New cycle infrastructure on London's streets

Summary report of on-street trials

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MAYOR OF LONDON

TRANSPORT FOR LONDON

EVERY JOURNEY MATTERS

Contents

A. Introduction

1. Purpose of this report:

This report summarises TfL's findings and conclusions from assessments on the impact of new cycle infrastructure on London's streets. It draws on technical data generated by TRL and sets out TfL's conclusions based on those findings. The following detailed reports for each trial can be found on the TRL website (www.trl.co.uk):

- PPR853 Bus Stop Bypasses - Accompanied visits of people with disabilities to Bus Stop Bypasses
- PPR854 Bus Stop Bypasses - Analysis of Pedestrian and Cyclist Behaviour via Video
- PPR855 Bus Stop Bypasses - Surveys of Pedestrians and Cyclists
- PPR856 Low-Level Cycle Signals - On-Street Observations of Early Release and Hold the Left
- PPR857 Understanding Bicycle Movements at Traffic Light Controlled Cycle Gates

TfL's main objectives were to assess whether these innovative techniques work as intended for all users, to identify if any significant risks are emerging for any specific user group and to use outputs to update technical design guidance. The purpose of this report is to inform future updates to the TfL Streets Toolkit (https://tfl.gov.uk/corporate/publications-and-reports/streets-toolkit).

The types of infrastructure covered in this project were generally those that, prior to the publication of the revised Traffic Signs Regulations and General Directions (TSRGD) (http://www.legislation.gov.uk/uksi/2016/362/contents/made) in 2016, had not been possible to introduce on UK roads without obtaining site-specific approval. This report therefore should also inform nationwide use of the various techniques described.

2. Design techniques subject to trials:

Most trials undertaken as part of this research focused on design techniques intended to remove or reduce conflict between cyclists and turning general traffic. These were largely related to the use of cycle-specific traffic signals. In addition, trials were conducted to assess the impact of Zebra crossings at bus stop bypasses (BSBs) on users' behaviours.

The design techniques subject to this analysis were:

- **Hold-the-left-turn*:** ahead/left-turning cyclists and left-turning general traffic are separately signalled
- **Early release*:** cyclists receive a green signal ahead of other traffic
- **Two-stage turns*:** facilities enabling cyclists to wait between signal phases and therefore avoid turning in conflict with other traffic
- **Cycle gates:** cyclists proceed from a 'reservoir' ahead of other traffic in both time and space, and are held while general traffic proceeds

- **Bus stop bypass crossings:** a segregated cycle track runs through the bus stop area behind the shelter, thereby creating an island for passengers boarding the bus and alighting at the stop.

* For these techniques, particular attention was given to the impact of cycle signals on pedestrians

3. Methodology

In 2015, TfL formed an internal technical group to oversee the monitoring of new cycling infrastructure. This formed part of a monitoring programme that also included cycle counts and intercept surveys.

The technical group agreed a brief that included research questions and a list of case study sites. The commission was divided into two parts; one covering techniques associated with signal-controlled junctions and the other covering crossings at bus stop bypasses (BSBs).

A separate approach was taken to monitoring BSBs because of specific stakeholder interests in the trial. Earlier in 2015, TfL had established a bus stop bypass working group (See Appendix 6.1 for details of stakeholders) to test a proposition to address concerns raised principally by groups representing visually impaired people.

The BSBs trial sought to assess:

- How people found the crossing point
- Pedestrian confidence when crossing the cycle track
- Bus passengers' feelings of safety when boarding and alighting buses.

The working group contributed to the brief and research questions as well as commenting on outputs throughout the commission.

Through a competitive procurement process, TRL was appointed for both parts of the commission. The site selection and research questions were then refined, and TRL devised appropriate methodologies to address the questions.

The agreed approach included the following types of monitoring and sample sizes:

- **Video capture and analysis** – to examine observed behaviour
  - For hold-the-left, early release and two-stage turns, cycle movements were assessed based on a fixed number of traffic signal cycles over a seven-day period (either 196 or 294)
  - For cycle gates, cycle movements were assessed through video monitoring with 1,993 at Queen Street Place and 758 at Lambeth Road - based on the first six complete traffic signal cycles of each hour, for 14 hours (7am to 8pm) for seven consecutive days
  - Cycle movements and interactions between pedestrians and cyclists at BSB sites were assessed using a sample of 588 cycle movement per site, in each of the two phases of the monitoring (7,056 cycle movements in total)

- For BSBs, 784 walking movements per site (9,408 in total) were assessed by video monitoring. In addition, cycle speeds were assessed by video monitoring on 294 cycle movements per site

- **Intercept surveys** – to assess user perceptions
  - Intercept surveys were carried out with 100 pedestrians to assess the hold the left technique and a further 103 to assess the early release technique
  - Intercept surveys were carried out with 40 cyclists and 80 pedestrians per BSB site (1,440 people in total) across two phases of the study
- **Accompanied journeys and semi-structured interviews** – to understand the experience of disabled people at BSBs
  - Accompanied journeys were carried out with 18 visually impaired people, 6 mobility impaired people, 6 hearing impaired people and 6 people with learning difficulties, where each person visited two trial sites across two phases of the study.

4. Monitoring sites

Twelve trial sites were selected, some of which would allow for monitoring of multiple techniques. All monitoring took place between July 2016 and March 2017.

Figure 7 below shows the location of each trial site and Table 1 shows, for each site, the technique being trialled and the method used.

Figure 1: Trial locations for signal controlled techniques and crossings at BSBs

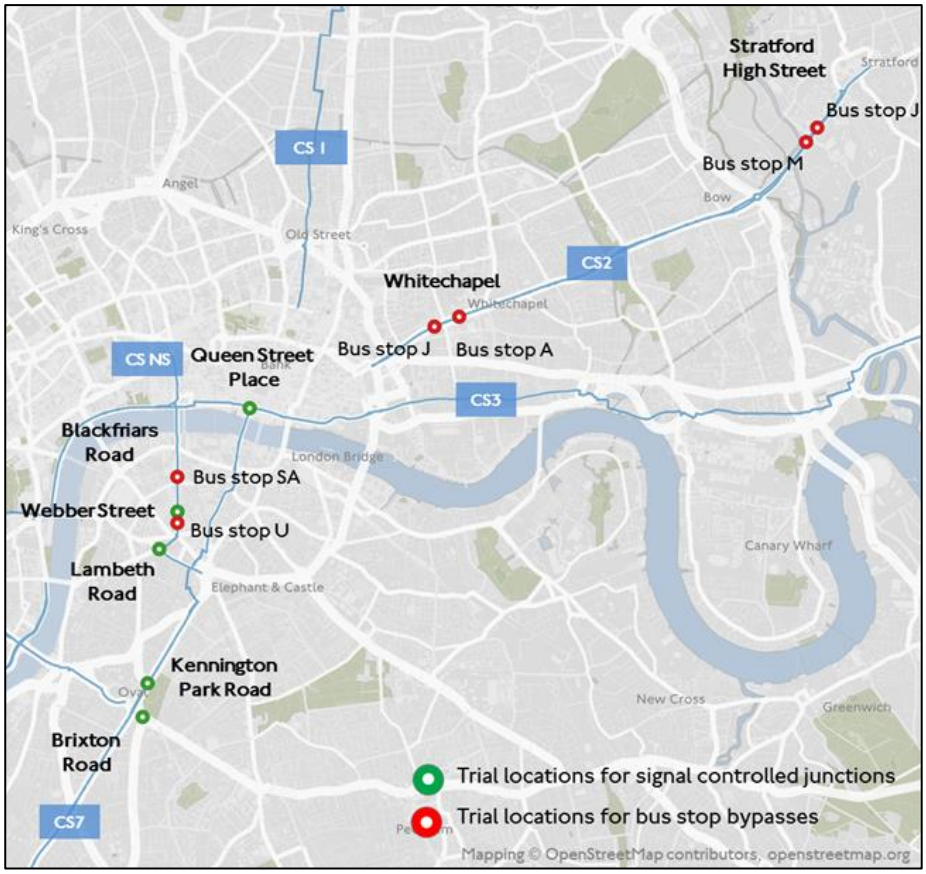


Table 1: Summary of monitoring sites

		Technique					Method		
Junction	**Arm**	Hold-the-left	Early release	Two-stage turn	Cycle gate	BSBs	Video	Intercept survey	Accompanied journeys
Mile End Road (CS2) / Burdett Road / Grove Road	Mile End Rd Eastbound	✓		✓			✓	✓	
	Mile End Rd Westbound	✓		✓			✓	✓	
	Burdett Rd Northbound		✓	✓			✓	✓	
	Grove Rd Southbound		✓	✓			✓	✓	
Blackfriars Road (CS6) / Webber Street (Q1)	Webber St Eastbound		✓				✓		
	Webber St Westbound		✓				✓		
Kennington Road / Kennington Park Road (CS7)	Kennington Park Rd NW/ and NE/bound	✓					✓		
Brixton Road / Camberwell New Road	Brixton Road Northbound	✓					✓		
Queen St Place (CS7) / Upper Thames Street (CS3)	Queen St Place Northbound				✓		✓		
Lambeth Road (CS6) / St George's Road	Lambeth Road Eastbound				✓		✓		
BSBs (6 sites)	N/A					✓	✓	✓	✓

B. Research objectives per trialled technique

This section provides brief descriptions of the types of infrastructure and the general questions that TfL set out to answer. More detailed and specific research questions were agreed with TRL and can be found in the TRL reports (www.trl.co.uk).

1. Hold-the-left turn

As described in the London Cycling Design Standards, a 'hold-the-left' involves separate signalling for cyclists and left-turning motor traffic, requiring a dedicated left-turning lane for general traffic and islands for signal infrastructure, and provision for cyclists turning right.

On-street trials were devised to address the following questions:

- Is hold-the-left used as intended by cyclists, i.e. do they use it or avoid it, and do they comply with the signals?
- Is there enough green time for cyclists to clear the cycle track? If not, what volume of cyclists can be accommodated?
- How comfortable pedestrians feel when crossing the road
- What information pedestrians use to know when to cross i.e. do people focus on the pedestrian signals, or do they try to work out when would be safe to cross by looking at general traffic and cycle signals?

Figure 2: Example of hold the left technique

2. Early release

As described in the London Cycling Design Standards, a ‘Cycle early release’ allows cyclists to proceed ahead of general traffic at signalised junctions. In most circumstances, early release must be applied to a layout with an advanced stop line (ASL), using a low-level cycle signal mounted under the associated primary traffic signal on a high-level signal pole.

The effectiveness of an early release depends on cyclists being aware that they receive this green cycle signal ahead of general traffic, and enabling them to proceed first while other traffic complies with signals.

On-street trials were therefore devised to address the following questions:

- Does the early release allow a cyclist to clear a potential conflict with turning general traffic?
- What factors contribute to cyclists not being able to use the early release – do they include: a) queuing behind other cyclists, or b) driver behaviour?
- Does early release contribute to cyclists making right turns that could increase the risk of collision with oncoming traffic?
- How comfortable pedestrians feel when crossing the road
- What information pedestrians use to know when to cross i.e. do people focus on the pedestrian signals, or do they try to work out when would be safe to cross by looking at general traffic and cycle signals?

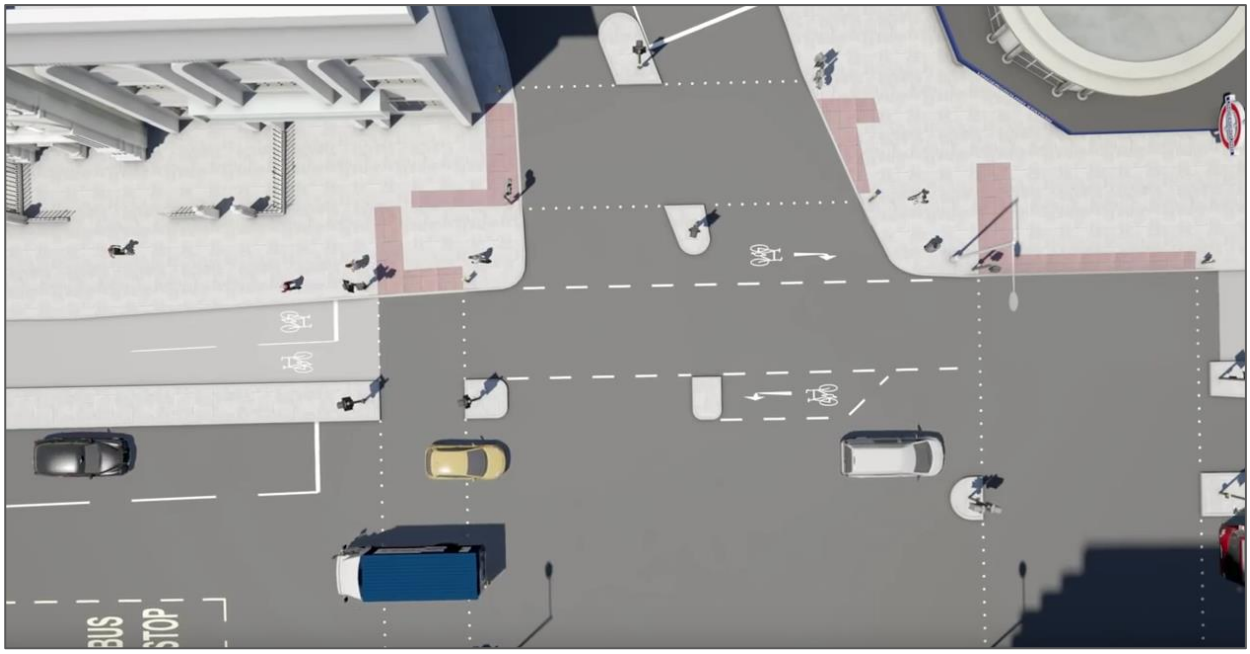
Figure 3: Example of early release technique

3. Two-stage turns

As described in the London Cycling Design Standards, ‘Two-stage turns’ are interventions that enable cyclists to make an opposed turn in two stages, i.e. without having to cross conflicting streams of traffic. This generally means a right turn from the nearside or a left turn across general traffic lanes from a two-way track on one side of the carriageway.

At the selected trial sites, two-stage turns are associated with hold-the-left and early release facilities. Data from those observations is also useful in establishing the circumstances under which two-stage right turn facilities are proving to be successful.

Figure 4: Layout diagram for the two-stage turns technique



4. Cycle gates

The cycle gate is a method of giving cyclists some time and space to move through a junction ahead of motorised vehicles. Current guidance recommends this technique as an option where there are a large number of turning movements by motorised vehicles, predominantly left turning.

The signal operation has to give cyclists enough time to clear potential points of conflict. There are two sets of signals and, for cyclists, two stop lines. The first, the cycle stop line, acts as a ‘gate’ to allow cyclists into a cycle reservoir while general traffic is held on a red signal. At the reservoir stop line, cyclists can then wait well ahead of general traffic, before both receive a green signal at the same time.

On-street trials were devised to establish:

- Whether the infrastructure is used as intended by cyclists, by measuring the proportion of cyclists who use the cycle gate, and their compliance with signals
- Whether the facility is compromised by general traffic failing to clear the reservoir, by measuring the frequency in which this occurs.

Figure 5: Example of cycle gate technique

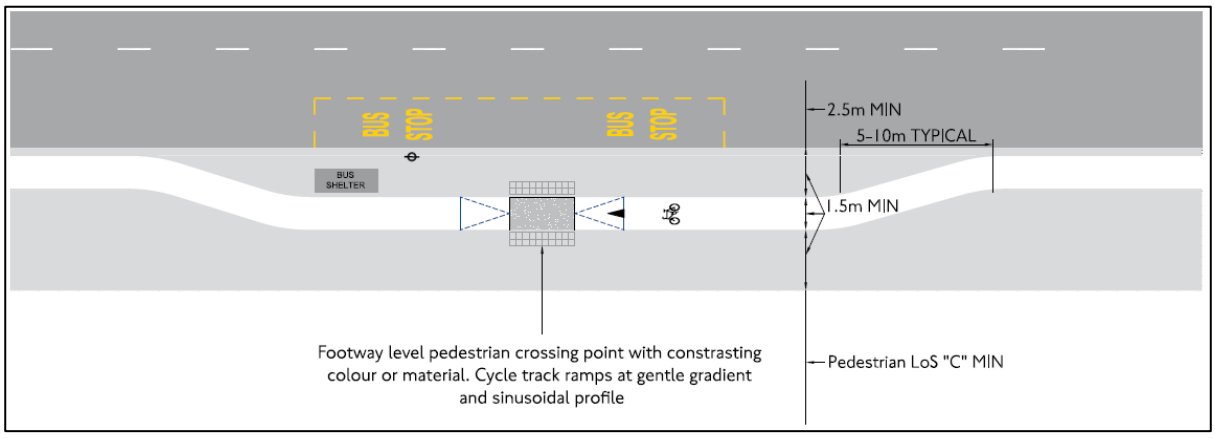
5. Techniques associated with crossings at bus stop bypasses:

The London Cycling Design Standards and Accessible Bus Stop Design Guidance provide guidance on the use and design of BSBs. It requires a crossing across the cycle track for pedestrians to access the bus stop island. The concept draws on successful examples of similar infrastructure which has been seen in other cities, such as Amsterdam, for decades.

In consultation with the working group, TfL carried out a trial which replaced the uncontrolled crossing at some BSBs with Zebra crossings, to assess their impact on pedestrians and cyclists, including disabled people.

Figure 6: Examples of crossings at BSBs without and with Zebra crossing

Figure 7: BSB layout diagram from TfL's Accessible Bus Stop Design Guidance



Zebra crossings marked over cycle tracks are enforceable in the same way as a Zebra crossing over any other carriageway, provided they comply with TSRGD – i.e. cyclists must stop for pedestrians to cross. Changes to TSRGD in 2016 allowed for the omission of zig-zag markings at Zebra crossings over cycle tracks, and for Belisha beacons to be optional.

Research questions were devised to enable a detailed comparison between uncontrolled and Zebra crossings at BSBs. The following outcomes were sought to determine whether Zebra crossings were preferable:

- Reduction in the severity of interactions between cyclists and pedestrians
- Improvement in give-way behaviour by cyclists at the crossing
- All users feeling safer and more comfortable
- Disabled people being able to find and use the crossing point more easily
- Disabled people feeling safer using the bus
- Increase in the number of people noticing the crossing point, particularly cyclists
- Increase in the number of people understanding who has priority at the crossing point, particularly cyclists recognising pedestrian priority at Zebra crossings
- Increase in the number of pedestrians crossing the cycle track at the designated crossing point
- No reduction in the proportion of cyclists in the cycle track rather than the main carriageway
- Reduction in the speed of cyclists

The trial also allowed for comparison between sites, addressing the following issues in particular:

- Whether there are clear differences between sites attributable to site-specific features, and whether the appropriate design approach might vary e.g. according to how busy the bus stop location is, or whether the cycle track has one or two-way flow
- Whether Belisha beacons at the Zebra crossings make a significant positive difference for pedestrians and cyclists to identify the crossing point.

Table 2: Configuration of trial sites for bus stop bypass crossings

Bus stop	Cycle track	Busy/Quiet	No. of Belisha beacons
Blackfriars Road SA – Southwark Station	2-way	Busy	On both sides of crossing
Blackfriars Road U – St George's Circus	2-way	Quiet	None
Whitechapel Road A – Royal London Hospital	1-way	Busy	None
Whitechapel Road J – East London Mosque	1-way	Busy	On footway side only
Stratford High Street J – Carpenters Road	1-way	Quiet	None
Stratford High Street M – Warton Road	1-way	Quiet	None

C. Findings and conclusions

This section summarises the main findings for each technique. The key evidence that supports these findings is contained in the appendices to this report and further details can be found in the relevant TRL trial report (www.trl.co.uk).

In light of the demonstrable benefits of the techniques assessed through this report for people walking, cycling and using public transport, advice in the London Cycling Design Standards will be updated to recommend their use in the appropriate context.

1. Hold-the-left turn

The trials of the hold-the-left technique showed that:

- Hold-the-left facilities did not deter cyclists from using the cycle track
- Overall, cyclists displayed a high level of compliance with the cycle-specific signals at hold-the-left facilities (87 per cent) which was 3 per cent greater than for those cyclists using the main carriageway and signals for general traffic
- Use of the cycle track and compliance with signals was significantly greater at Kennington Park Road (92 per cent) than at Brixton Road (88 per cent) or Mile End Road eastbound (77 per cent) and Mile End Road (83 per cent); reasons for this could include:
  - Cyclists using the cycle tracks got the same amount of green time as traffic moving in the same direction
  - Segregation started in advance of the junction (compared with other sites where cyclists can make a last-minute decision to switch lanes)
- The four sites show that hold-the-left can be applicable where there is a dominant cycle movement in parallel with a heavy movement of motor traffic, or where there is a relatively even split between cyclists turning left and proceeding ahead
- At hold-the-left sites, cyclists received sufficient green time for the demand.

2. Early release

Trials of the early release technique showed that:

- Cyclists were almost always (88 per cent) able to make use of the early release facility – where they did not, there are no clear reasons why this was the case (See Appendix 3.2)
- There was no evidence of cyclists being prevented from using the early release because of queuing behind other cyclists
- There was little evidence (3 per cent) of motorists misunderstanding the cycle early release, i.e. proceeding on the cycle signal (See Appendix 4.2)

- Early release has a greater potential benefit for cyclists at junctions with longer signal cycles (where cyclists are more likely to arrive on a red signal) or where the approach with the early release has a short green time
- There was little evidence of a correlation between cyclists' ability to benefit from early release and either motorist encroachment on the ASL or motorists proceeding on the early release signal.

3. Two-stage turns

Trials of the two-stage turns techniques showed that:

- There appeared only to be an incentive to perform a right turn in two stages where the conventional right turn was banned – although it could also have been because the two-stage turn is not well established among people cycling in London
- The results suggest that for a large multi-lane junction, more than 60 per cent of cyclists use the conventional right turn facility and gap seek before making the turn
- The study compared two junctions and more research is needed to understand behaviours across a wider range of junction arrangements.

4. Impact of cycle signals on pedestrians

The impact of cycle signals on pedestrians was assessed at trial sites for the hold-the-left, early release and two-stage turns techniques. While some pedestrians may not feel entirely comfortable with the complexity of a junction such as Mile End Road / Burdett Road, there was little evidence to suggest that the infrastructure gave rise to particular safety issues:

- The majority of pedestrians felt confident using the crossings (70 per cent with hold-the-left and 82 per cent with early release – See Appendix 4.1)
- All those surveyed at hold-the-left sites either looked at the pedestrian signals, or looked at the signals for general traffic and/or checked appropriately for gaps in the traffic before crossing.

Designers should bear in mind the following findings about the behaviour of pedestrians:

- Many pedestrians (36 per cent) used the segregating islands to cross in multiple stages, particularly when crossing from the footway rather than from the central island (See Appendix 4.3)
- Relatively few pedestrians (20-30 per cent) paid any attention to cycle signals
- Over 50 per cent of pedestrians used both the pedestrian and general traffic signals to decide when it was safe to cross (See Appendix 4.3).

Feedback from the questionnaire indicated that some respondents were concerned that the signals and/or junction layout were confusing for pedestrians, however no evidence was found to indicate that pedestrians are likely to misinterpret the various signals and wrongly conclude that it is safe to cross.

5. Cycle gates

Trials of the cycle gate technique showed that:

- Cycle gates were operating as intended, and the majority of cyclists chose to use them
- More cyclists were likely to use the cycle gate facility if they were segregated on the approach – if infrastructure allows for a late decision to switch to a general traffic lane, then some cyclists are likely to do so
- There was no increase in cyclist non-compliance with signals at peak times – cyclists were more likely to pass through a red signal during off-peak times (approx. 60 per cent off-peak compared to 30 per cent during the am peak)
- Where cycle flows were high (indicatively, 10 or more cyclists in a given signal cycle) then cyclists were significantly more likely to pass the cycle stop line on a red signal. However, 19 per cent then complied with the signal at the reservoir stop line (See Appendix 5.1)
- There was little evidence of other vehicles undermining the operation of the cycle gate by getting stuck in the reservoir on a red signal (3 per cent). When they did so (57 per cent), it was predominantly because they crossed the first stop line when there was a red signal (See Appendix 5.4).

6. Techniques associated with crossings at bus stop bypasses

Owing to there being demonstrable benefits to pedestrians from replacing uncontrolled crossings with Zebra crossings at BSBs, TfL proposes to implement Zebra crossings at existing and proposed BSBs on the Transport for London Road Network (TLRN).

The trials of crossings at BSBs showed that:

- There are demonstrable benefits to pedestrians from replacing uncontrolled crossings with Zebra crossings at BSBs. Trials of Zebra crossings at BSBs showed that they:
    - Reduced the likelihood of high level interactions between walking and cycling movements (see Appendix 6.3 for levels of interactions)
    - Allowed visually impaired people to find the crossing more easily
    - Increased the feeling of safety among disabled people boarding and alighting from the bus
    - Increased the feeling of safety generally at BSBs
    - Made the crossing-point more noticeable for pedestrians and cyclists
    - Clarified that cyclists should give way to pedestrians
    - Encouraged more pedestrians to use the crossing-point
    - Did not, in isolation, discourage people from cycling in the cycle track
- There were benefits for disabled people, especially visually impaired people who could find the crossing-point more easily
- There were no obvious dis-benefits to cyclists, although this is based on a trial of Zebra crossings at existing ‘stand-alone’ sites. The impact of successive BSBs with Zebra crossings would need further monitoring.

- Zebra crossings did not substantially affect give way behaviour from cyclists or reduce cycle speeds. However both the increased understanding of who had right of way and the decrease in severity of incidents provide support for the use of Zebra crossings at BSBs, in place of uncontrolled crossings
- There were no clear influences from site-specific conditions – e.g. nothing to suggest that Zebra crossings ought to be used for two-way tracks only or busy sites only
- There was little evidence that Belisha beacons added a significant benefit therefore the default should be to omit them
- Owing to the little evidence of improved give way behaviour, it is recommended that complementary measures are also introduced. These could include audio announcements on buses on the approach to a BSB, and behaviour change activities to encourage cyclists to give way at Zebra crossings.

Table 3 overleaf summarises the outcomes of the Zebra crossing trials at BSBs.

Table 3: Summary of outcomes of BSB trials

Outcome that would demonstrate positive effect of having Zebra crossings at BSBs	Reflected in results	Details
Number and/or severity of interactions is reduced	Yes	20 'higher level' interactions (significant conflict between pedestrians and cyclists – see Appendix 6.3) with uncontrolled crossings and 10 with the Zebra crossings – of these, most involved cyclists taking evasive action to avoid pedestrians
More cyclists give way at the crossing	Marginally	Cyclists gave way 33 per cent of the time with uncontrolled crossings, and 38 per cent of the time with Zebra crossings
People generally feel safer and more comfortable using the BSB	Yes	Nearly 70 per cent of pedestrians felt 'very safe' or 'quite safe' with the Zebra crossing, compared with less than 60 per cent with the uncontrolled crossing
Disabled people find and use the crossing-point more easily	Yes	For visually impaired people, the tactile tails allow people to find the crossing more easily, audible announcements on buses tell people there is a cycle track to cross when alighting, and Zebra crossings generally increased feelings of safety. Some difficulties remain for visually impaired people, even with Zebra crossings, particularly when crossing from bus stop to footway. Other groups had few problems with either crossing type.
Disabled people feel safer using the bus stop	Yes	
More people notice the crossing (especially cyclists)	Yes	75 per cent of pedestrians noticed the Zebra crossings, compared with 64 per cent for the uncontrolled crossings; more cyclists generally noticed the crossings, with a small increase (80 per cent to 82 per cent) for Zebra crossings
More people know cyclists should give way	Yes	A large increase (from 34 per cent to 76 per cent) in people knowing that pedestrians have priority once the Zebra crossings were introduced. The increase was larger for cyclists (32 per cent before, 82 per cent after)
More people cross at the crossing-point	Yes	39 per cent of pedestrians used the crossing-points when they were uncontrolled, and 53 per cent when they became Zebra crossings
No reduction in percentage of people using the cycle track	Yes	The Zebra does not reduce cyclists' use of the cycle track (90 per cent before, 93 per cent after) and cycle speeds are unchanged (the slight variation in average of 14.4mph before and 14.3mph after is not statistically significant)
Reduction in cycle speed on approach to the crossing	No	

Appendices – relevant trial outcomes

The appendices listed below contain the trials' detailed results summarised in **section C**.

Appendix 1 - Hold-the-left

1.1 Use of the cycle track and signal compliance

- Ninety-one percent of cyclists used the cycle track in preference to the main carriageway
- Of those 91 per cent, 87 per cent proceeded on a green signal; the lowest level of compliance was at Mile End Road eastbound and highest at Kennington Park Road
- Compliance for cyclists using the main carriageway was only slightly lower (83 per cent on average)
- At three out of four sites, compliance was greater for those using the cycle track

Table 4: Signal compliance at hold-the-left sites

		Mile End Road Eastbound	Mile End Road Westbound	Brixton Road	Kennington Park Road	Total
Cycle track	No. of cyclists	323	285	355	764	**1,727**
	No. proceeding on green	248	236	312	702	**1,498**
	Proceeding on green	77%	83%	88%	92%	**87%**
Main carriageway	No. of cyclists	52	50	69	6	**177**
	No. proceeding on green	48	41	54	5	**148**
	% proceeding on green	92%	82%	78%	83%	**83%**
	% using cycle track	86%	85%	84%	99%	**91%**

Sampling methodology: for each arm, the first two signal cycles seen from the start of every other hour for 14 hours each day, for 7 days, i.e. 2 x 7 x 7 = 98

1.2 Cycle movements at hold-the-left sites

- At three out of four sites, cyclists in the cycle track mainly proceeded ahead (varying between 84 per cent and 90 per cent)
- The exception was Kennington Park Road, where the movements were more evenly split (57 per cent proceeding ahead and 43 per cent turning left)
- In total, less than 1 per cent of cyclists using the cycle track and 10 per cent of those using the carriageway turned right. Kennington Park Road and Brixton Road had 0 right-turners in the carriageway as the movement is not permitted
- However at the Mile End Road sites, 78 per cent of right-turning was carried out from the main carriageway rather than from the cycle track (in a two-stage turn) which is likely due to confident cyclists making the decision to turn right early, and positioning themselves accordingly

Table 5: Cycle movements at hold-the-left sites

		Mile End Road Eastbound	Mile End Road Westbound	Brixton Road	Kennington Park Road	Total
Cycle track	No. of cyclists	323	285	355	764	**1,727**
	Turning left	47	24	51	329	**451**
	Proceeding ahead	276	256	298	435	**1,265**
	Turning right	0	5	6	0	**11**
Main carriageway	No. of cyclists	52	50	69	6	**177**
	Turning left	5	0	8	3	**16**
	Proceeding ahead	42	37	61	3	**143**
	Turning right	5	13	0	0	**18**

Sampling methodology: for each arm, the first two signal cycles seen from the start of every other hour for 14 hours each day, for 7 days, i.e. 2 x 7 x 7 = 98

1.3 Cyclists are able to clear the track on the green signal

- In 97 per cent of signal cycles, all cyclists cleared the cycle track on the green signal
- In cases where cyclists did not clear the track, this was because they had chosen to stop rather than owing to a lack of green time

Table 6: Clearance of cyclists on green at hold-the-left sites

	Mile End Road Eastbound	Mile End Road Westbound	Brixton Road	Kennington Park Road	Total
Signal cycles in which all cyclists cleared on green	143	146	147	147	**583**
Signal cycles in which not all cyclists cleared on green	4	1	0	0	**5**
% in which all cyclists cleared	3%	1%	0%	0%	**3%**

Sampling methodology: first three signal cycles seen from the start of every other hour for 14 hours each day, for 7 days, i.e. 3 x 7 x 7 = 147

Appendix 2 - Early release

2.1 Proportion of cyclists who stand to benefit from early release

- Approximately two-thirds of cyclists at Webber Street and four-fifths of cyclists at Burdett Road and Grove Road arrived at the junction on a red signal, and could therefore benefit from the early release
- This is consistent with the difference between the signal cycle times for the two junctions: 88-104 seconds for Webber Street and 112-120 seconds for Burdett Road / Grove Road, hence there is a greater chance of cyclists arriving on red at Burdett Road

Table 7: Cyclist action at early release signals

	Burdett Road	Grove Road	Webber Street Eastbound	Webber Street Westbound	Total
Cyclists arriving on green	29 (17%)	40 (21%)	64 (32%)	57 (33%)	**190 (26%)**
Cyclists arriving on a red	145 (83%)	147 (79%)	136 (68%)	117 (67%)	**545 (74%)**
Total no. of cyclists	174	187	200	174	**735**

Sampling methodology: for each arm, the first two signal cycles seen from the start of every other hour for 14 hours each day, for 7 days, i.e. 2 x 7 x 7 = 98

2.2 Cyclists' ability to proceed using the early release signal (video monitoring)

- Cyclists were present in 88 per cent of the signal cycles and were therefore able to benefit from the early release
- In only 1 per cent of cases did the presence of other cyclists prevent them from using the early release – four out of five such instances were at Webber Street westbound
- In the remainder of cases, cyclists were either not aware of the early release or chose not to use it for a reason undeterminable by this research

Table 8: Cyclist action at early release signals

		Burdett Road	Grove Road	Webber Street Eastbound	Webber Street Westbound	Total
Cyclists able to proceed ahead of general traffic		155 (97%)	132 (81%)	139 (85%)	121 (90%)	**547 (88%)**
Cyclists not able to proceed (queuing behind other cyclists)		1 (1%)	0	0	4 (3%)	**5 (1%)**
Cyclists did not notice early release or waited for general traffic green		4 (3%)	31 (19%)	24 (15%)	9 (7%)	**68 (11%)**
No. of signal cycles	Cyclists present	160	163	163	134	**620**
	No cyclists present	36	33	33	62	**784**

Sampling methodology: first two signal cycles seen from the start of every hour for 14 hours each day, for 7 days, i.e. 2 x 14 x 7 = 196

2.3 Driver encroachment into an early release ASL

- For three of the four sites, there was encroachment by drivers of 2.5 metres or more into the ASL in approximately 1 in 10 signal cycles
- At Webber Street westbound this occurs more frequently – approx. 1 in 4 signal cycles
- Similar behaviour was observed between drivers in different lanes except at Grove Road where there was a slightly greater tendency for right-turners to encroach into the ASL
- Cyclists' ability to get to the front of the ASL, and so benefit from the early release, could be impeded the more that vehicles encroach - especially with larger volumes of cyclists

Table 9a: Driver action at early release signals at trial sites

		Burdett Rd	Grove Rd	Webber St Eastbound	Webber St Westbound	Total
First waiting vehicle encroaches by 2.5m+		17 (9%)	28 (10%)	9 (9%)	25 (26%)	**79 (12%)**
ASL waiting area mostly clear (5m+ available)		179 (91%)	251 (90%)	89 (91%)	73 (74%)	**592 (88%)**
No. of signal cycles	Vehicles present	196	279	98	98	**671**
	No vehicles	0	15	0	0	**15**

Table 9b: Breakdown of driver behaviour by approach lane

	Burdett Rd		Grove Road		
Lane	Left	Right	Left	Middle	Right
First waiting vehicle encroaches by 2.5m+	8 (8%)	9 (9%)	8 (9%)	6 (6%)	14 (16%)
ASL waiting area mostly clear (5m+ available)	90 (92%)	89 (91%)	85 (91%)	90 (94%)	76 (84%)

Sampling methodology: for each general traffic lane at each junction, first two signal cycles seen from the start of every other hour for 14 hours each day, for 7 days, i.e. 2 x 7 x 7 = 98. Burdett Road has two lanes, Grove Road three lanes and Webber Street one lane in both directions.

2.4 Influence of the early release signal on drivers

- There was a high level of compliance with the green signal at Burdett Road and Grove Road, but a significant variation at Webber Street with many instances of general traffic proceeding on the starting amber signal (i.e. the last few seconds of the cycle early release)
- In comparison there were relatively few examples of general traffic proceeding on the cycle early release signal. Whether a cyclist was present appears to have little effect on this pattern of behaviour

Table 10: Driver action at early release signals at trial sites and breakdown of behaviour by approach lane

		Burdett Rd	Grove Rd	Webber St Eastbound	Webber St Westbound	Total
No. of signal cycles in which the first vehicle waiting at the stop line proceeds	on cycle ER / cyclist present	1 (1%)	1 (1%)	3 (3%)	7 (7%)	**12 (2%)**
	on cycle ER / no cyclist present	0	0	5 (5%)	4 (4%)	**9 (1%)**
	on starting amber for general traffic	2 (1%)	0	33 (34%)	23 (23%)	**58 (9%)**
	on green for general traffic	189 (98%)	277 (99%)	57 (58%)	64 (65%)	**587 (88%)**
No. of signal cycles	Usable sample	192	278	98	98	**666**
	Data missing	4	16	0	0	**20**

Sampling methodology: for each arm, the first two signal cycles seen from the start of every other hour for 14 hours each day, for 7 days, i.e. 2 x 7 x 7 = 98

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Appendix 3 - Two-stage turns

3.1 Two-stage turns at hold-the-left sites

See Table 5 in Appendix 1.2

- There was minimal number of right-turning cycling people at any of the sites (approximately 1 per cent of all cycle movements analysed)
- Sixty-two percent of the right turns were made from the carriageway (in one movement) and all at Mile End Road

3.2 Two-stage turns at early release sites

Note: formal two-stage right turn facilities are provided at Grove Road / Burdett Road, but not at Webber Street

- Burdett Road showed the highest number of cyclists carrying out the two-stage right turn (27 per cent)
- One of the main reasons for this could be owing to the conventional right turn being banned from Burdett Road (although it is notable that 8 per cent use the early release to turn right in one movement, and the remaining 66 per cent wait in the centre of the junction for a gap in traffic).
- Eighty-eight percent of those who turned right from Webber Street (westbound) into Blackfriars Road did so by using the early release, whilst the percentage of cyclists was much lower – particularly at Burdett Road (8 per cent)/ Grove Road (18 per cent)

Table 11: How cyclists turn right at early release sites

	Burdett Rd	Grove Rd	Webber St Eastbound	Webber St Westbound	Total
Two-stage right turn	17 (27%)	4 (2%)	0	0	**21 (7%)**
'Conventional' right turn (with general traffic)	42 (66%)	146 (80%)	7 (50%)	6 (13%)	**201 (65%)**
Using the early release (turning in one movement before opposing general traffic gets green)	5 (8%)	32 (18%)	7 (50%)	42 (88%)	**86 (28%)**

Sampling methodology: first three signal cycles seen from the start of every hour for 14 hours each day, for 7 days, i.e. 3 x 14 x 7 = 294 signal cycles

Appendix 4 - Impact of cycle signals on pedestrians

4.1 Feeling of confidence when crossing at hold-the-left sites

- Levels of confidence were high at HTL1 (66 per cent), whilst a wider range of results (and therefore more uncertainty) were found at HTL2 and HTL3
- Comments associated with uncertainty related to:
    - Confusion / over-complication (including both the layout, and the crossing-point itself)
    - Taking a long time to cross
    - People taking risks when they see the red man and the traffic light on red
    - People not realising they should check the cycle track before they cross
    - Having to check too many lights

Table 12: Pedestrian surveys at hold-the-left sites: how confident or uncertain do you feel about crossing here?

		Very uncertain	Quite uncertain	Neither confident nor uncertain	Quite confident	Very confident
No.	HTL1 (western arm)	3	6	7	22	9
	HTL2 (eastern arm)	3	6	5	5	6
	HTL3 (eastern arm)	2	8	5	7	3
	Total	**8**	**22**	**17**	**34**	**18**

%	HTL1 (western arm)	19%	15%	66%
	HTL2 (eastern arm)	36%	20%	44%
	HTL3 (eastern arm)	40%	20%	40%
	Total	**30%**	**17%**	**53%**

Sampling methodology: 99 participants

4.2 Feeling of confidence when crossing at early release sites

- Higher levels of confidence than at hold-the-left sites but still some uncertainty
- There were fewer variations by arm, with the highest levels of confidence at ER4 (84 per cent)
- Comments associated with uncertainty were not specific to the early release facility but related to:
    - Uncertainty about where traffic is coming from
    - Too many lanes, too many signals
    - Having to wait too long for the pedestrian green man

Table 13: Pedestrian surveys at early release sites: How confident or uncertain do you feel about crossing here?

		Very uncertain	Quite uncertain	Neither confident nor uncertain	Quite confident	Very confident
No.	ER1 southern arm	2	4	2	13	4
	ER2 southern arm	2	3	1	16	6
	ER3 northern arm	3	2	1	11	7
	ER4 northern arm	1	1	2	12	10
	Total	**8**	**10**	**6**	**52**	**27**

%	ER1 southern arm	24%	8%	68%
	ER2 southern arm	18%	4%	78%
	ER3 northern arm	21%	4%	75%
	ER4 northern arm	8%	8%	84%
	Total	**18%**	**6%**	**77%**

Sampling methodology: 103 participants

4.3 Information used by people crossing at hold-the-left sites

- Out of all the information available to pedestrians, the pedestrian signals are the most important as 88 per cent of pedestrians looked at them when making the decision to cross the road
- Eighty-six percent of pedestrians either checked that all vehicles (including cyclists) were stopped or checked that there was a sufficient gap to allow safe crossing
- No one crossed the road without being aware of what general traffic was doing

Table 14: Pedestrian surveys at hold-the-left sites: which signals did you look at before crossing?

		Yes	No	Don't know
Pedestrian signals	Crossed on green man	57	14	2
	Crossed on red man	25		
	Crossed during countdown	2		
General traffic signals		46	52	2
Cycle signals		20	77	2

Sampling methodology: 100 participants

Table 15: Pedestrian surveys at hold-the-left sites: did you look at traffic on the road before crossing?

Yes, I checked that all motor vehicles and cyclists were stopped	**52%**
Yes, I checked that motor vehicles were stopped	**8%**
Yes, I checked there was a sufficient gap between moving vehicles / cyclists	**34%**
Yes, but I am not sure what the vehicles were doing	**0%**
Yes, but I am not sure what the cyclists were doing	**1%**
No, I just looked at the traffic lights	**5%**

Sampling methodology: 100 participants

Table 16: Pedestrian surveys at hold-the-left sites: Did you cross in one movement?

Crossing from footway to island	Yes	58%
	No*	42%
Crossing from island to footway	Yes	71%
	No*	29%

* Meaning that people stopped in line with the segregating island for the cycle track

Sampling methodology: 100 participants including 25 surveyed crossing from footway to island and 75 surveyed crossing from island to footway

Checking for a perceptual error: Could pedestrians using the crossing observe a red cycle signal and incorrectly perceive that all traffic is stopped at red?

- Pedestrians would be at risk of making this error if:
  - They did not look at the signals for general traffic
  - They did not look at the pedestrian signals, and
  - They crossed on a red man.
- TRL's further analysis showed that only two of the 97 in the sample met these three criteria. Of those, one checked that all motor vehicles and cyclists were stopped before crossing and the other checked there was a sufficient gap to cross safely
- Those pedestrians are therefore very unlikely to have crossed the road on a red cycle signal

4.4 Information used by people crossing at early release sites (intercept surveys)

As with hold-the-left sites, the most important piece of information that pedestrians rely on when making the decision to cross the road is the pedestrian signal – 88 per cent of people looked at these.

Table 17: Pedestrian surveys at early release sites: what did you look at before crossing?

		Yes	No	Don't know
Pedestrian signals	Crossed on green man	67	10	2
	Crossed on red man	18		
	Crossed during countdown	6		
General traffic signals		60	43	0
Cycle signals		31	69	3

Sampling methodology: 103 participants

Checking for a perceptual error: Could pedestrians using the crossing observe a red cycle signal and incorrectly perceive that all traffic is stopped at red?

- Only one person in the survey said they looked at cycle signals, but did not look at the pedestrian signals or look at what the cyclists were doing
- The precise timing of this individual's crossing, relative to the early release signal, is not known

Appendix 5 - Cycle gates

5.1 Route choice and signal compliance at cycle gates

- Overall the majority of cyclists chose to use the cycle gate (87 per cent) with a greater proportion at Queen Street Place (97 per cent) than at Lambeth Road (61 per cent)
- Signal compliance was comparable for users of the cycle gate at the two sites:
  - 68 per cent complied with both sets of signals
  - 20 per cent passed the cycle stop line on red
  - 12 per cent passed the reservoir stop line on red
  - 19 per cent passed the cycle stop line on red but then waited for the green at the reservoir stop line

Table 18: Cyclist route choice and signal compliance at cycle gate sites

	Queen Street Place		Lambeth Road		Total	
Cyclist route choice	Cycle track	General traffic lane	Cycle track	General traffic lane	**Cycle track**	**General traffic lane**
Total	1,934 (97%)	59 (3%)	466 (61%)	292 (39%)	**2,400 (87%)**	**351 (13%)**
Compliance at cycle stop line signal and reservoir stop line signal						
Green – Green	1,298 (67%)	46 (78%)	337 (72%)	138 (47%)	**1,635 (68%)**	**184 (52%)**
Green – Red	185 (10%)	2 (3%)	83 (18%)	0	**268 (11%)**	**2 (1%)**
Red – Green	425 (22%)	4 (7%)	41 (9%)	113 (39%)	**466 (19%)**	**117 (33%)**
Red – Red	26 (1%)	7 (12%)	5 (1%)	41 (14%)	**31 (1%)**	**48 (14%)**

Sampling methodology: first six signal cycles seen from the start of every hour for 14 hours each day, for 7 days, i.e. 6 x 14 x 7 = 588 signal cycles.

5.2 Relationship between cycle flow and signal compliance

- Cycle counts at the two sites varied depending on the day of the week and time of day, and ranged from 302 to 418 at Queen Street Place, and 124 to 149 at Lambeth Road. Weekend counts were much lower for both sites with ranges between 51-70 and 30 to 45 respectively.
- Cycle numbers peaked between 8am and 10am at Queen St Place

- At both sites, the proportion of cyclists using the cycle track and then passing a red signal was lower in the morning peak than at off-peak times; Lambeth Road also had a lower proportion in the afternoon peak

5.3 Relationship between signal compliance and the number of cyclists in a signal cycle

- The largest number of cyclists seen using the cycle track in one signal cycle was 32 at Queen St Place and 8 at Lambeth Road
- Overall, the proportion of cyclists who did not comply with the reservoir stop line did not appear to be affected by the volume of cyclists using the cycle gate; however it did have an effect on behaviour at the cycle stop line at Queen Street Place – with 10 or more cyclists, a higher proportion passed the cycle stop line on a red signal but then waited at the reservoir stop line
- The same effect was not seen at Lambeth Road, which had lower cyclist numbers per signal cycle

5.4 General traffic clearance of the reservoir

Few instances were observed of general traffic failing to clear the reservoir – where they did, the main reason was non-compliance with the signal at the first (general traffic) stop line.

Table 19: General traffic clearance of the cycle gate reservoir

	Queen Street Place	Lambeth Road
General traffic clears	566 (96%)	580 (99%)
General traffic stopped in reservoir	22 (4%)	8 (1%)

Sampling methodology: first six signal cycles seen from the start of every hour for 14 hours each day, for 7 days, i.e. 6 x 14 x 7 = 588 signal cycles.

Table 20: Reasons for general traffic failing to clear the cycle gate reservoir

	Queen Street Place	Lambeth Road
Queuing traffic on Upper Thames Street / St George's Road	4	0
Non-compliance with red signal at first stop line	10	7
Cycle track used by motorised traffic (motorcycle, scooter)	4	1
Other	4	0

Sampling methodology: first six signal cycles seen from the start of every hour for 14 hours each day, for 7 days, i.e. 6 x 14 x 7 = 588 signal cycles.

Appendix 6 - Crossings at bus stop bypasses

6.1 BSB working group

In 2013 TfL began introducing BSBs and committed to keep their design under review to assess their impact on protected groups (older and disabled people). TfL decided to investigate Zebra crossings as an option for addressing the concerns raised by some of these groups, especially organisation representing blind and partially sighted people. A working group was formed with internal and external stakeholders to assist in developing trials of Zebra crossings at BSBs. The Bus Stop Bypasses Working Group consists of:

- Guide Dogs
- Royal National Institute of Blind People (RNIB)
- London TravelWatch
- Transport for All
- Living Streets
- London Cycling Campaign
- Cycling GB
- Age UK London
- Cycling Embassy of Great Britain
- Action on Hearing Loss
- Royal London Society for Blind Children (RSBC)
- TfL Valuing People Group

Membership was determined with the objective of ensuring a balance of views across sectors and a collaborative approach to solving and mitigating concerns; ensuring representation of organisations supporting blind and visually impaired people, and older people. TfL's statutory watchdog, London TravelWatch was also included.

The group was set up to:

- Support the development of a trial of Zebra crossings on BSBs
- Co-ordinate participation in the trials from representative groups
- Develop communications around the use of BSBs during the mini-Zebra crossing trial and for any future infrastructure changes to them
- Input into and review the monitoring results

The group was actively involved in the development of the Zebra crossings trial, scrutinising the approach and methodology, and ensuring TfL address the issues which most affect pedestrians and cyclists using these crossings.

Topics that were discussed by the working group:

- The trial's objectives
- The designs of infrastructure included the trial
- Methodology of the trial, and questions included
- The results of the trial

6.2 Before and after pictures for BSBs trials

a. Blackfriars Road, Southwark

Before: Uncontrolled crossing

After: Zebra crossing

Stop SA, Southwark Station (Bus routes 43, 63, 388 (northbound))

Stop U, St George's Circus (Bus routes 43, 63, 388 (northbound))

b. Stratford High Street, Newham

Before: Uncontrolled crossing

After: Zebra crossing

Stop J, Carpenters Road (Bus routes 25, 276, 425, D8 (westbound))

Stop M, Warton Road (Bus routes 25, 108, 276, 425, D8 (eastbound))

c. Whitechapel Road, Tower Hamlets

Before: Uncontrolled crossing

After: Zebra crossing

Stop A, Royal London Hospital (Bus routes 25, 205, 254 (westbound))

Stop J, East London Mosque (Bus routes 25, 205, 254 (eastbound))

6.3 Interactions between cyclists and pedestrians

The levels of interactions between pedestrians and cyclists were defined as follow:

- Level 1: Precaution – For example, a pedestrian or cyclist markedly slowing down in carriageway in response to another user requiring the same space.
- Level 2: Controlled Action – Pedestrian or cyclist deviating from route.
- Level 3: Near Miss – Pedestrian or cyclist rapidly slowing down, stopping or changing direction to avoid collision.
- Level 4: Very Near Miss – Pedestrian or cyclist using emergency braking or violent swerve.
- Level 5: Collision – Contact between a pedestrian and a cyclist.

Levels 1 and 2 can be considered as an outcome of cyclists and pedestrians simply being in the same place at the same time (usually crossing each other's paths) and giving way to each other, and do not necessarily imply any adverse interaction. The total number of interactions is largely a function of how busy any given site is, whereas the Levels describe those interactions.

- Regardless of the provision of Zebra crossing, the majority of interactions were low-level interactions (level 1 and 2)
- The number of higher level interactions, which includes near misses and collisions, decreased by 50 per cent with the implementation of Zebra crossings
- Whilst the number of interactions was higher overall with the Zebra crossing, the majority of these were lower-level interactions, which includes precautionary behaviour e.g. giving way
- The largest number of interactions (155; 53 per cent) occurred at the crossing-point following installation of the Zebra crossings; however the majority (81 per cent) of these were categorised as 'level 1: precaution' and the number of higher-level interactions at the crossing-point decreased from 13 to 3
- Most of the higher-level interactions were at the Whitechapel Road sites (80 per cent for the uncontrolled crossing, reducing to 70 per cent with the Zebra crossing)

Table 21: Interactions at BSBs

		Lower-level interactions		Higher-level interactions			Total
		Level 1: Precaution	Level 2: Controlled Action	Level 3: Near Miss	Level 4: Very Near Miss	Level 5: Collision	
All	Before	180	55	18	1	1	**255**
	After	240	43	10	0	0	**293**
Away from crossing-point	Before	102	28	7	0	0	**137**
	After	114	17	7	0	0	**138**
At crossing-point (or within 1m)	Before	78	27	11	1	1	**118**
	After	126	26	3	0	0	**155**

Sampling methodology: 3,528 cycle movements

Table 22: Breakdown of higher-level interactions at BSBs by site

	Before		After	
	At crossing-point	Away from crossing	At crossing-point	Away from crossing
Blackfriars SA	0	0	0	0
Blackfriars U	0	0	0	0
Stratford J	2	0	0	0
Stratford M	2	0	0	3
Whitechapel A	6	6	2	3
Whitechapel J	3	1	1	1
Total	**13**	**7**	**3**	**7**

Sampling methodology: 3,528 cycle movements

6.4 Give-way behaviour at the crossing point

- A slightly higher percentage of both pedestrians and cyclists gave way upon introduction of Zebra crossings
- Instances of both parties giving way substantially reduce with the Zebra crossings, suggesting that they might introduce more certainty one way or the other

Table 23: Give way behaviour at BSB crossings

	Before	After
Cyclist gave way	68 (27%)	91 (31%)
Pedestrians gave way	146 (57%)	183 (62%)
Both gave way	40 (16%)	19 (6%)

Sampling methodology: Before: 255 interactions, After: 293 interactions

6.5 Feeling of safety when crossing

- From the intercept surveys, there was an increase in the proportion of pedestrians feeling ‘safe’ using the BSB, and fewer pedestrians felt ‘unsafe’
- There was no significant difference between the crossing types in cyclists feeling ‘safe’ or ‘unsafe’

Table 24: Intercept survey responses showing feeling of safety when crossing

All responses – both directions	% feeling safe		% feeling unsafe	
	Before	After	Before	After
Pedestrians	58	68	13	7
Cyclists	75	74	3	5

Sampling methodology: Before: 488 Pedestrians, 245 cyclists, After: 476 pedestrians, 239 cyclists

6.6 Disabled people finding and using the crossing-point

- Overall, participants in the accompanied journeys found it easier to find the Zebra crossing, compared with uncontrolled crossing. The improvement was more noticeable when crossing from the footway to the bus stop island (62 per cent found uncontrolled crossings easily, increasing to 85 per cent with Zebra crossings), with significant numbers of people still finding difficulties when crossing from the bus stop island to the footway
- The group which had the greatest increase in ease of finding the crossing-point was amongst the visually impaired participants; from the footway to the bus stop, the improvement was 36 per cent to 71 per cent, and from the bus stop to the footway there was a smaller increase, from 53 per cent to 60 per cent
- When crossing from bus stop to footway, 40 per cent of visually impaired participants had difficulty with the Zebra crossing – comments revealed that some of them were not expecting to have to look for a crossing
- Other participants generally had no problems finding either the uncontrolled or Zebra crossings

Table 25: Responses in the accompanied journeys study showing whether people understood where to cross

Footway to bus stop	% finding easily		% who had difficulty	
	Before	After	Before	After
Mobility impaired	83	100	17	0
Learning disabilities	100	100	0	0
Deaf or hard of hearing	80	100	0	0
Blind or partially sighted	36	71	48	24
All	**62**	**85**	**26**	**12**

Sampling methodology: Before: 18 participants, After: 18 participants

Bus stop to footway	% finding easily		% who had difficulty	
	Before	After	Before	After
Mobility impaired	83	100	0	0
Learning disabilities	100	83	0	17
Deaf or hard of hearing	100	100	0	0
Blind or partially sighted	53	60	17	40
All	**74**	**79**	**9**	**23**

Sampling methodology: Before: 18 participants, After: 18 participants

- When asked about using the crossing-point, again, only the visually impaired participants had any difficulty with either the uncontrolled or Zebra crossing
- In both directions – i.e. footway to bus stop and bus stop to footway – a significantly higher proportion of visually impaired people reported that the crossing was easy to use
- There were small decreases in the numbers of people who had difficulty crossing but the proportion of visually impaired people having difficulty crossing from bus stop to footway remained high (at 47 per cent) even after the introduction of Zebra crossings

Table 26: Responses in the accompanied journeys study showing ease of use of the crossing types

Footway to bus stop	% using easily		% who had difficulty	
	Before	After	Before	After
Mobility impaired	100	100	0	0
Learning disabilities	100	100	0	0
Deaf or hard of hearing	80	100	0	0
Blind or partially sighted	30	61	36	28
All	**62**	**81**	**18**	**14**

Sampling methodology: Before: 18 participants, After: 18 participants

Bus stop to footway	% using easily		% who had difficulty	
	Before	After	Before	After
Mobility impaired	100	83	0	0
Learning disabilities	100	83	0	0
Deaf or hard of hearing	60	100	20	0
Blind or partially sighted	24	53	53	47
All	**56**	**73**	**29**	**21**

Sampling methodology: Before: 18 participants, After: 18 participants

- When asked about boarding the bus, the proportion of participants finding it easy rose from 69 per cent to 88 per cent after implementation of Zebra crossings; however, there was no improvement for mobility impaired participants

Table 27: Responses in the accompanied journeys study showing ease of boarding the bus

Boarding the bus generally	% boarding easily		% who had difficulty	
	Before	After	Before	After
Mobility impaired	67	50	33	25
Learning disabilities	83	83	17	0
Deaf or hard of hearing	100	100	0	0
Blind or partially sighted	54	94	13	0
All	**69**	**88**	**16**	**3**

Sampling methodology: Before: 18 participants, After: 18 participants.

6.7 Disabled people feeling safer using the bus stops

- The majority of participants (67 per cent) felt safer using the Zebra crossings, compared with uncontrolled crossings, although there was a decrease of 17 per cent for mobility impaired people
- Reasons for not feeling safe did not predominantly involve the crossing type but several of the blind and partially sighted participants said they felt unsafe crossing because cyclists cannot be heard (exacerbated by background noise)
- Detailed comments show that people often feel unsafe crossing when getting off the bus when the bus is not the first one at the stop, and where finding the crossing is therefore more challenging (note that not knowing if the bus will stop in the expected place is a generic issue for bus stops, but subsequently having to find a crossing-point over a cycle track is specific to BSBs)
- Blind and partially sighted participants also identified inconsistency of parts (i.e. crossing-to-flag direction and distance between) as being a factor in feeling unsafe
- Issues for wheelchair users (covered by the Mobility Impaired category) included space for manoeuvring a wheelchair on the island, difficulties caused by blister tactile paving (particularly for Zebra crossings, where there is more tactile paving to negotiate) and concerns about staying out of the cycle track

Table 28: Responses in the accompanied journeys study showing feeling of safety when crossing

Footway to bus stop	% feeling safe		% neutral		% feeling unsafe	
	Before	After	Before	After	Before	After
Mobility impaired	67	50	16	33	17	17
Learning disabilities	100	100	0	0	0	0
Deaf or hard of hearing	60	83	20	17	20	0
Blind or partially sighted	23	56	44	1	33	33
All	**49**	**67**	**28**	**14**	**23**	**19**

Bus stop to footway	% feeling safe		% neutral		% feeling unsafe	
	Before	After	Before	After	Before	After
Mobility impaired	67	50	16	33	17	17
Learning disabilities	83	83	17	0	0	17
Deaf or hard of hearing	40	83	40	17	20	0
Blind or partially sighted	18	64	46	18	36	18
All	**44**	**74**	**32**	**12**	**24**	**14**

Sampling methodology: Before: 18 participants, After: 18 participants

6.8 Noticing the crossing

- Significantly more pedestrians noticed the crossing in the form of a Zebra crossing (75 per cent) than as an uncontrolled crossing (64 per cent)
- While there was also an increase among cyclists, it was only 2 per cent higher
- A greater proportion of cyclists (80 per cent before, 82 per cent after) than pedestrians (64 per cent before, 20 per cent after) noticed the crossing regardless of its type

Table 29: Intercept survey responses showing people noticing the crossing

All responses	% noticing crossing		% not noticing crossing	
	Before	After	Before	After
Pedestrians	64	75	36	25
Cyclists	80	82	20	18

Sampling methodology: Based on total sample of 1440 respondents (80 pedestrians and 40 cyclists per site).

6.9 Understanding who has priority

- Zebra crossings had a significant impact on whether people understood who has priority. The proportion of respondents thinking that pedestrians have priority increased from 34 per cent at the uncontrolled crossings to 76 per cent at Zebra crossings
- Over 80 per cent of those cycling were clear that pedestrians have priority with a Zebra crossing
- Far fewer people were ‘not sure’ about priority after the implementation –dropping from 14 per cent with the uncontrolled crossings to 4 per cent with the Zebra crossings

Table 30: Intercept survey responses showing perceptions of priority at crossing

All responses	% pedestrians have priority		% cyclists have priority		% not sure	
	Before	After	Before	After	Before	After
Pedestrians	35	73	44	17	12	4
Cyclists	32	82	50	9	17	5
All	**34**	**76**	**46**	**14**	**14**	**4**

Sample: Before: 486 pedestrians, 246 cyclists, After: 476 pedestrians, 240 cyclists.

6.10 Where people cross

- A higher proportion of people used the crossing-point after the Zebra crossings were introduced, especially when crossing from the bus stop to the footway
- This is consistent with responses from the intercept surveys to a question about crossing location – 36 per cent said they used the crossing-point in the before survey and 44 per cent said they used it in the after survey

Table 31: Use of the pedestrian crossing, from video analysis

All responses	Crossing to the bus stop		Crossing from the bus stop	
	Before	After	Before	After
Crossing within 1m of the crossing	32	40	48	61
Crossing elsewhere	68	60	52	39

Sampling methodology: 4,704 pedestrian movements

Table 32: Intercept survey responses showing use of the pedestrian crossing

	Before	After
Yes, I did use the crossing	172 (36%)	208 (44%)
No, I did not use the crossing	309 (64%)	263 (56%)

Sampling methodology: Before: 481 participants, After: 471 participants

6.11 Where people cycle

- There was a 2 per cent increase in people using the track after implementation of the Zebra crossing, therefore there was no evidence that suggested people were discouraged from using the cycle track
- There was also no evidence of a link between cyclists' use of the cycle track and the presence of a bus at the bus stop. The 'before' survey showed the proportion of cyclists using the track was 90 per cent with no bus present and 89 per cent if there was a bus; the respective figures for the 'after' survey were both 93 per cent

Table 33: Use of cycle track by cyclists versus use of main carriageway, from video analysis

	Before	After
Cyclist used the cycle track	3,165 (93%)	3,279 (95%)
Cyclist used the main carriageway	237 (7%)	160 (5%)

Sampling methodology: first six cyclists seen from the start of every hour for 14 hours each day, for 7 days, i.e. 6 x 14 x 7 = 588 cyclists per site

Table 34: Intercept survey responses showing if the BSB affected the way cyclists rode

	Before	After
Yes, it did affect the way I rode	176 (72%)	174 (73%)
No, it did not affect the way I rode	69 (28%)	65 (27%)

Sampling methodology: Before: 245 participants, After: 239 participants

6.12 Speed of cyclists

- The average speed of cyclists did not change significantly; overall there was a decrease of 0.1mph
- The trial showed slightly higher cycle speeds at peak commuting times (AM: 15.9mph, PM: 15.1mph) in the before surveys and a reduction of 0.8mph in the morning peak once the Zebra crossings were introduced
- Before the implementation of Zebra crossings, 38 per cent of people were cycling at more than 15mph which then dropped to 34 per cent
- There was some variance between sites, e.g. 4.2mph faster at Blackfriars Road U than the average 11.7mph at Whitechapel J

Table 35: Average speed of cyclists across all sites, by hour, from video analysis

	Before	After
Average speed, 7am to 8pm	14.4	14.3
AM – highest hourly average (7-8am)	15.9	15.1
PM – highest hourly average (6-7pm)	15.1	15.1

Sampling methodology: first three cyclists seen from the start of every hour for 14 hours each day, for 7 days, i.e. 3 x 14 x 7 = 294 cyclists per site

Table 36: Number of cyclists recorded in each speed range, from video analysis, across all sites

	Before	After
Below 10mph	237 (13%)	193 (11%)
10-15mph	858 (49%)	969 (55%)
16-20mph	588 (33%)	528 (30%)
Above 20mph	81 (5%)	74 (4%)

Sampling methodology: first three cyclists seen from the start of every hour for 14 hours each day, for 7 days, i.e. 3 x 14 x 7 = 294 cyclists per site

6.13 Variations by site - give way behaviour

- Four of the six sites showed improvement in give-way behaviour by cyclists after the Zebra crossings were implemented; Blackfriars Road SA had a very large improvement (+56 per cent) but also the smallest sample size (i.e. the lowest number of instances of cyclists and pedestrians arriving at the crossing at the same time)
- The proportion of cyclists who gave way at the uncontrolled crossings at Stratford M and Whitechapel J was significantly higher than at all other sites; these two sites then saw substantial reductions in the proportion of cyclists giving way at Zebra crossings
- Overall, the proportion of cyclists that gave way increased at the sites without Belisha beacons
- Overall, the proportion of cyclists that gave way substantially decreased at sites with Belisha beacons

Table 37: Comparison of give way behaviour, broken down by site

	Cyclists gave way	
	Before	After
Blackfriars SA	3 (18%)	13 (72%)
Blackfriars U	6 (26%)	5 (45%)
Stratford J	5 (23%)	8 (32%)
Stratford M	20 (65%)	13 (30%)
Whitechapel A	22 (17%)	36 (32%)
Whitechapel J	22 (65%)	16 (19%)

Sampling methodology: first six signal cycles seen from the start of every hour for 14 hours each day, for 7 days, i.e. 6 x 14 x 7 = 588 signal cycles.

Table 38: Comparison of give way behaviour at crossings with and without Belisha beacons

	Before	After
Cyclists gave way at sites with Belishas (as % of all give-ways)	25 (49%)	29 (28%)
Cyclists gave way at sites without Belishas (as % of all give-ways)	43 (21%)	62 (32%)

Sampling methodology: first six signal cycles seen from the start of every hour for 14 hours each day, for 7 days, i.e. 6 x 14 x 7 = 588 signal cycles.

6.14 Variations by site – understanding who has priority

The biggest impact on understanding of priority was shown at Blackfriars SA (56 per cent), which had the lowest baseline (29 per cent) to the highest percentage of people understanding that pedestrians have priority (85 per cent)

Table 39: Survey responses on who has priority at the crossing-point, broken down by site

	Pedestrians have priority (%)		Unsure (%)		Cyclists have priority (%)	
	Before	After	Before	After	Before	After
Blackfriars SA	29	85	25	6	46	9
Blackfriars U	28	80	32	5	40	15
Stratford J	36	67	16	13	48	20
Stratford M	34	73	20	6	46	21
Whitechapel A	43	66	13	15	44	19
Whitechapel J	41	68	18	13	41	19

Sample size: 80 for each site, except:
Before: Blackfriars SA (78), Whitechapel A (88), After: Stratford J (79), Stratford M (78) and Whitechapel J (79)

6.15 Variations by site – pedestrians feeling of safety

- Three of the six sites saw a significant improvement in feeling of safety; three had very little or no improvement
- It was not possible to conclude that any site-specific factors were behind this – each of the three locations had one site where there was an improvement and one where there was not
- Of the two sites with Belisha beacons, one had a significant improvement in feeling of safety (Blackfriars SA – two way track) but the other did not (Whitechapel J – one way track)

Table 40: Weighted average score (out of 5) for feeling safe at the bus stop

	Feeling of safety – pedestrians only	
	Before	After
Blackfriars SA	3.2	3.8
Blackfriars U	3.5	3.5
Stratford J	3.9	3.9
Stratford M	3.4	3.9
Whitechapel A	2.9	3.7
Whitechapel J	3.4	3.5

Sampling methodology: Before: 476 participants, After: 460 participants

6.16 Variations by site – noticing the crossing

- There was a greater increase in the proportion of pedestrians and cyclists who noticed a crossing after the Zebra crossing was implemented, at sites with Belisha beacons
- However, only around one in ten of those saying they noticed the crossing cited 'lights or Belisha beacon' as the reason for this
- One in 25 said they noticed the crossing because of its 'lights or Belisha beacon' at sites that did not have a Belisha beacon

Table 41: Survey responses on noticing the crossing, broken down between sites with and without Belisha beacons

		Before	After	Change
Sites with Belisha beacons	Pedestrians noticed the crossing (%)	63	83	+32%
	Cyclists noticed the crossing (%)	72	81	+13%
Sites without Belisha beacons	Pedestrians noticed the crossing (%)	65	72	+11%
	Cyclists noticed the crossing (%)	83	83	0

Sampling methodology: Before: 486 pedestrians, 246 cyclists, After: 478 pedestrians, 240 cyclists

Table 42: Survey responses on what distinguished the crossing-point among those who noticed it, broken down between sites with and without Belisha beacons

	% citing lights or Belisha beacons	% citing other factors	Number of responses
Sites with Belisha beacons	11%	89%	38
Sites without Belisha beacons	4%	96%	56

Sampling methodology: Before: 486 pedestrians, 246 cyclists, After: 478 pedestrians, 240 cyclists

6.17 Variations by site – pedestrians use of the crossing-point

Belisha beacons appear to have a positive influence on people noticing the crossing; there was a greater increase in the proportion of pedestrians and cyclists who noticed a crossing, after the Zebra crossing was implemented, at sites with Belisha beacons.

Table 43: Pedestrians use of the crossing zone with and without Belisha beacons

	Southwark SA and Whitechapel J		Southwark U, Stratford J, Stratford M, and Whitechapel A	
	Before	After – with Belisha beacon	Before	After – without Belisha beacon
Pedestrians who used the crossing zone (zone C) to cross	68	151	352	391
Total sample pdestrians crossing the cycle track	218	285	868	809
Proportion of people crossing who crossed using the crossing zone (zone C) to cross	31%	53%	41%	48%

Sampling methodology: Before: 1086, After: 1094