to 4). These are approximations because of difficulties obtaining an exact count of those affected when a large group is involved in the multiple conflicts. The estimated number of pedestrians involved in such multiple conflicts are shown in Figure 139 and Figure 140

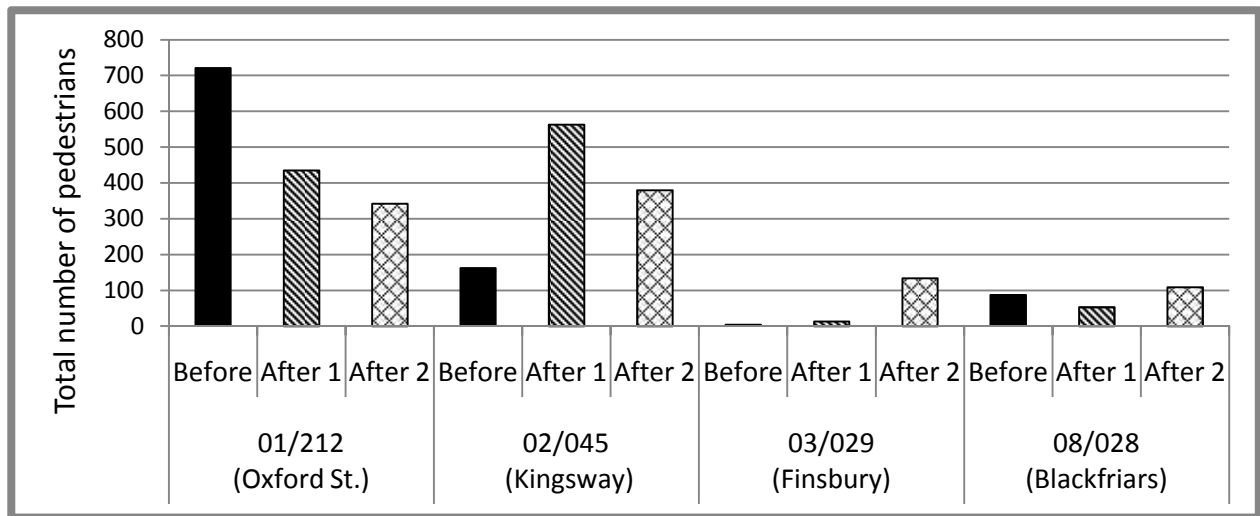


Figure 139 Number of pedestrians involved in all conflicts – Group 1

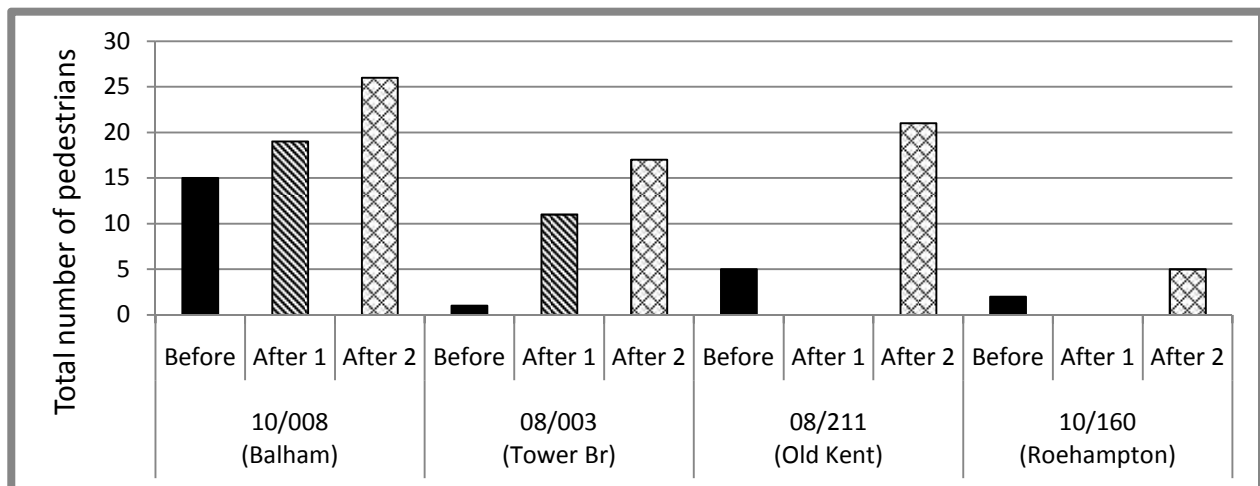


Figure 140 Number of pedestrians involved in all conflicts – Group 2

The number of pedestrians being involved in a conflict significantly decreased on Oxford Street, but increased on all other sites, with the increase being significant on five sites.

The trends in the number of pedestrians involved mirror those of the number of conflicts. There were decreases in the number of pedestrians involved in conflicts on Oxford Street, but increased on all other sites in the 'After 2' survey. These values have been standardised by the number of pedestrians using the crossing to estimate the probability of a pedestrian being involved in a conflict, see Figure 141 and Figure 142.

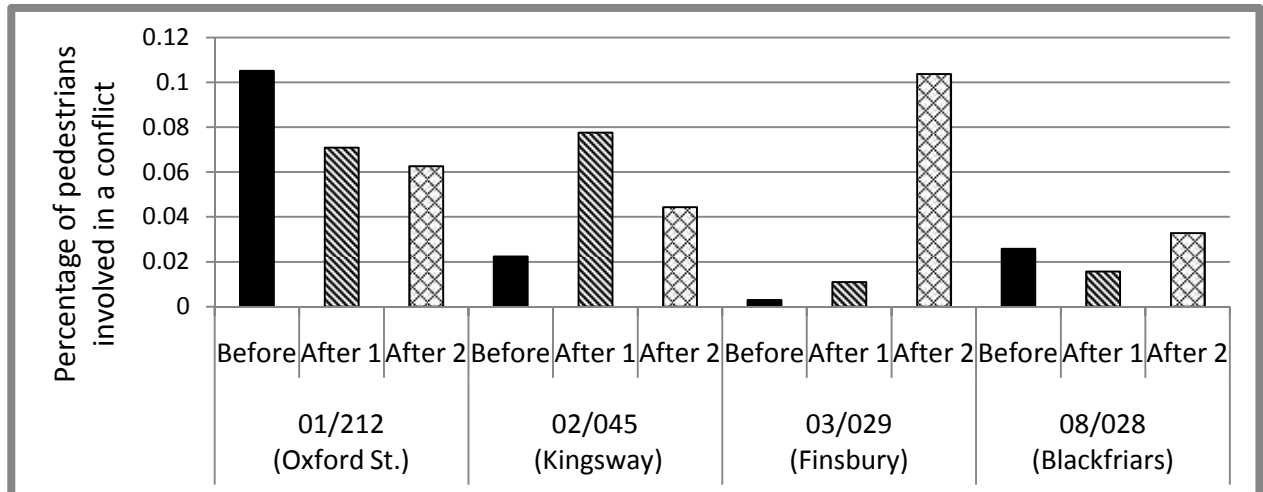


Figure 141 Percentage of pedestrians at each site involved in a conflict – Group 1

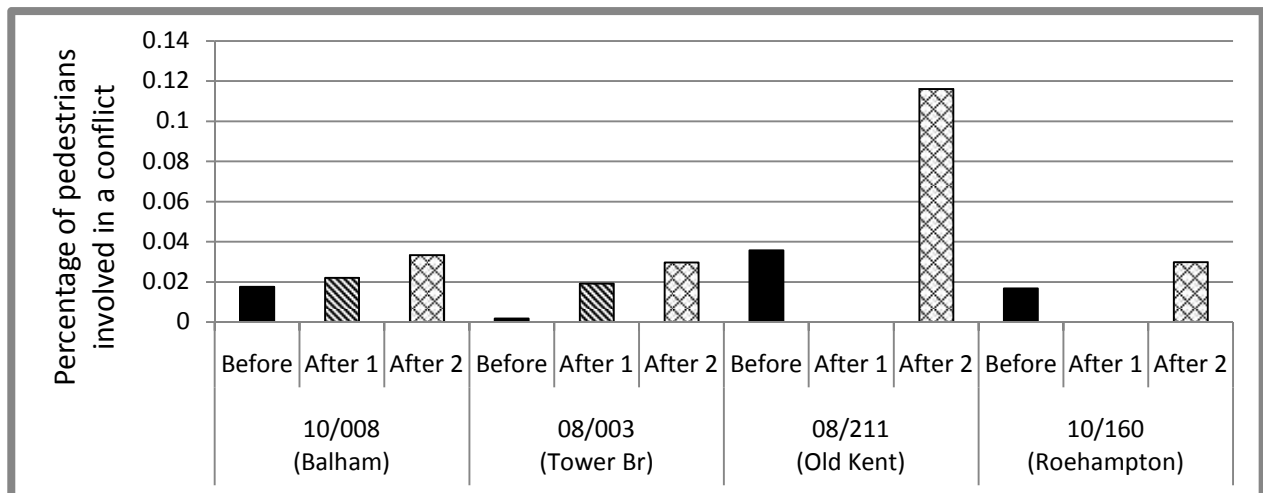


Figure 142 Percentage of pedestrians at each site involved in a conflict – Group 2

The probability of a pedestrian being involved in a conflict significantly decreased on Oxford Street in the 'After 2' survey. However, the probability of a pedestrian being involved in a conflict increased on all other sites and the increases were significant on five sites.

7.3.4 Other overall findings

It is possible to compare and contrast the circumstances underlying both the single person and multi-person conflicts. This analysis indicates that in general:

- Most conflicts on sites involve cars and light goods vehicles, as these are the main component of traffic.
- There were increases in conflicts involving cycles and the percentage of conflicts involving them was greater than the percentage of the traffic they represented, as was the case with motorcycles.
- There were more conflicts involving vehicles entering, than exiting the junction. However, the introduction of PCaTS did not appear to affect this ratio.
- Most conflicts occurred whilst the Red Man was showing. On high flow sites, single person conflicts appeared to be more likely to occur shortly after the start of the Red Man, whilst multiple person conflicts were more likely later.

7.4 Summary of Findings

The conflict analysis was conducted in two separate elements, the first considered conflicts involving a single pedestrian (single conflict), whilst the second considered those involving more than one pedestrian (multiple conflict). This was necessary owing to variations in the information that could be collected for the two types of conflict. However, the overall conclusions are:

1. On all sites, most of the conflicts occurred during the Red Man. For single conflicts an average of 94% occurred during the Red Man on the high pedestrian flow sites (Group 1) and 84% on the low flow pedestrian sites (Group 2). For single conflicts, there was weak evidence that increases did occur shortly after the start of the Red Man, on the high flow sites. Similarly, with multiple conflicts 97% were during the Red Man on the high pedestrian flow sites (Group 1) and 100% on the low flow pedestrian sites (Group 2). On the two highest flow sites (Oxford Street and Kingsway) these occurred shortly after the start of the Red Man, although they generally appeared to occur more than 4 seconds after the start of the Red Man on the other two high flow sites.
2. On all sites except Oxford Street and Kingsway the number of conflicts varied in accordance with the pedestrian flows in all three surveys. On the two highest flow sites there were at most 240 conflicts in any one survey, on the next highest flow sites 80, and on the lowest flow sites 22, conflicts in any one survey. These conflicts were observed for 15 minute periods in each of 12 hours. Thus they implied maximum conflict rates were 80, 27 and 7 per hour on these three types of sites.
3. In the 'After 2' surveys, single conflict rates (of level 1 and above) were similar to the 'Before' survey on Oxford Street and Kingsway. However, they increased from 0.3 to 3.7% on Finsbury. Also, the conflict rate increased on the other five sites from within the range 0.2 to 2.1% to with the range 3.0 to 10.5% in the 'After 2' surveys. This was after a limited settling period (2 to 3 months). The initial effects shortly after the package of measures (including PCaTS) was introduced were increases, significant at the 95% level, on Oxford Street from 1.2% to 1.9% (85 to 114) and Kingsway from 0.7% to 1.2% (60 to 104). There was also a significant increase on Finsbury from 0.3% to 0.9% (4 to 11) and a significant

decrease on Old Kent from 2.1% to 0.0% (4 to 0); however, these two results should be treated with caution due to the low sample sizes.

4. In the 'After 2' surveys, multiple conflict rates (of level zero and above) reduced on Oxford Street from 2.3 to 1.1%. However, there were increases on the other three higher flow sites, with the increases being significant on Kingsway (0.5 to 1%) and Finsbury (0 to 2.5%). As expected, the number of multiple conflicts on the lower flow sites were small and occurred with less than 0.7% of pedestrian flow, therefore changes were not significant.
5. Overall, considering single and multiple conflicts the rate significantly decreased on Oxford Street (3.5 to 2%), but increased on all other sites and the increases were only not significant on Kingsway and Roehampton. Considering the five sites with significant increases, the conflict rate increased from within the range 0.2 to 1.1% to with the range 1.9 to 2.8% on three of the sites. On Finsbury the conflict rate increased from 3.0 to 6.2% and on Old Kent Road it increased from 2.8 to 11.1%
6. In the 'After 2' surveys, any increases in single conflict rates were generally associated with minor, precautionary (Level 1), conflicts. There were decreases in the number of higher level conflicts on Oxford Street (28 to 4) and Kingsway (29 to 6), but increases on two of the lower pedestrian flow sites, one of which was significant. In the 'After 1' survey, there were increases on Oxford Street in Level 2 (26 to 53) and Level 3 (2 to 9) conflicts, which were significant at the 95% Level. On Kingsway, there were increases in Level 3 (2 to 6) and Level 4 (0 to 2) conflicts however these were not statistically significant.
7. In the 'After 2' surveys, there were decreases in numbers of multiple conflicts of all levels of severity. On Kingsway there were increases in Level 1 multiple conflicts (6 to 73), but a reduction in the number of higher level multiple conflicts (24 to 12). On both Finsbury and Blackfriars there were increases in both Level 1 and higher level multiple conflicts.
8. Overall, in the 'After 2' survey, (single and multiple) conflicts reduced at all levels on Oxford Street: Level one from 145 to 98 and higher levels from 94 to 13. However, they increased at all levels on Old Kent Road (Level one from 3 to 12 and higher levels from 1 to 8) and Blackfriars (Level one from 35 to 52 and higher levels from 3 to 11). On the remaining five sites the Level 1 conflicts increased whilst the higher level conflicts decreased: the total number of Level one conflicts across the five sites increased from 52 to 236, whilst the higher level conflicts decreased from 58 to 23.
9. On most sites more men than women were involved in conflicts in all three surveys.
10. The analysis indicated that more 30 to 60 year olds were involved in conflicts in the 'Before' survey (58%). In the 'After 2' survey the percentage of 30 to 60 year olds involved in conflicts increased to 93%. However, in the 'After 1', whilst the schemes were settling in, more under 30 year olds were involved (55%).
11. On Oxford Street there were large increases in the number of single pedestrian conflicts involving cars and light goods vehicles in the 'After 1' survey, and this was also generally true on Kingsway. The increase was maintained on Kingsway, but was no longer evident on Oxford Street, in the 'After 2' surveys. The main consistent trend was an increase in the percentage of conflicts involving cycles, which increased on six sites and was statistically significant on three sites. The percentage of conflicts involving cycles (on high flow sites with greater than 10 conflicts) ranged from 0 to 48% in the 'Before' survey and 22% to 64% in the 'After 2' survey. This percentage is greater than the percentage of traffic flow they represent, which was less than 18% on all sites and in all surveys. Similarly,

the percentage of pedestrian conflicts involving motorcycles was greater than the proportion of the traffic flow they represented on the high flow sites.

12. On high flow sites there was a significant decrease in the percentage involving buses. However, the most significant increase in multiple conflicts on high flow sites occurred amongst cycles, as the percentage involving them increased from 25% in the 'Before' to 40% in the 'After 2' survey. There was also a non-significant increase from 0 to 14% on the low flow sites.

8 Results: Vehicles (Video Data)

8.1 Site Characteristics

8.1.1 Flow Composition

Traffic flow has a direct implication for the delay to traffic. Higher traffic flows generally result in longer queues and longer delays for drivers, although the actual effect will depend on the flows on all arms of the junction and the signal strategy in use. It should be noted that this study examines the percentage of capacity utilised throughout all observed traffic signal cycles at the studied junction. It is therefore an average effect and not based on situations where the demand exceeds capacity, where the changes in signal timings could potentially have a greater effect on junction throughput: this analysis is being separately conducted by TfL.

Traffic flows can also influence pedestrian behaviour. Under high flow conditions pedestrians are less likely to cross in gaps between traffic platoons. However, there is a higher probability of a conflict for those pedestrians that do decide to cross without priority.

It would therefore be preferable that the traffic flows on the observation days remain as stable and comparable as possible. Variation between traffic flow observations was minimised by conducting the surveys on the same day of the week (where possible). However, whilst the 'Before' surveys were in school term time, some of the 'After 1' surveys had to be scheduled in the school summer holiday of 2010, which would be expected to influence the observed traffic flows. The 'After 2' surveys were all carried out between 21st September 2010 and 18th October 2010, and would therefore be expected to be comparable with the flows in the 'Before' surveys.

Classified traffic flows can be converted into an overall estimate of the road space used and therefore the relative amount of capacity used by the vehicles. These are calculated using the PCU (Passenger Car Units) estimates detailed in Table 13.

Vehicle Type	Cycle	Motorcycle	Car/ LGV	HGV	Bus/ Coach
PCU value	0.3	0.75	1	2	3

Table 13 PCU values

The average hourly traffic flows observed, which were estimated from the quarter hour observation periods, are shown in Figure 143 and the percentage change in average hourly flow is shown in Figure 144. The hourly flow profiles for all sites are presented in Appendix C.

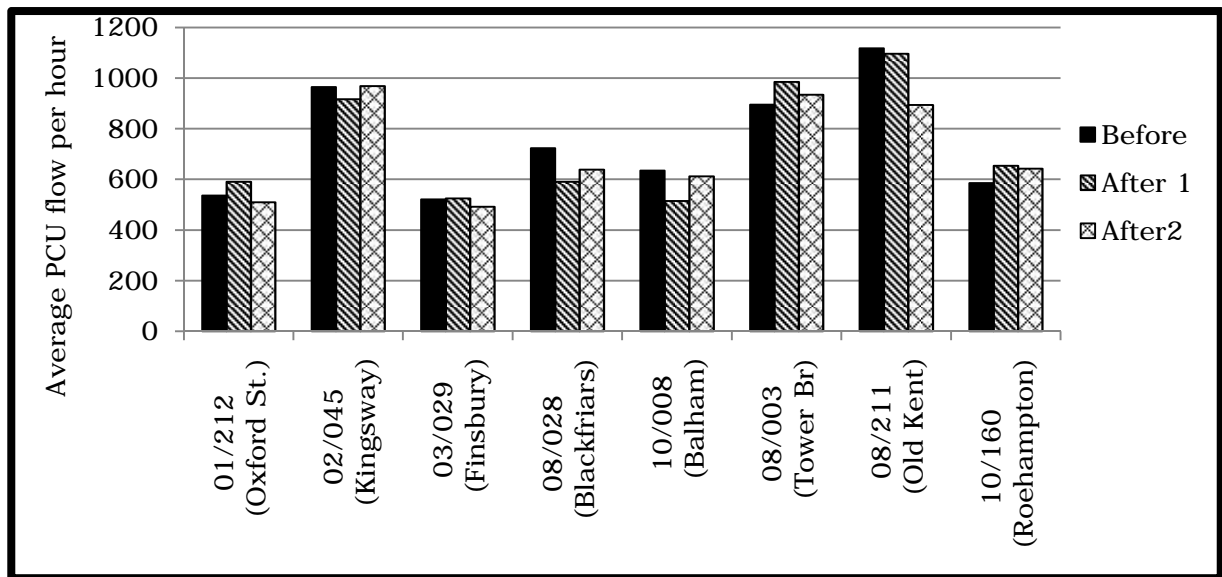


Figure 143 Average PCU flow for each site

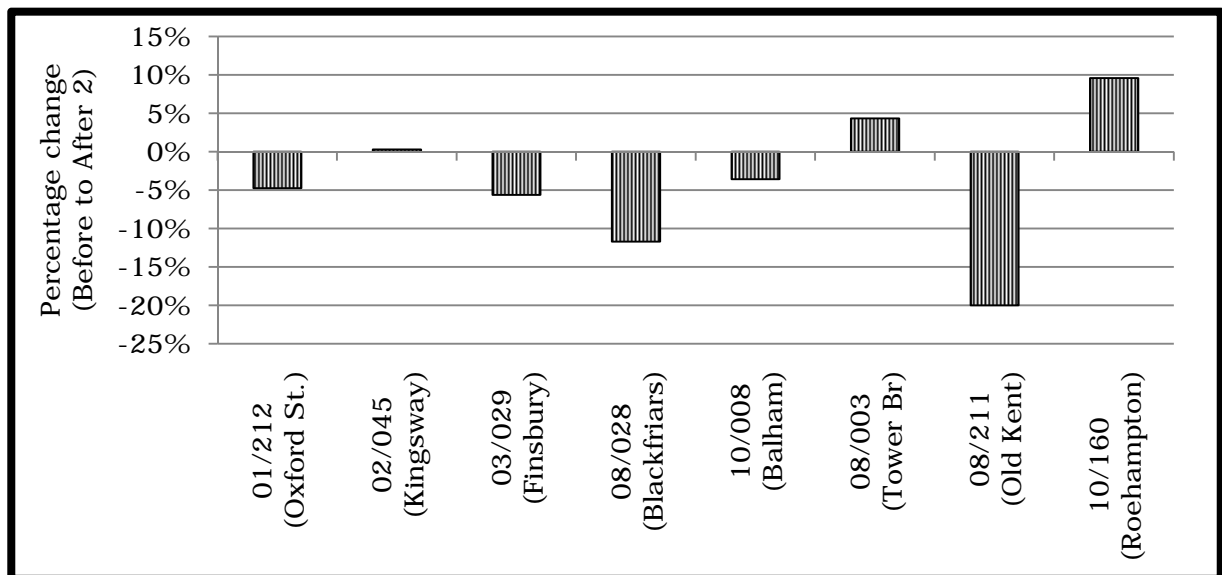


Figure 144 Average change in PCU flow

Flows were reasonably consistent (within 10%) between the 'Before' and the 'After 2' surveys on six of the eight sites, and were within 5% on four sites.

Generally, the observed flows in the 'After 2' surveys were more comparable to the 'Before' survey flows, than those observed in the 'After 1' surveys: the exceptions being Blackfriars (12%), and Old Kent (20%), where the flows decreased between the 'Before' and the 'After 2' surveys. In the case of Old Kent there was a traffic accident in the area which affected flows in the afternoon.

Considering the changes in traffic flows between the 'Before' and 'After 1' surveys:

- On Finsbury and Old Kent, traffic flows were stable (+1% and 2% respectively) between the 'Before' and 'After 1' surveys
- The traffic flow profiles throughout the day were reasonably consistent between the 'Before' and 'After 1' surveys on both Kingsway and Oxford St. However,

there was an overall increase of 10% on Oxford Street and an overall decrease of 5% on Kingsway in traffic flow.

- The traffic flows on the other sites in the 'After 1' survey did vary; the flow profiles on Tower Bridge were reasonably consistent, and had only increased in the evening peak with an overall increase of 10%. Those on Roehampton had also altered with slight reductions in the morning, but increases in the afternoon and evening peak: significant reductions were recorded at 8:00, 9:00 and 11:00 and significant increases at 16:00 and 18:00, with an overall increase of 12%.
- The flows on Balham and Blackfriars had altered throughout the day in the 'After 1' survey. Those on Balham had significant decreases (see Figure C-25 and C-26) from 9:00 to 12:00, from 16:00 to 17:00 and from 18:00 to 19:00, overall the decreases were 19% and 18% respectively in the 'After 1'.

Similarly, the changes between the 'Before' and the 'After 2' surveys were:

- In the 'After 2' survey there was a 5% reduction in average flow on Oxford Street compared to the 'Before' survey, with a similar profile but minor fluctuations in the flows between hours. The fluctuations resulted in significant changes in flow during the following hours: decreases at 7:00, 9:00 and 16:00, also increases at 11:00 and 12:00.
- On Kingsway there was a slight change (less than 1%) compared with the 'Before' survey, and the flows were more in line with the 'Before' observations than those in the 'After 1' survey. Again there was a similar profile but minor fluctuations in the flows between hours. The fluctuations resulted in significant increases at 12:00, 14:00 and 18:00 and decreases at 7:00, 11:00, 13:00 and 16:00.
- On average there was a 6% reduction in flow on Finsbury in the 'After 2' survey compared with the 'Before' survey, however the flow profiles were very similar throughout the day.
- On Blackfriars, the flow profiles were similar. However, the flows in 'After 2' survey were similar to those in the 'Before' survey for the morning period but similar to the 'After 1' (and reduced compared to the 'Before' survey) in the afternoon period giving an overall reduction of 12% between the 'After 2' and 'Before' surveys. There were significant increases in flow at 7:00 and 9:00 and significant decreases at 15:00 and 17:00 in the 'After 2' survey.
- Flows on Balham in the 'After 2' were on average 4% lower than in the 'Before' survey. The profile implied increased peak flows, but reductions in off-peak flows, with significant increases 7:00 to 8:00 and 16:00 to 19:00 and significant decreases 9:00 to 12:00 and 14:00 to 15:00.
- In the 'After 2' survey at Tower Bridge the flow profiles was very similar to the 'Before' survey. Overall there was a 4% increase compared to the 'Before' survey. This consistency resulted in the only significant changes in hourly flow being a decrease at 7:00 and an increase at 13:00.
- At Roehampton the flows profiles observed were quite volatile. Overall, on average, those in the 'After 2' survey were similar to the 'After 1' survey showing an overall increase of about 10% compared to the 'Before' survey. Flows on Roehampton were variable showing significant increases at 7:00, 10:00, 16:00 and 18:00 and significant decreases 8:00, 11:00, 13:00 and 17:00.
- Flows on Old Kent were similar in the 'Before' and 'After 2' surveys up until 14:00, the difference being less than 2%. However, there was an accident in the Tower Bridge area in the afternoon and this resulted in the flows being an

average of 27% less than the 'Before' survey in the afternoon and 20% less over the whole day.

In addition to the overall flow, the flow composition and turning proportions can also influence pedestrian behaviour, and turning proportions can affect delay. In terms of vehicle delay a change in turning proportions can affect the number of vehicles using of the approach lanes at the junction. Pedestrian behaviour and types of conflict can vary with the types of vehicles present, as the road space used and vehicle speed vary. The flow compositions are shown in Figure 145 and Figure 146.

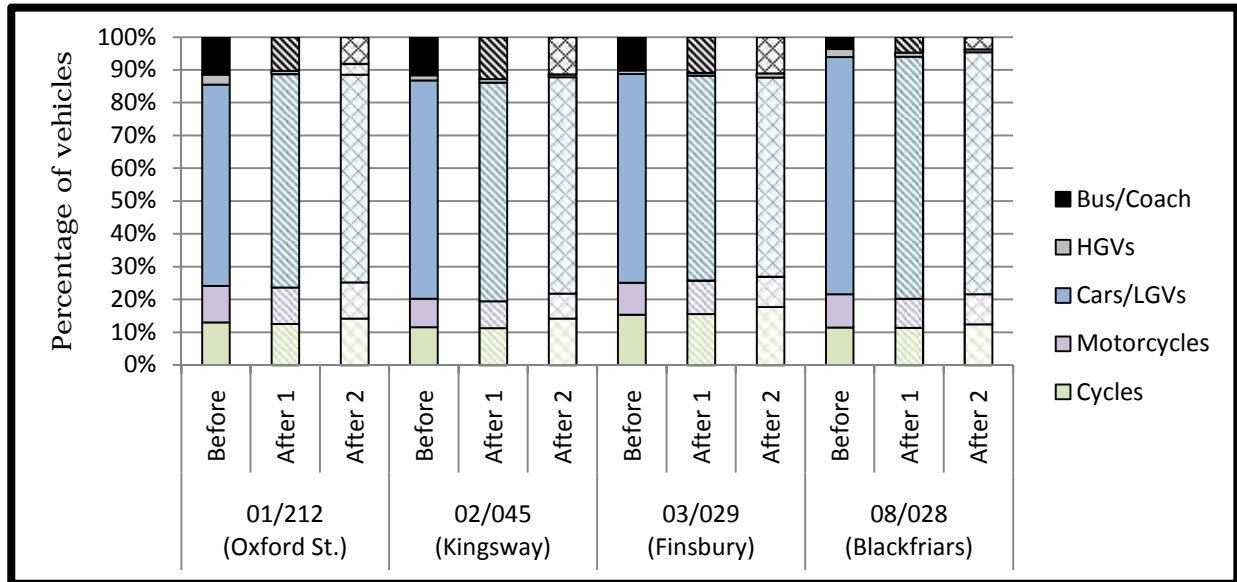


Figure 145 Vehicle Flow Composition - Group 1

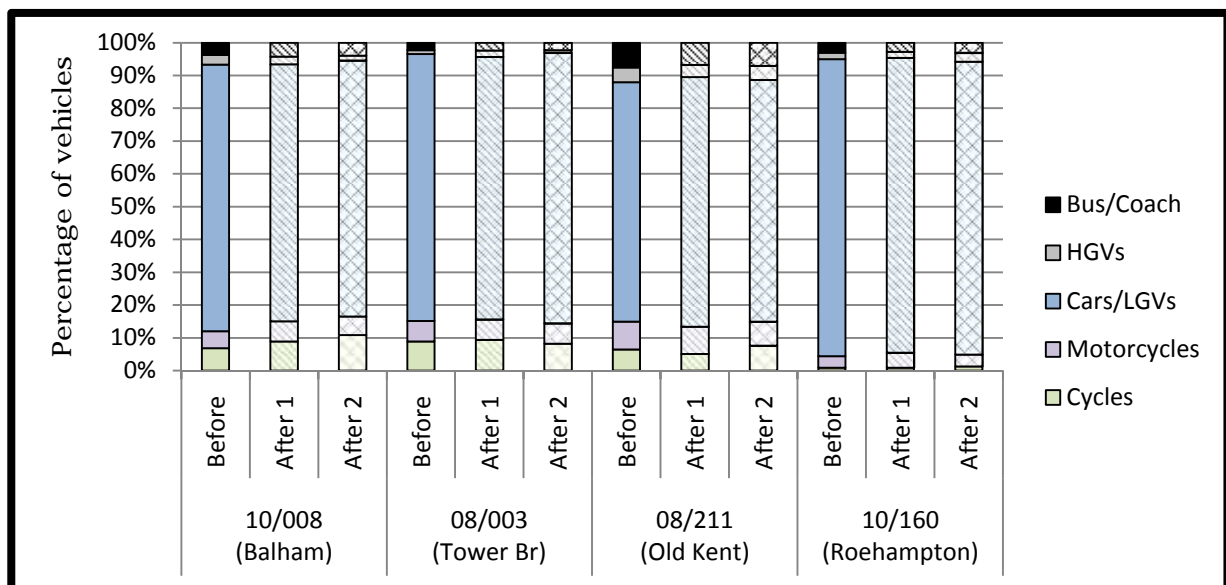


Figure 146 Vehicle Flow Composition - Group 2

Flow composition was consistent on all sites between the surveys, with any significant changes in the percentage of a vehicle type in the flow at most 4%.

Turning proportions were consistent in the surveys at all sites, with any significant changes in the percentage making a given movement being at most 4%.

The flow compositions were all reasonably consistent between the three surveys, the only notable small variations were:

- Balham: the proportion of cars and LGVs had significantly reduced from 81% to 78% in the 'After 1' and this was maintained in the 'After 2' (78%). HGVs were significantly reduced from 3% to 2% and cycles were significantly increased from 7% to 11%.
- Old Kent: the proportion of cycles had significantly decreased, and the proportion of cars (and LGVs) increased, although by 3% at most, between the 'Before' and the 'After 1' surveys. However, the percentage of these vehicles in the 'After 2' and 'Before' surveys were similar.
- Oxford St: the proportion of cars/LGVs significantly increased by 4% and the proportion of HGVs significantly decreased by 2% in the 'After 1' survey compared to the 'Before' survey. However, the percentage in the 'After 2' survey were similar to those in the 'Before' survey. There was a decrease in the percentage of bus/coaches (11% to 8%) in the 'After 2' which is likely to have been due to coaches rather than buses.
- Blackfriars: In the 'After 2' survey there was a significant decrease in the proportion of HGVs from 3% to 1% compared to the 'Before' survey.
- Kingsway: In the 'After 2' survey there was a significant decrease in the proportion of HGVs from 2% to 1% and also a significant increase in the proportion of cycles from 12% to 14% compared to the 'Before' survey.

Similarly, the turning proportions were reasonably consistent between the three surveys, with the following small exceptions:

- Finsbury: the proportion of vehicles turning left significantly decreased from 14 in the 'Before' survey to 11% of the total flow in the 'After 1' survey. In contrast, this turning proportion significantly increased (from the 'Before' survey) to 17% of the total flow in the 'After 2'.
- Blackfriars: the proportion of vehicles turning left significantly decreased from 11 in the 'Before' survey to 7% of the total flow in the 'After 1' survey. The percentage turning left in the 'After 2' survey was 8% which was also a significant decrease compared with the 'Before' survey.
- Tower Bridge: the proportion of vehicles turning left increased slightly (significant at 90% confidence level) from 14 in the 'Before' to 16% in the 'After 2' survey.

8.1.2 Traffic Signal Timings

Signal timing can affect both the delay to vehicles and pedestrian behaviour. The amount of green time in each traffic signal cycle and the number of cycles per hour determine the priority provided to the traffic on the arm of the junction. It therefore also determines the queues and delays on the junction's arm. In contrast, providing longer green times to traffic on a junction's arm, reduces the priority to pedestrians and causes them to have to wait longer to cross the road without utilising gaps in the traffic. Figure 147 and Figure 148 show the average red and green time in each cycles provided for traffic on the arm studied.

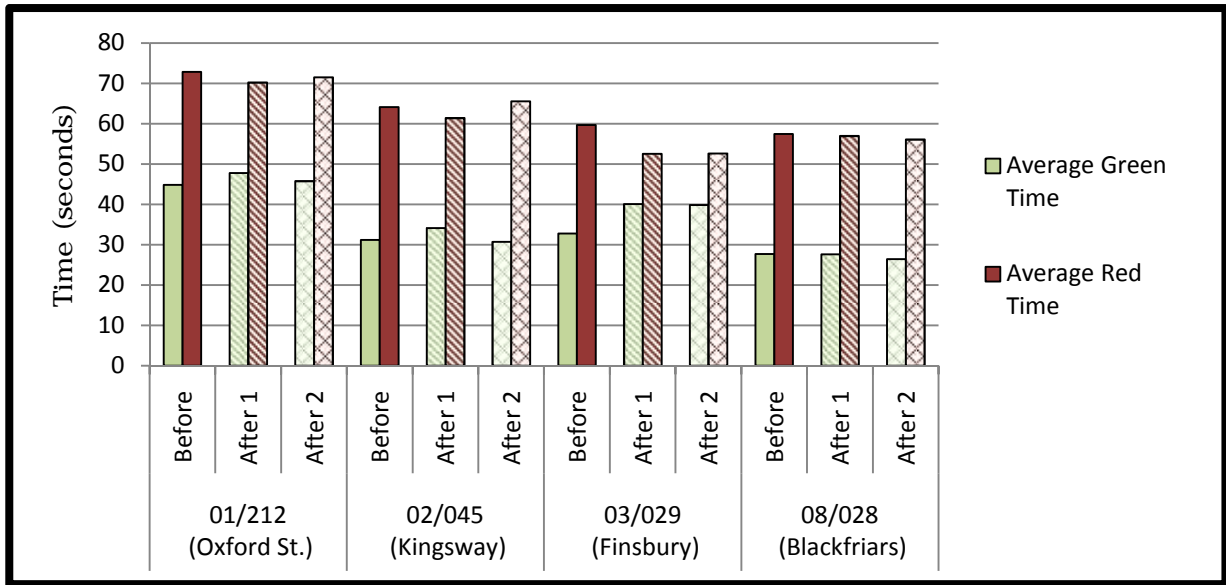


Figure 147 Average phase durations – Group 1

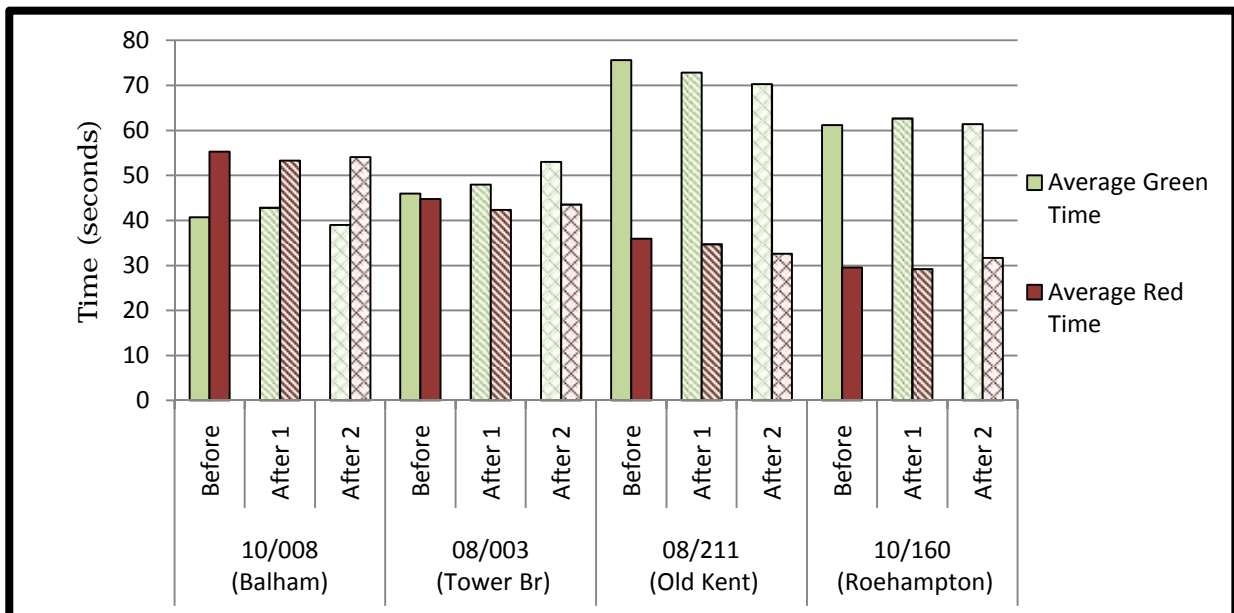


Figure 148 Average phase durations – Group 2

Times of signal phases and duration of cycle times were observed from the videos for a quarter of an hour in each of 12 hours. These observations implied that cycle times remain constant on all surveys on four sites. However they had decreased slightly on two sites, by less than 3 seconds, decreased by 9 seconds on the Old Kent site and increased by 5 seconds on the Tower Bridge site.

Initial increases (After 1 surveys) in traffic green time on seven sites remained constant on four sites. There appeared to be further increases on the Balham, but there were decreases on the Tower Bridge, Old Kent site and Kingsway sites.

The following changes had occurred on the studied sites in the 'After 1':

- Uniquely, on Old Kent Road the average green time, and red time, per cycle had decreased by 4%, and the number of cycles per hour had increased by 4%
- On all other sites the number of cycles per hour had changed by 1% or fewer
- The green time on Blackfriars had not changed by a significant amount
- The green time on Balham, Tower Bridge and Roehampton had increased by a small amount: by approximately 2 seconds or 2 to 5%
- The green time on Oxford Street and Kingsway had increased by a small but proportionally greater amount: by approximately 3 seconds or 6 to 9%
- The green time on Finsbury had increased by a large amount: by approximately 7 seconds or 22%

The following changes occurred in the 'After 2':

- The observed average cycle time, compared to the previous two surveys, decreased on Blackfriars slightly from 85 to 83 seconds, and on Balham from 96 to 93 seconds, whilst on Tower Bridge there was an increase from 91 to 96 seconds. The observed average cycle time on Old Kent decreased further from 112 seconds in the 'Before' to 103 seconds in the 'After 2' survey
- The observed average green time on four of the eight sites were reasonably consistent (within 2 seconds) between the 'After 1' and 'After 2' surveys.
- However, in the 'After 2' survey the observed average green time on Tower Bridge increased from 46 seconds in the 'Before', to 48 in the 'After 1', and then 53 seconds in the 'After 2' surveys. On Old Kent the green time decreased from 76 seconds in the 'Before' to 70 seconds in the 'After 2' survey (a further decrease from the 'After 1' survey). Also, there were decreases of 4 seconds on Balham and 3 seconds on Kingsway between the 'After 1' and 'After 2' surveys.

8.1.3 Junction Capacity and Vehicle Throughput

A junction has a given maximum capacity which is a result of the number of approach lanes and the green time available to traffic. The extent to which this capacity is utilised is determined by the traffic flow and the turning proportions. Close to capacity the queues and delays experienced by vehicles increase dramatically. This section examines the percentage of capacity utilised throughout all observed traffic signal cycles at the studied junction. It is therefore an average effect and not based on situations where the demand exceeds capacity, where the changes in signal timings could potentially have a greater effect on junction throughput: this analysis is being separately conducted by TfL.

A simple rule of thumb assumption is made in this section. It is assumed that the capacity of a junction can be estimated as 0.5 PCUs (Passenger Car Units) per second of green time per lane at the signals. Also, it is assumed that the vehicles distribute themselves equally between the traffic lanes and therefore the calculation may slightly underestimate the percentage of capacity used. The results of these calculations are shown in Figure 149.

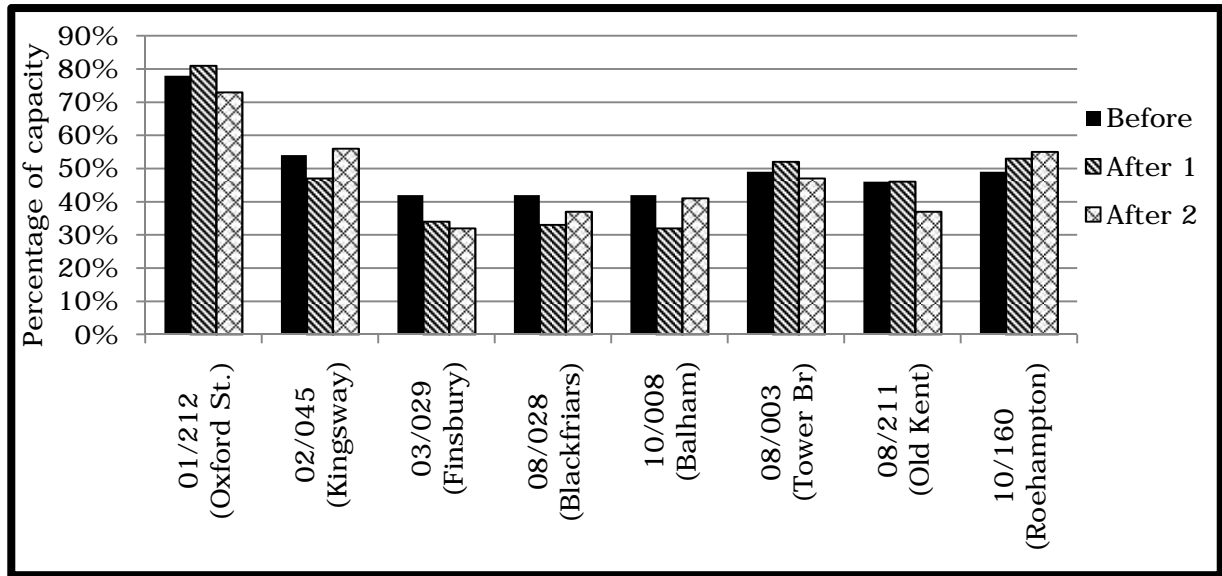


Figure 149 Percentage of capacity used

The percentage of junction capacity utilised decreased on six sites (although one of these was only a marginal change), and increased on two sites.

Capacity used was affected by both changes to the traffic flows during the surveys and changes to the timing of the traffic signals. The probable reasons for the overall effect at each junction have been explored and elucidated.

The changes in capacity used on the studied junction arm are dependent on both the change in traffic flow and the change in green time available to traffic. The changes that should result in reductions in capacity used, and therefore traffic queues and delays are shown in green in Table 14. Also, the reductions in capacity used achieved are also shown in green.

Site	Percentage change in average PCUs per hour 'After 1'	Percentage change in average green time per cycle 'After 1'	Change in percentage of capacity used 'After 1'
01/212 (Oxford St)	10.1%	6.4%	3%
02/045 (Kingsway)	-5.0%	9.5%	-7%
03/029 (Finsbury)	0.7%	22.2%	-8%
08/028 (Blackfriars)	-18.3%	-0.5%	-9%
10/008 (Balham)	-19.0%	5.0%	-10%
08/003 (Tower Br)	10.0%	4.4%	3%
08/211 (Old Kent)	-2.0%	-3.7%	0%
10/160 (Roehampton)	11.5%	2.4%	4%

Table 14 Changes in flows and capacity used: 'After 1' compared to 'Before'

Table 15 below updated with 'After 2' compared to 'Before' (see below)

The following changes and potential explanations were observed in the 'After 1' see new bullet points below in yellow:

- Balham and Kingsway: Reductions in flow (PCUs) and increases in green time resulted in a smaller percentage of the junction capacity used
- Finsbury: A slight increase in flow was more than compensated by a large increase in green time, causing a reduction in the percentage of capacity used
- Blackfriars: A large decrease in flow resulted in a reduction in the percentage of the capacity used
- Old Kent: A slight reduction in flow was offset by a decrease in the green time
- Oxford St, Tower Bridge and Roehampton: An increase in flow was partially offset by an increase in green time and resulted in a slight increase in the junction capacity used

Site	Percentage change in average PCUs per hour 'After 2'	Percentage change in average green time per cycle 'After 2'	Change in percentage of capacity used 'After 2'
01/212 (Oxford St)	-4.8%	2.0	-5%
02/045 (Kingsway)	0.3%	-1.6	2%
03/029 (Finsbury)	-5.6%	21.5	-10%
08/028 (Blackfriars)	-11.7%	-4.8	-5%
10/008 (Balham)	-3.6%	-4.3	-1%
08/003 (Tower Br)	4.4%	15.3	-2%
08/211 (Old Kent)	-20.0% ⁹	-7.1	-9%
10/160 (Roehampton)	10.3%	0.3	6%

Table 15 Changes in flows and capacity used: 'After 2' compared to 'Before'

The following changes and potential explanations were observed in the 'After 2':

- Oxford Street and Finsbury: reductions in flow (PCUs) and increases in green time resulted in a smaller percentage of the junction capacity being used.
- Tower Bridge: A slight increase in flow was more than compensated by a large increase in green time, causing a reduction in the percentage of capacity used
- Blackfriars, Balham and Old Kent: A decrease in flow resulted in a reduction in the percentage of the capacity used
- Roehampton: An increase in flow was partially offset by an increase in green time and resulted in a slight increase in the junction capacity used
- Kingsway: A slight increase in flow and reduction in green time per cycle resulted in a greater percentage of the junction capacity being used.

8.2 Effects of PCaTS on Vehicle Delay and Driver Behaviour

8.2.1 First Vehicle Delay

Overall delay is dependent on a number of factors including the traffic flow on the link, the resulting traffic queues, and the signal timings at the junction. It is possible to measure it by timing a random sample of vehicles upstream of any traffic queues and recording the time the same vehicles enter the junction. The difference between this time and a free-flow travel time between the two timing points is the delay experienced by the vehicle. This needs to be measured for a large number of vehicles to take account of the high degree of variation encountered through traffic flow and queue length variations.

This study focussed a simpler measure of delay experienced near to the junction owing to the traffic signal timings. It recorded the time the first vehicle to stop at each red traffic light reached a point 15 metres upstream of the stop line, and the time it reached

⁹ It is understood that an accident occurred in the afternoon of the 'After 2' survey near to the Old Kent site

20 metres after the stop line. It therefore was mainly related to the signal timings, reduced the number of factors affecting delays, and would be expected to overestimate the change in delay in low flow conditions. It does, however, provide an insight into the changes in delay occurring with the signal re-timings. These are shown in Figure 150 and Figure 151, and summarised in Table 16 and Table 17.

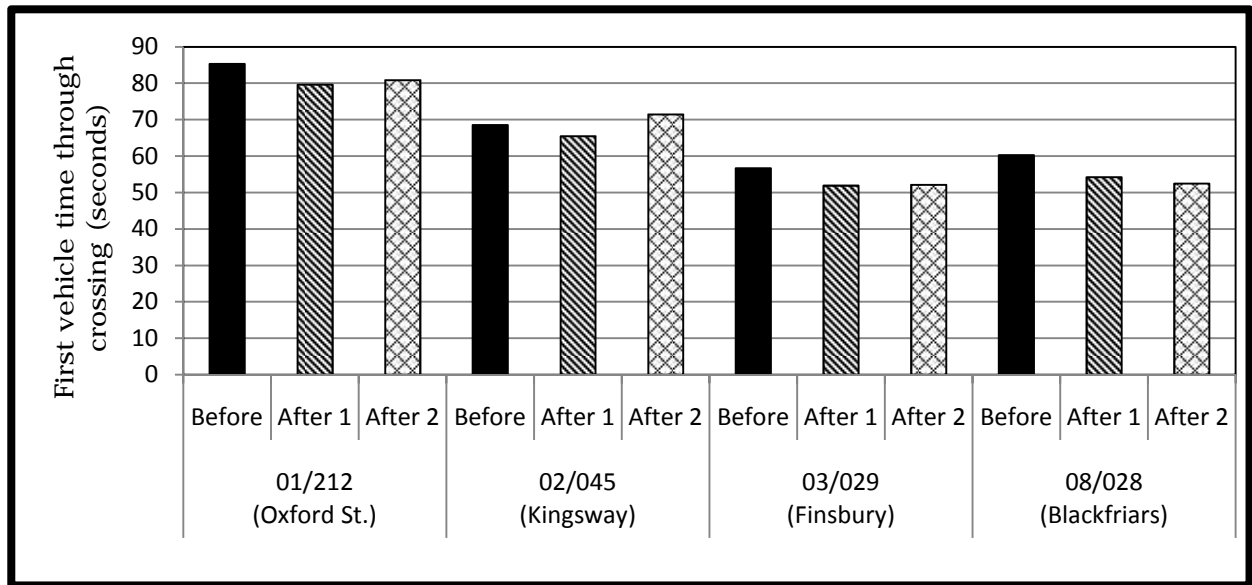


Figure 150 Time from 15m before to 20m after the crossing – Group 1

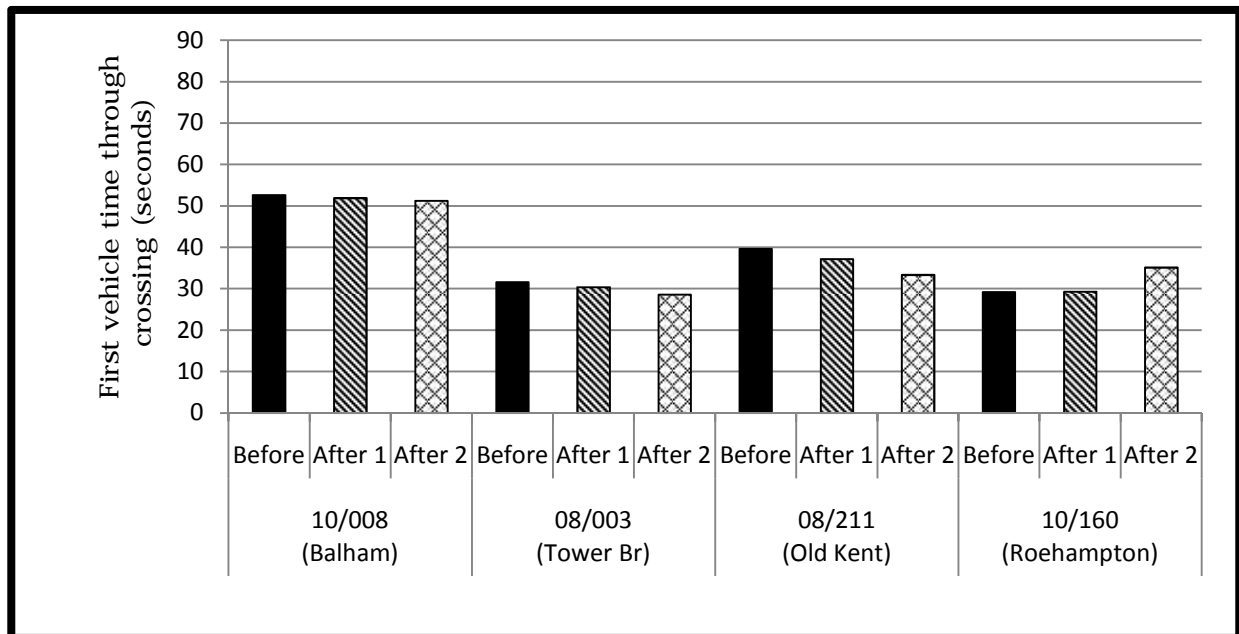


Figure 151 Time from 15m before to 20m after the crossing – Group 2

A number of factors will influence vehicle delay. However, first vehicle delay should be related to the red time at the traffic signals. There was a weak indication that first vehicle delay decreased by approximately 0.5 seconds for each second reduction in red time in the 'After 1' survey, but a slightly stronger indication that it reduced by 1 second for each second reduction in red time in the 'After 2' survey.

Site	Percentage change in average PCUs per hour 'After 1'	Percentage change in average green time per cycle 'After 1'	Change in average first vehicle delay 'After 1'
01/212 (Oxford St.)	10.0%	6.4%	-1.5
02/045 (Kingsway)	-5.0%	9.5%	-3.0
03/029 (Finsbury)	0.7%	22.2%	-4.7
08/028 (Blackfriars)	-18.3%	-0.5%	-6.0
10/008 (Balham)	-19.0%	5.0%	-0.7
08/003 (Tower Br)	10.0%	4.4%	-1.2
08/211 (Old Kent)	-2.0%	-3.7%	-2.5
10/160 (Roehampton)	11.5%	2.4%	0.1

Table 16 First vehicle delays (Green = Beneficial): 'After 1' compared to 'Before'

Site	Percentage change in average PCUs per hour 'After 2'	Percentage change in average green time per cycle 'After 2'	Change in average first vehicle delay 'After 2'
01/212 (Oxford St.)	-4.8%	2.0	-4.4
02/045 (Kingsway)	0.3%	-1.6	3.0
03/029 (Finsbury)	-5.6%	21.5	-4.5
08/028 (Blackfriars)	-11.7%	-4.8	-7.8
10/008 (Balham)	-3.6%	-4.3	-1.4
08/003 (Tower Br)	4.4%	15.3	-3
08/211 (Old Kent)	-20.0%	-7.1	-6.3
10/160 (Roehampton)	10.3%	0.3	6.0

Table 17 First vehicle delays (Green = Beneficial): 'After 2' compared to 'Before'

The average delay to the first vehicle to stop at the junction reduced at seven of the eight sites: by between 0.7 and 6 seconds a vehicle in the 'After 1' surveys. It also reduced at six sites in the 'After 2' compared to the 'Before' survey by between 1.4 and 7.8 seconds.

At six of these sites in the 'After 1' survey, the amount of green time had increased, whilst the cycle time had remained the same: i.e. the traffic red time had decreased. At the other site (Blackfriars) the green time had not changed greatly, but the traffic flow

had decreased by almost 20%; and it is suspected that this resulted in the large reduction in delay.

At the seventh site (Old Kent) in the 'After 1' survey, the average red and green time decreased, as did the traffic flow. Overall, this resulted in no change to the delay to the first vehicle to arrive at the stop line.

In the 'After 2', at all six sites where the first vehicle delay had decreased, there were associated decreases in traffic signal red time, and the changes in traffic signal timings and traffic flow had resulted in a decrease in the percentage of the junction capacity being used. Similarly, on the other two sites there were increases in traffic signal red time, and the changes in traffic signal timings and traffic flow had resulted in a increase in the percentage of the junction capacity being used.

The relationship between the signal timings and vehicle delay was also further explored by directly relating the change in delay to the first vehicle with the reduction in traffic signal red time, see Figure 152

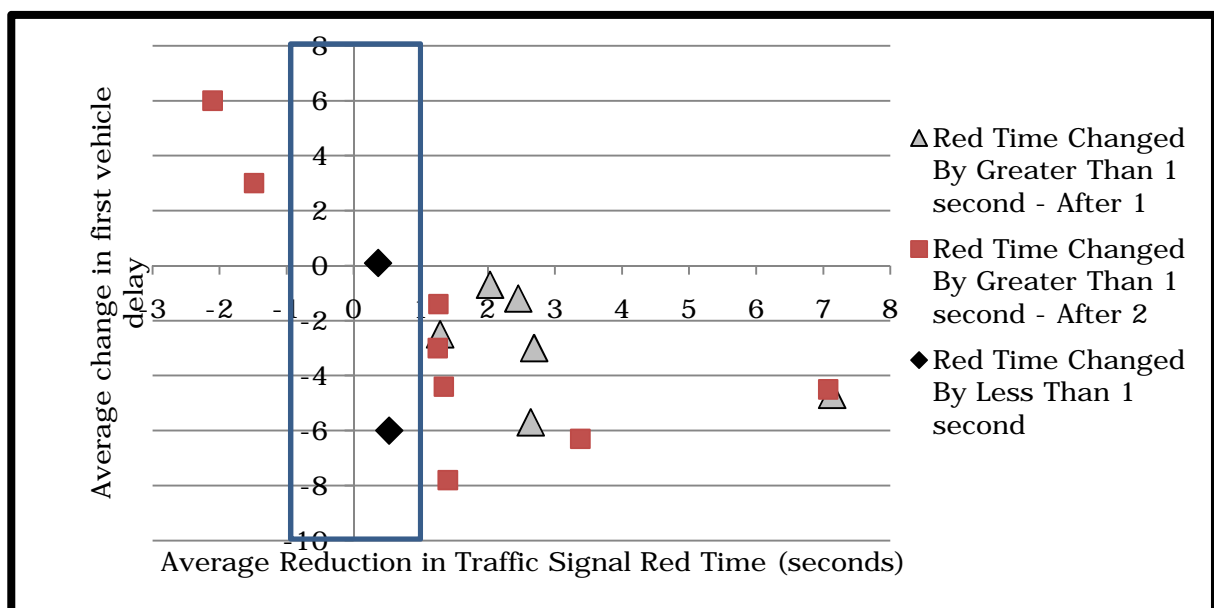


Figure 152 Relationship between vehicle delay and signal times

The following are implied by the graph:

- As expected, measuring the delay to the first vehicle tended to isolate the changes in delay from changes in traffic flow
- At sites where the traffic signal red time was changed by greater than one second, the delay to the first vehicles appears to be directly related to it
- A fitted regression line explained 25% of the variation in the 'After 1' data relative to the 'Before' data, and predicted that the first vehicle delay was reduced by 0.5 seconds for every second reduction in red time.
- A fitted regression line explained 48% of the variation in the 'After 2' data relative to the 'Before' data, and predicted that the first vehicle delay was reduced by approximately 1 second for every second reduction in red time. This possibly implies that drivers have settled in to the changes at the junction and were more likely to make use of any reductions in traffic signal red time.
- The delay to the first vehicle in the 'After 1' surveys also reduced at Roehampton and Blackfriars, where the traffic signal red time had reduced by less than one second. The reasons for these changes are unclear. However, there was a large

reduction in flow on Blackfriars, which may have reduced queuing times from 15 metres before the stop line. Also, on the Roehampton site the traffic flow had only increased in the evening peak (see Appendix C), and was only approximately 600 vehicle per hour (or one every 6 seconds) in the 'Before' survey. Thus the time between the start of red and the first vehicle to arrive at the signals may have reduced during the 'After 1' survey in the evening peak

8.2.2 Traffic Stopping Position

Vehicles waiting at traffic signals will generally stop in an advantageous position to observe the available information on the changes in priority to assist in minimising the driver's delay. In the simplest case they stop in a position where they can clearly see the traffic signal heads, either on the near or possibly on the far side of the junction. Drivers' will also use information on the change in priority from the signal heads on other junction arms, i.e. the change to a red signal before the change to a green traffic signal on their junction arm.

The Countdown units at the PCaTS sites studied are also a potential source of information for drivers waiting at the junction. They can use them to predict the change in priority from pedestrians to vehicles. It is therefore possible that they will alter their position within the carriageway to view the Countdown information. This could be apparent in the distance they stop from the stop line at the junction. The possibility is that they would decide to stop further forward in order to view the Countdown display. The distances that the first drivers to arrive at the junction stopped relative to the junction's stop line were recorded in the following distance bands:

- -3 = 4 metres or more before the stop line
- -2 = 2 to 4 metres before the stop line
- -1 = 0 to 2 metres before the stop line
- 1 = 0 to 2 metres after the stop line
- 2 = 2 to 4 metres after the stop line
- 3 = 4 metres or more after the stop line

Therefore a decrease in the average banded stop distance implies that vehicles are stopping further behind the stop line. It should also be noted that apart from Oxford St, Tower Bridge and Finsbury, the sites had an ASL before the stop line. Consequently, a vehicle stopping in front (positive value) of these stop lines are in reality stopping in the ASL. The average stopping positions of the observed vehicles are shown in Figure 153 and Figure 154.



Figure 153 Average stopping position of vehicles – Group 1

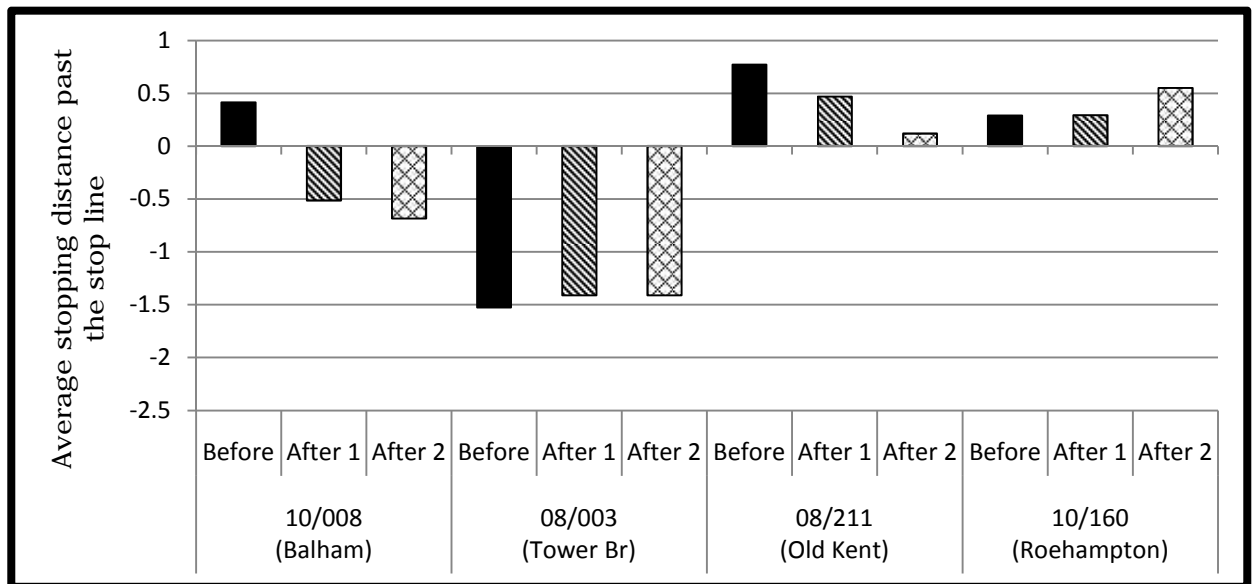


Figure 154 Average stopping position of vehicles – Group 2

At the three sites without an ASL (Oxford Street, Balham and Tower Bridge) most vehicles stopped behind the stop line and PCaTS had little effect on driver behaviour.

At the five sites with an ASL there was weak evidence that drivers were more likely to stop further behind the stop line after the introduction of PCaTS.

The average stopping distance past the stop line reduced at six of the eight sites in the 'After 1' which was maintained in the 'After 2' except for Roehampton which showed a small increase (less than 1 metre) and Finsbury which appeared to show a larger increase of under about 2 metres. However, this analysis cannot isolate the actual primary cause of this change. Further analysis was performed to consider the percentage of vehicles that stopped either in front of the junctions stop line, and those stopped within 2 metres of it, see Figure 155.

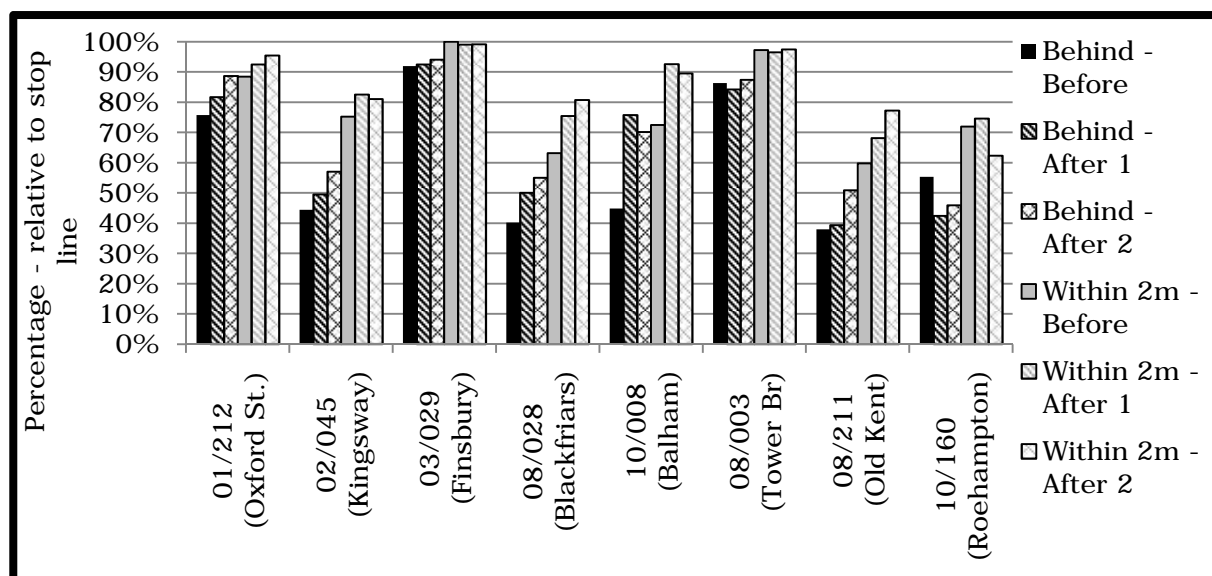


Figure 155 Percentage of vehicles near to over in front of the stop line

At Oxford St, Finsbury and Tower Bridge, none of which had an ASL, the average stopping positions were consistently behind the stop line, with approximately 75% to 100% in both the 'Before', 'After 1' and 'After 2' periods. Also, as expected, nearly all vehicles stopped within 2 metres of the stop line. The differences between the 'Before' and 'After 1' surveys were small and not statistically significant.

At the other five sites, the percentage of vehicles stopping behind the stop line increased in four cases, although only one of these was statistically significant (at the 95% confidence level). At Roehampton, the percentage stopping over the stop line increased, but a higher percentage stopped at most 2m over the stop line, hence the average distance remained constant.

The 'After 2' results were similar to those in the 'After 1' survey, except for Old Kent and Blackfriars. Both of which showed increases in vehicles stopping behind the stop line and Roehampton which showed decreases in stopping behind the stop line (and within 2m of the stop line) compared with the 'Before' data.

In addition, in the 'After 1', the percentage of vehicles stopping behind or at most 2m after the stop line, increased on all sites with an ASL, and the differences were statistically significant on two of the sites. The 'After 2' results were similar to the 'After 1' results except for Roehampton discussed earlier. Overall, the available evidence weakly indicates that:

- The drivers were generally more likely to stop behind the stop line when the Countdown units were present.

8.2.3 Time Traffic Starts to Move

Vehicles should prepare to move in the red/amber phase (duration being 2 seconds), and start to move after the start of the traffic green phase. In reality, many drivers use the available information to predict the change to red/amber and then start to move early. It is possible that drivers will therefore use the information on the Countdown display to obtain an advanced notification of the change in priority, and start to move earlier than without the Countdown display. The actual time the first vehicle to arrive at the junction after the change to red, and stop at the junction, subsequently started to move forward was recorded.

The few vehicles that started moving (possibly edging forward) before the start of the red/amber phase were removed, and the average time the remainder started are shown in Figure 156 and Figure 157.

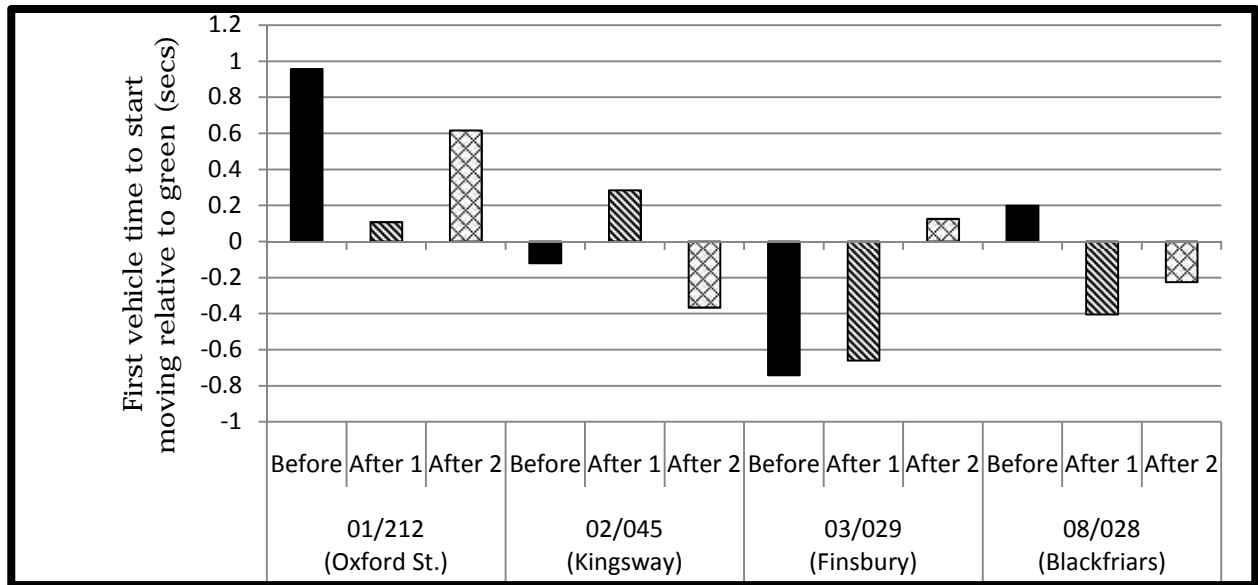


Figure 156 Time vehicles started to move – Group 1

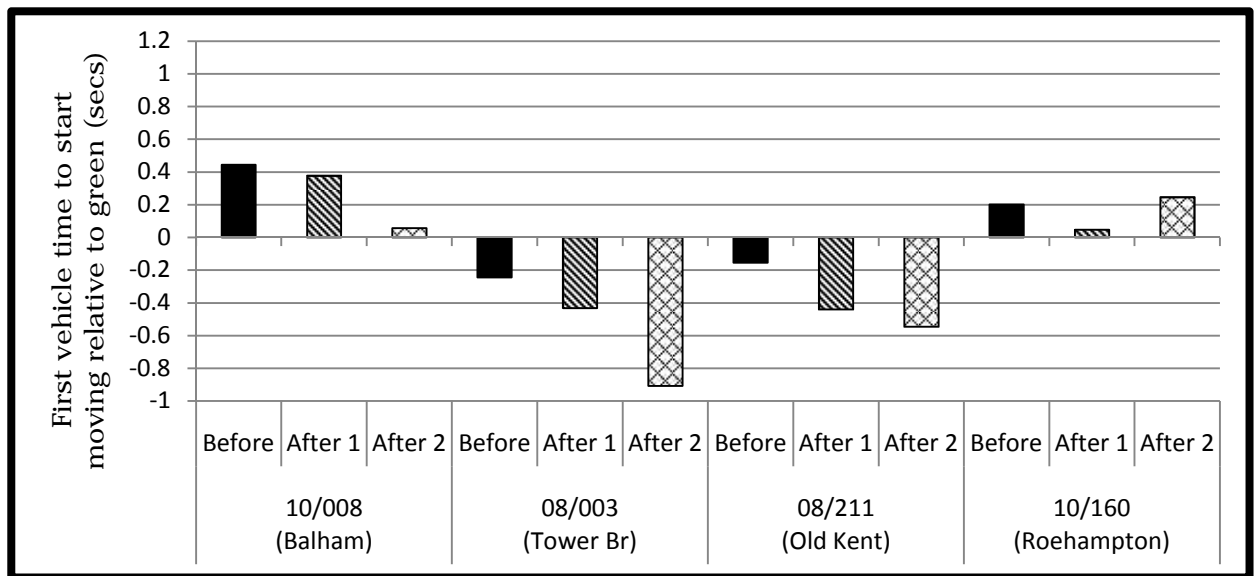


Figure 157 Time vehicles started to move – Group 2

The overall indications are that with PCaTS, vehicles started to move forward slightly earlier with PCaTS on the majority of sites, up to a maximum of 0.9 seconds earlier in the 'After 1', and 0.7 seconds earlier in the 'After 2'. However, there were indications that vehicles started to move forward slightly later on two sites in both surveys.

In the 'After 1' survey on the four sites with low to medium pedestrian flows (less than 1000 over the 3 hours of data collection) the average time that vehicles started to move forward relative to the green light was earlier by 0.1 to 0.3 seconds. On the higher

pedestrian flow sites, the average time that vehicles started to move forward: was earlier by approximately 0.9 and 0.6 seconds on Oxford Street and Blackfriars; and was later by approximately 0.4 and 0.1 seconds on Kingsway and Finsbury, respectively.

In the 'After 2' survey, compared to the 'Before' survey, on the four sites with low to medium pedestrian flows the average time that vehicles started to move forward relative to the green light was earlier by 0.4 to 0.7 seconds, except on Roehampton where the times were approximately the same. Also, with the exception of Roehampton, there was an indication that the vehicle drivers had adapted over time and started to move earlier in the 'After 2' than the 'After 1' survey. On the higher pedestrian flow sites, the average time that vehicles started to move forward: was earlier by approximately 0.3 and 0.4 seconds on all except Finsbury; and was later by approximately 0.9 seconds on Finsbury. However, there were no trends over time at these sites.

From section 6.2.1, we know that on most sites, pedestrians were more likely to start crossing in the early part of the Countdown (compared to the Blackout), but less likely to start to cross near the end of the Countdown. It is therefore possible that the reduction in time to move forward on 6 out of 8 sites (in both 'After' surveys) is associated with fewer pedestrians on the crossing, and/or with the ability of drivers to see the Countdown information.

The high degree of variance in the time that vehicles started to move forward resulted in only average changes of 0.3 seconds and greater being significant. That is, the decreases of 0.9, 0.6 and 0.3 seconds on Oxford St, Blackfriars and Old Kent respectively were significant, as was the increase of 0.4 seconds on Kingsway in the 'After 1' survey, and all reductions were significant in the 'After 2' survey.

8.2.4 Time to Reach Crossing

An important time to consider is the time that the vehicles reached the crossing. This is the time that potential conflicts can occur if pedestrians are still using the crossing. However, conversely, this time may also be affected by pedestrians crossing in the Blackout/Countdown period. Therefore it is difficult to isolate the causes and effects in this measure, and it is open to being effected by other confounding factors. The average time the first vehicles reached the crossing are summarised in Figure 158 and Figure 159.

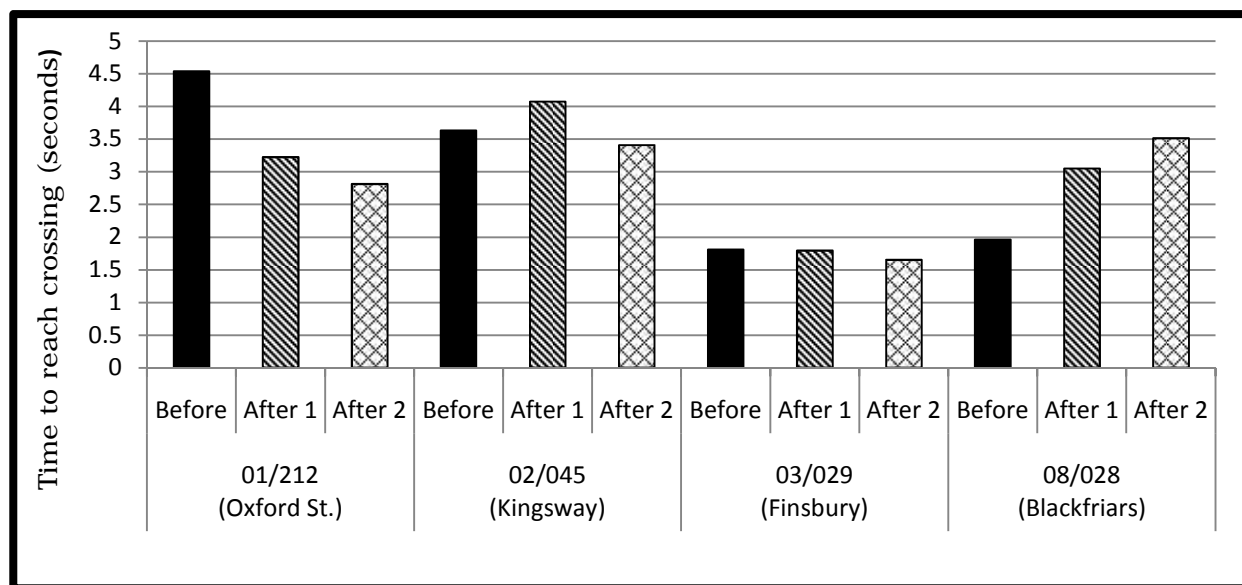


Figure 158 Time for vehicles to reach the crossing – Group 1

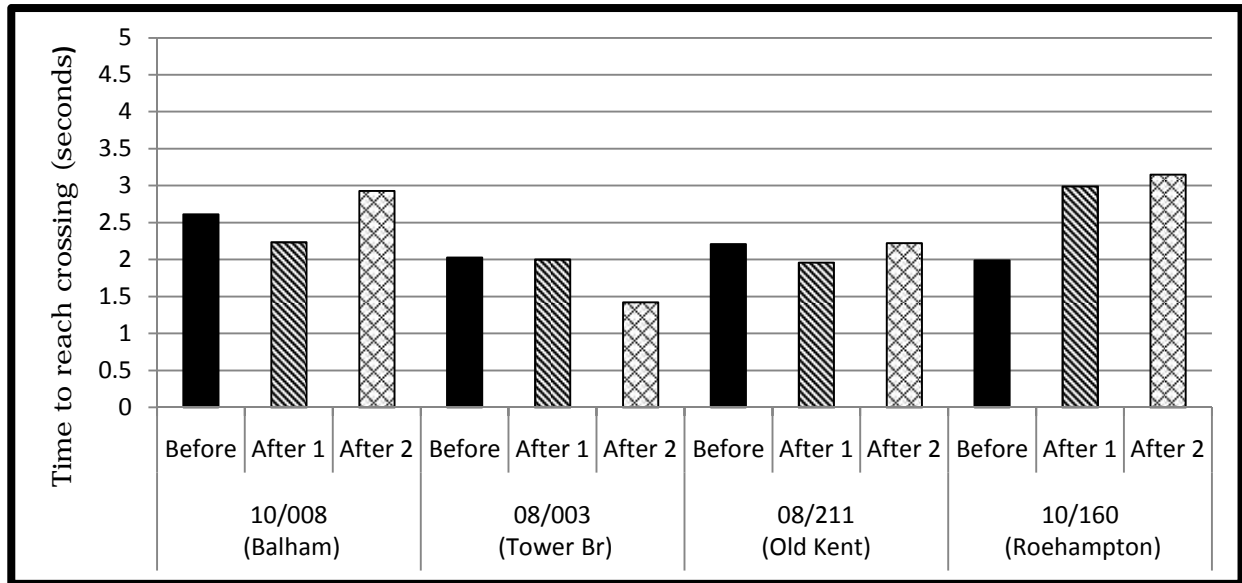


Figure 159 Time for vehicles to reach the crossing – Group 2

The overall indications are that with PCaTS at sites without an ASL, vehicles reached the crossing after the start of the green phase, but were approximately 1 to 2 seconds earlier on Oxford St, and up to 0.5 seconds earlier at Tower Bridge.

Vehicles generally reached the crossing in line with the time they started to move forward but other factors appeared to have caused vehicles to slow down on some sites.

The 'After 2' results were generally in agreement with the 'After 1'. However, the times were slightly earlier (by at least 0.5 seconds) Kingsway and Tower Bridge, and slightly later on Blackfriars and Balham.

The three crossings without an ASL on the approach were Oxford St, Tower Bridge and Finsbury. On Oxford St, there was a large decrease (After 1) and a slight further decrease (After 2) in the average time for vehicles to reach the crossing after the start of the green light. For this site the average stopping position was further back from the stop line; however, this was balanced by the trend that the vehicles started to move earlier.

On Finsbury, the average time for vehicles to reach the crossing after the start of the green light was unchanged. On Finsbury Road the vehicles had not changed their stopping position 'After 1', but were slightly closer to the stop line in the 'After 2', and the change in the time they moved forward was small (0.08 seconds 'After 1') but considerable later (0.8 seconds) in the 'After 2'. Therefore, it appears reasonably consistent that there was no difference in the average time vehicles reached the crossing.

On Tower Bridge the time that vehicles reached the crossing was unchanged in the 'After 1' survey, but slightly earlier (by 0.5 seconds) in 'After 2'. On Tower Bridge, vehicles stopped at the same distance from the stop line and started slightly earlier (0.3 seconds in the 'After 1' and 0.5 seconds in the 'After 2'). So, the trends on the time they reached the crossing were consistent.

The time to reach the crossing on Balham and Old Kent Road had decreased (After 1) which is consistent with the vehicles stopping only slightly further from the junction and

with them starting to move sooner after the start of the traffic green. However, the time to reach the crossing in the 'After 2' surveys was greater than the 'Before' survey on Balham and approximately the same time on the Old Kent site. The vehicles were stopping further back from the junction in the 'After 2' surveys, but they were also observed to start moving earlier.

On Kingsway, vehicles reached the crossing later in the 'After 1' survey. This is consistent with them starting to move forward later, possibly owing to pedestrians starting to use the crossing further into the Blackout/Countdown period. In the 'After 2' the time to reach the crossing had returned to the 'Before' level which is consistent with when they started to move.

In the 'After 1' and 'After 2' surveys, Roehampton and Blackfriars appear initially to be anomalies. Vehicles on average stopped at the approximately the same distance from (or slightly less in front of) the stop line, started to move at the same time or slightly earlier, but reached the crossing approximately 1 to 1.5 seconds later in the 'After 1' survey. Further investigation shows that vehicles take consistently longer from starting to move forward to reaching the crossing in the 'After 1' survey on both these sites. The reason for this is unclear, it is possibly owing to pedestrians crossing at the end of the Countdown and drivers needing to show caution, which would be consistent with the observations on Kingsway.

It should be noted that actual time, relative to the start of the traffic green, that the vehicles reached the crossing depends on both the time they started to move and the time it took them to reach the crossing. For example, between 33 and 65% of the first vehicles to arrive on Finsbury (and between 48 and 77% on Tower Bridge) started to move at least one second before the start of the traffic green. Further on these sites the average time for vehicles to reach the crossing was at most two seconds. Therefore, it is possible that these vehicles could be in conflict with pedestrians remaining on the crossing in the All Red period, close to the start of the traffic green. This is investigated further in Section 9 for these two sites.

8.3 Summary of Findings

1. Average traffic flows entering the junction (vehicle throughput) measured in the 'After 1' surveys increased on Oxford Street (+10%), Roehampton (+12%) and Tower Bridge (+10%) and decreased on Balham (-19%) and Blackfriars (-18%). These traffic flows were similar (less than 5% different) in the 'Before' and 'After 1' surveys on the other three sites. In the 'After 2' surveys the change in traffic flows compared to the 'Before' survey were less than 5% on four sites, increased on Roehampton (+10%) and decreased on Finsbury (-6%), Blackfriars (-12%), and Old Kent (-20%). However, the reduction on Old Kent was probably owing to an accident in the Tower Bridge area. The three sites with the highest average PCU flows were Old Kent, Kingsway and Tower Bridge.
2. The proportion of the flow in each vehicle class was similar between the three surveys for each site, with only relatively small (significant but less than 4%) changes. The significant changes were in the 'After 1' survey were the proportion of cars and light goods vehicles on Balham, Old Kent Road and Oxford street. In the 'After 2' survey there were decreases in the proportion of HGVs at Blackfriars, Balham and Kingsway and increases in the proportion of cycles at Balham and Kingsway.
3. Signal timings had changed between the surveys. Uniquely, in the 'After 1' survey, on Old Kent Road the average green time, and red time, per cycle had decreased by 4%, and the number of cycles per hour had increased by 4%. On all other sites the number of cycles per hour had changed by 1% or less. However, the Green time for traffic had increased on these sites by up to 7 seconds in the 'After 1' survey. There was evidence that cycles time had slightly varied in the

'After 2' survey on four sites, and the green time remained consistent between the two after surveys on four sites out of the eight. On Tower Bridge the green time increased slightly again and at Old Kent where the Green decreased again: from 76 in the 'Before', to 70 seconds in the 'After 2' survey. On Balham and Kingsway, increases in the 'After 1' survey were not evident in the 'After 2' survey.

4. The average capacity of each site was analysed for all traffic signal cycles observed, and therefore the effect when demand exceeds capacity could potentially be different: this is being separately investigated by TfL. Also, demand flow was not measured, however the junction throughput, i.e. flow into the junction was measured for each traffic cycle. In the 'After 2' surveys, on Balham and Kingsway reductions in flow into the junction and increases in green time resulted in a smaller percentage of the junction capacity used. On Finsbury a large increase in green time caused a reduction in the percentage of capacity used. On Blackfriars a large decrease in flow into the junction resulted in a reduction in the percentage of the capacity used. On Old Kent a slight reduction in flow into the junction was offset by a decrease in the green time. On Oxford St, Tower Bridge and Roehampton an increase in flow was partially offset by an increase in green time. Therefore on these sites the traffic green time per cycle increased as did the flow into the junction, and overall the percentage of the theoretical junction capacity used increased. In the 'After 2' surveys, on Oxford Street, and Finsbury, reductions in flow into the junction and increases in green time resulted in a smaller percentage of the junction capacity used. On Tower Bridge and Roehampton increases in flow were either fully, or partially, compensated for by a large increase in green time. Decreases in flow on Blackfriars, Balham and Old Kent resulted in a reduction in the percentage of capacity used. On Kingsway an increase in flow and reduction in green time per cycles resulted in a greater percentage of the junction capacity being used.
5. In the 'After 1' surveys, the average delay to the first vehicle to stop at the junction reduced at seven of the eight sites: by between 0.7 and 6 seconds per vehicle. In the 'After 2' surveys it reduced at six sites by between 1.4 and 7.8 seconds. In the 'After 2' survey there was an indication that first vehicle wait time was reduced by 1 second for each second reduction in red time.
6. The average distance vehicles waited behind the stop line increased at six of the eight sites in the 'After 1' which was approximately maintained (or increased) in the 'After 2' except for Roehampton which showed a small increase (less than 1 metre) and Finsbury which appeared to show a larger change of about 2 metres. At Oxford St, Finsbury and Tower Bridge, none of which had ASLs, the average stopping positions were consistently behind the stop line. At the other five sites in the 'After 1' surveys, the percentage of vehicles stopping over the stop line decreased in four cases, although only one of these changes was statistically significant, this was maintained in the 'After 2' survey, except for Old Kent and Blackfriars where there were increases in vehicles stopping behind the stop line and Roehampton that had decreases in stopping behind the stop line.
7. Vehicles started to move forward slightly earlier with PCaTS on sites with low and medium pedestrian flows: 0.1 to 0.3 seconds on average in the 'After 1' and with the exception of Roehampton 0.4 to 0.7 seconds in the 'After 2'. However, for the four sites with high pedestrian flows, vehicles started to move forward later on two, and earlier on the other two, sites in the 'After 1' surveys. In the 'After 2' surveys they started to move slightly earlier on three sites, and earlier (up to a maximum of 0.9 seconds earlier) on the other site.
8. For the sites without an ASL, vehicles reached the crossing after the start of the green phase, approximately 1 second earlier on Oxford St, and at the same time on the two other sites without an ASL. For the sites with an ASL, vehicles reached

the crossing in line with the time they started to move forward on three of the sites, but other factors appeared to have caused vehicles to slow down on two sites. The 'After 2' results are generally in line with the 'After 1' results however it was noted that Oxford Street, Kingsway and Tower Bridge showed slight decreases in the time to reach the crossing compared to those observed in the 'After 1' level.

9 Pedestrians remaining on crossing at the end of the pedestrian phase

The analysis in previous sections has focused on the point in the pedestrian cycle at which pedestrians start to cross the road. This section examines those pedestrians remaining on the crossing just before traffic is released – i.e. those pedestrians who have not cleared the crossing by the time traffic is given a green signal.

Analysis was conducted at two of the eight sites to quantify the number of pedestrians that remain on the crossing in the final 6 seconds leading up to the green traffic phase. It was also only conducted for the 'Before' and 'After 2' surveys to consider the effects after the schemes had settled in.

The results in this section are based upon a different sample to that contained elsewhere in this study: i.e. two of the eight sites. This affects the general applicability of the findings. That is different behaviours may occur on sites with higher, or lower, pedestrian flows and on sites where traffic on the same arm does not gain immediate priority. Furthermore, only the 'Before' and 'After 2' surveys were analysed and therefore any observed differences are after the schemes had settled in.

Figure 160 indicates the pedestrian phases occurring at these times on the two sites (Finsbury and Tower Bridge), with the blue line indicating the start of the six seconds that were studied.

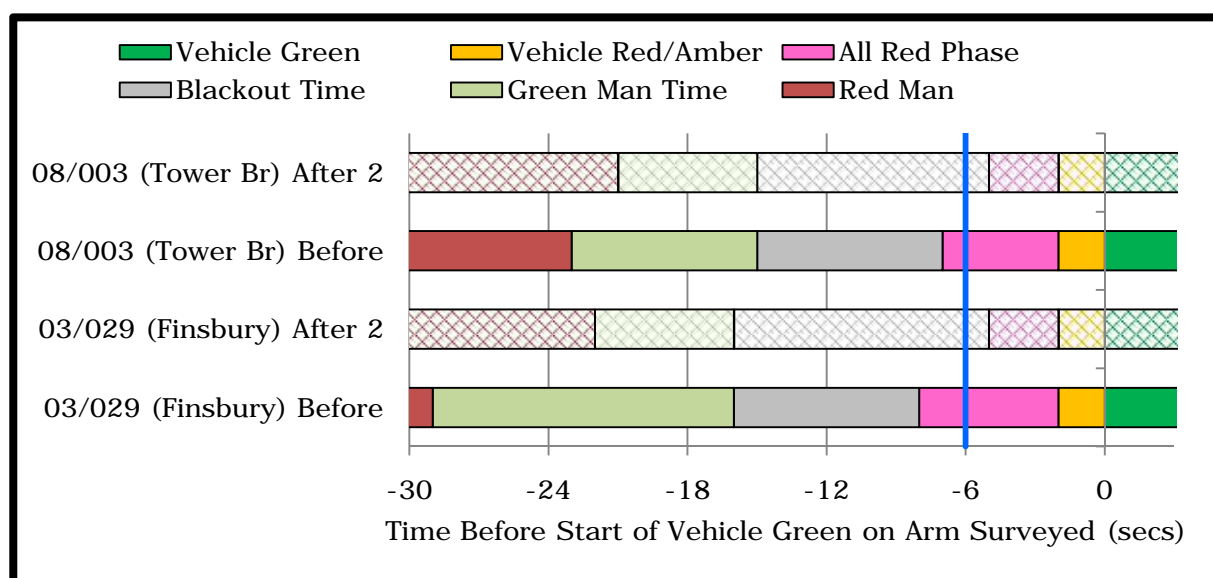


Figure 160 – Signal timings relative to the start of vehicle green on arm surveyed (Finsbury and Tower Bridge)

On both sites the pedestrian signal displayed 6 seconds prior to traffic green was:

- 'Before' survey: Red Man showing, and had been showing for a few seconds.
- 'After 2' survey: the last second of countdown displayed.

The two sites chosen for further investigation were Finsbury and Tower Bridge. These were selected because the junction arm that was being monitored at these sites was given vehicle priority immediately after the pedestrian phase. As a consequence the pedestrians on these crossings had the shortest time available before being in potential conflict with traffic, particularly those on the side of the crossing directly in front of waiting traffic (referred to as Side A).

Key Finding

The differences in the number, and proportion, of pedestrians remaining on the crossing at the following two second intervals before the change in priority to traffic with PCaTS were:

- 0 seconds – None
- 2 seconds – Slightly greater, but not statistically significant
- 4 and 6 seconds – Greater and statistically significant

9.1 Sample sizes and statistical validity

The sampling built upon the main sample from the previous analysis. It therefore collected data from the twelve quarter hour observation periods between 07:00 and 19:00. The number of signal cycles in each quarter hour period was approximately 9 or 10, i.e. the cycle time was approximately 90 seconds. However, pedestrians were not observed using the crossing in all of these cycles. A summary of the number of signal cycles and the percentage of these where pedestrians were using the crossing (at 6, 4, 2 and 0 seconds before traffic green) is summarised in Table 18

Table 18 – Total number of pedestrians using the Crossings

Site	Survey	Approximate Flow	Number of observed cycles	Number of cycles with pedestrians using crossing		Percentage of cycles with pedestrians using crossing	
				min	max	min	max
Finsbury (03/029)	Before	1000	109	66	71	61%	65%
	After 2	1000	118	84	90	71%	76%
Tower Bridge (08/003)	Before	250	110	39	45	35%	41%
	After 2	250	108	34	38	31%	35%

Flows and sample sizes are sufficient on Finsbury to investigate changes in the number and proportion of pedestrians on the crossing between the two surveys. However, those on Tower Bridge were smaller and unlikely to result in statistically robust findings.

To ensure that subsequent analysis used statistical tools that were valid for this data set, a further investigation was performed on the underlying distribution of numbers of pedestrians on the crossing. This was found to be in line with expectations so the confidence intervals reported later are considered accurate.¹⁰

9.2 Pedestrians on the crossing

This focussed analysis was primarily aimed to understand any differences in the number of pedestrians remaining on the crossing at the change to traffic priority before, and after, the PCaTS package of measures were introduced. This was measured as the number of pedestrians on each side of the carriageway were observed to be within the confines of the crossing area as the change in priority approached. The average numbers of pedestrians on the crossing have been calculated at two second intervals from six seconds before the priority change up until the change occurred (0 seconds). These values, together with their associated 95% confidence limits, are shown in Table 19. Further, green shading has been applied if the confidence limits associated with the 'Before' and 'After 2' surveys do not overlap and the trends in the averages are also displayed in Figure 161.

Table 19 – Average number of pedestrians using the Crossings

Time Before Start of Traffic Green		Finsbury	Finsbury	Tower	Tower
		(03/029) Before	(03/029) After 2	Bridge (08/003) Before	Bridge (08/003) After 2
6 seconds	Average	0.90	1.64	0.37	0.34
	Lower limit	0.73	1.40	0.27	0.24
	Upper limit	1.10	1.87	0.51	0.47
4 seconds	Average	0.82	1.50	0.37	0.27
	Lower limit	0.66	1.28	0.27	0.51
	Upper limit	1.00	1.72	0.51	0.83
2 seconds	Average	0.75	1.16	0.29	0.25
	Lower limit	0.60	0.97	0.20	0.16
	Upper limit	0.93	1.36	0.41	0.36
0 seconds	Average	0.71	0.75	0.27	0.18
	Lower limit	0.56	0.61	0.18	0.11
	Upper limit	0.88	0.93	0.39	0.27

¹⁰ In line with expectation the data were found to follow the Poisson distribution with good agreement, and this has been used, together with the Central Limit Theorem, to calculate the confidence intervals contained in the next section.

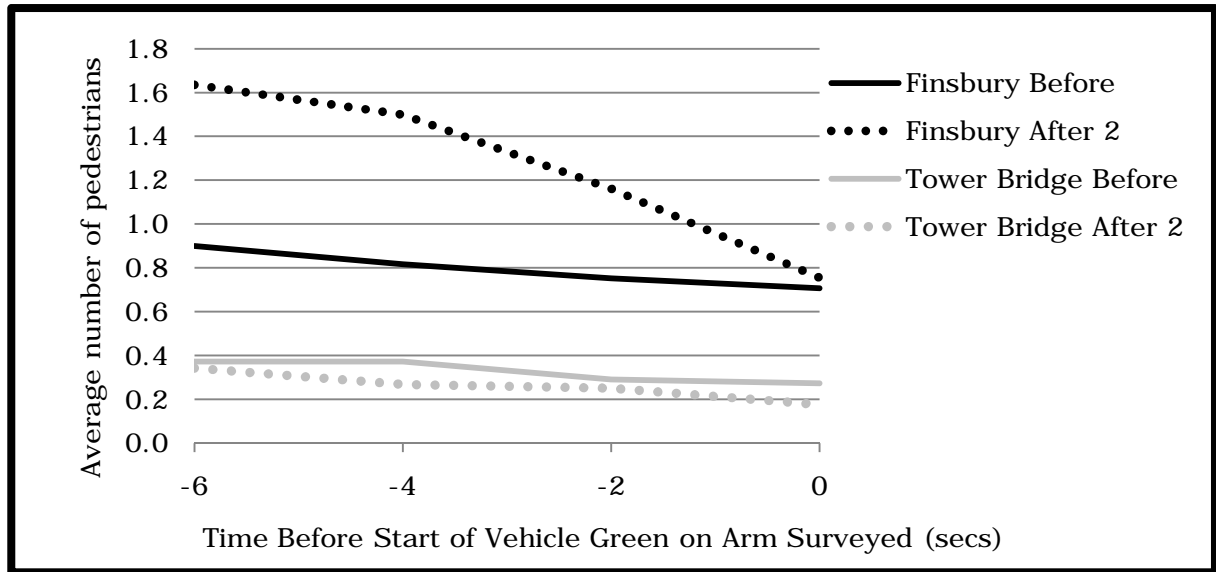


Figure 161 – Average number of Pedestrians on the crossings (Sides A and B)

On Finsbury, the site with sufficient sample sizes for robust results, the number of pedestrians on the crossing increased with PCaTS at 6 and 4 seconds before the change to traffic green, and the confidence intervals imply these differences are statistically significant: the increase being between 82 and 84%. The difference decreased closer to the change to the start of the traffic green, and there was effectively no difference at the point where priority was provided to vehicles.

The above analysis does not differentiate between pedestrians according to the side of the road from which they started to cross. There is however a possibility that the behaviour of those pedestrians crossing from the side of the road on which vehicles are queuing (Side A) will be different from those crossing from the opposite side (Side B). So, further analysis has been performed to answer this question.

The previous analysis was then repeated, but with Side A and Side B data treated separately. The results are shown in Figure 162 and Figure 163 below.

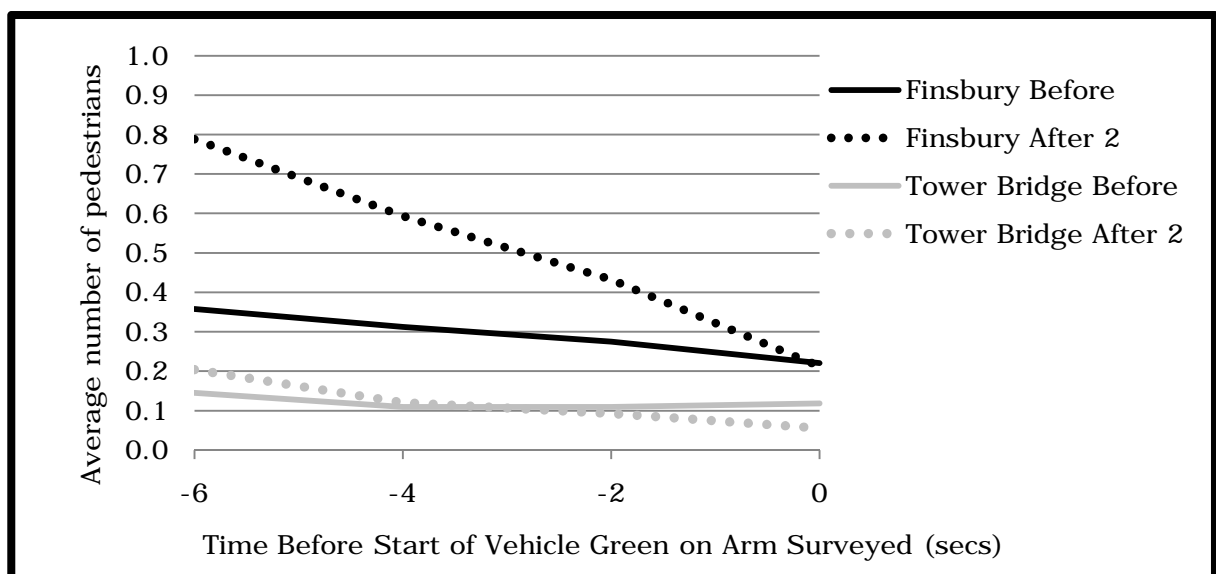


Figure 162 – Average number of Pedestrians on the crossing (Side A)

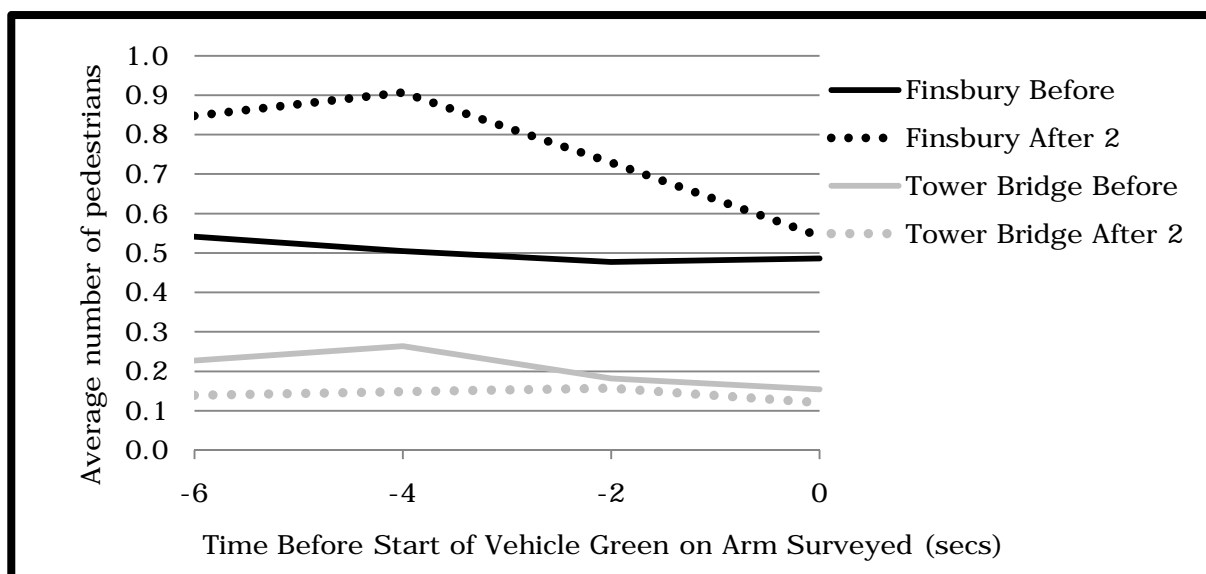


Figure 163 – Average number of Pedestrians on the crossing (Side B)

More pedestrians were on Side B of the crossing than on Side A for times close to the start of the traffic green. These pedestrians are not starting from directly in front of the waiting vehicles, so may perceive they have more time to cross. However, the relative trends between the 'Before' and 'After 2' surveys were the same for both starting sides.

On Finsbury, the site with the greatest flows and the most robust results, there were a greater number of pedestrians on the crossing at these times in the 'After 2' survey. However, the difference in the average number on the crossing reduced as the start of the traffic green approached, and the numbers were indistinguishable when the traffic signals changed.

The above analysis directly addressed the specific question as to the number of pedestrians on the crossing. However, it cannot account for variations in pedestrian flows. Therefore, in addition to the number of pedestrians on the crossing (i.e. those “on crossing”), the analysis also collected the number of pedestrians on the pedestrian island and on each footway who were intending to use the crossing (i.e. those “off crossing”). The total number of observed pedestrians are summarised in Table 20.

Table 20 – Total number of pedestrians using the Crossings

Time Before Start of Traffic Green	Zone	Finsbury, Before	Finsbury, After 2	Tower Bridge, Before	Tower Bridge, After 2
6 seconds	On Crossing	98	193	41	37
	Off Crossing	60	66	30	22
4 seconds	On Crossing	89	177	41	29
	Off Crossing	61	58	41	24
2 seconds	On Crossing	82	137	32	27
	Off Crossing	70	79	50	31
0 seconds	On Crossing	77	89	30	19
	Off Crossing	93	122	55	39

The total number of pedestrians using the Finsbury crossing had not altered between the two surveys, see Section 6.1.2. However, the number of pedestrians using the crossing during the small time interval investigated in this section did increase in the ‘After 2’ survey.

The reason for this is unclear; however, it could be a result of differences in methods of counting pedestrians in the two analyses. In the previous analysis, pedestrians were counted as using the crossing only if they initially stepped onto it. Whilst in this analysis they were counted if they were on the crossing at a given time. Therefore, it is possible that pedestrians who “cut the corner” by starting crossing upstream, or downstream, of the crossing and then walked onto it close to the end of the pedestrian phase were not counted in the previous analysis but were within this analysis, for more detail on the methodology see Section 2.

9.3 Proportion of pedestrians on and off the crossing

The previous section has shown an increase in the number of pedestrians remaining on the crossing as the change in priority to traffic approached, however this increase declined with time so that no difference remained when the actual change in priority occurred. This analysis, although informative, is affected by two issues, Firstly, the average numbers of pedestrians included all pedestrian cycles, and these include times when no pedestrians were using the crossing. Secondly, the number of pedestrians on the crossing does not account for variations in pedestrian flows.

These issues can be removed by considering the proportion of the pedestrians using the crossing that were on the road: i.e. not on the footway or pedestrian island at the time of the observation. This is therefore directly related to the proportion of pedestrians who made the decision to cross at that time, although it excludes any that were crossing the road but not using the crossing, see Figure 164.

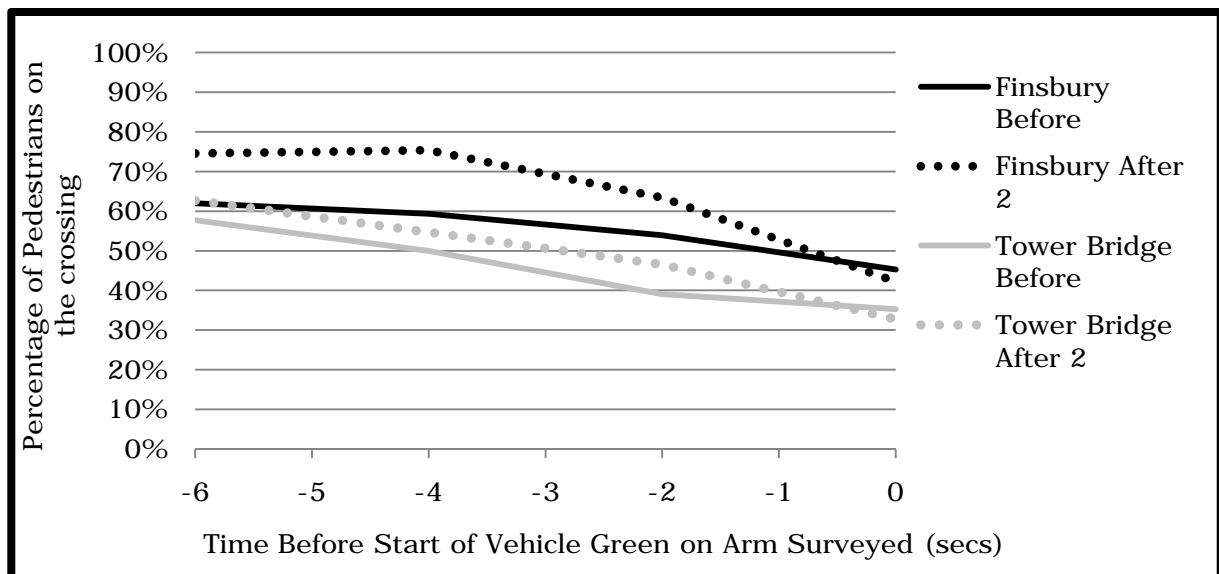


Figure 164 - Proportion of Pedestrians on the crossing (Finsbury and Tower Bridge)

A greater proportion of pedestrians made the decision to cross, resulting in a greater percentage of them remaining on the crossing at 6 to 2 seconds before the change to traffic green. However, as with the previous analysis, the proportion remaining on the crossing drops rapidly as the change of phase approaches so that the same proportions of pedestrians were on the crossing at the actual signal change. The trends in this analysis and the previous analysis on the number of pedestrians on the crossing are

consistent. The difference is that this analysis removes external changes in pedestrian flows. Thus it implies the percentage of pedestrians on the crossing increased by 12 to 16% at 6 to 4 seconds before the change to traffic green: compared to the 82 to 84% increase in numbers of pedestrians.

The increases on Finsbury were statistically significant at the 95% confidence level at 6 and 4 seconds before the change, and at the 90% confidence level at 2 seconds before the change.

The results from Tower Bridge needed to be treated with caution owing to the smaller sample sizes. However, the changes were consistent with those on Finsbury, although smaller and not statistically significant.

9.4 Summary of observations of pedestrians remaining on crossing

Overall, this analysis has shown that with PCaTS (and the associated package of changes) the number, and proportion, of pedestrians remaining on the crossing shortly before the change in priority to traffic (i.e. the traffic green) increased. This is consistent with the earlier findings that more pedestrians start to cross later in the countdown phase in comparison to the Blackout. However, this difference decreased with time as the traffic green approaches, and there were no differences with PCaTS by the start of the traffic green (0 seconds).

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