# Designing the Future

## Shared Space: Operational Assessment

Report for Department for Transport

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# Executive Summary

## Aim

This report has been prepared for the Department for Transport (DfT) to provide an operational assessment of Shared Space schemes. By using an evidence led approach, supported by observational data from existing schemes, the report is part of a larger study which aims to provide design guidance on the development of Shared Space schemes.

As noted in the previous Appraisal report[1], it is acknowledged that there is limited research available, particularly into the operation of Shared Space schemes in the UK. The data collection process and subsequent statistical analysis described in this report has therefore been developed with the intention of addressing knowledge gaps, by collecting observational data of driver and pedestrian behaviour and interactions at selected sites across the UK.

## Methodology

The methodology consisted of three distinct phases: Selection of appropriate sites to be included in the operational assessment; Collection of observational data of pedestrian and driver behaviour; and Statistical analysis of the data.

Ten sites were selected based on site visits and site maps (which detailed the street layout and key characteristics). A mixture of sites were chosen taking into account; street type (link, square or junction), the level of traffic and pedestrian flows (high, medium and low) and various street characteristics. Selected street characterises were then classified for each site in order to determine a Shared Space rating[2].

Data was collected at each site using Video data and Automatic Traffic Counts (ATC). Video data was obtained from video footage at each site; observers extracted the data by watching the video tapes for a sample period within selected hours on each day. Data on two types of user behaviour was collected: static pedestrian counts; and information about encounters (when two users attempt to use the same space at the same time). In addition automatic traffic counters were installed at six[3] out of the ten sites. The counters provided the level of traffic flow, by class (car, buses, motorcyclists and vans / lorries) as well as the mean speed and 85$^{th}$ percentile speed.

## Conclusions

The operational assessment of the selected Shared Space schemes assisted in addressing the knowledge gaps highlighted in the Appraisal Report of understanding: the changes to pedestrian's behaviour; and the changes to driver's behaviour, in particular when drivers are more likely to give way to pedestrians.

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[1] DfT Shared Space Project PPRO 04/16/19, Stage 1: Appraisal of Shared Space, Report for Department for Transport, October 2009, MVA Consultancy

[2] Note that this Shared Space rating is indicate only and is heavily dependent on the variables included in the questionnaire and the relative weights assigned to them.

[3] At the other four sites (Seven Dials, Elwick Square, New Road Brighton, Y Maes Caernarfon), counters could not be installed due to concerns about damaging the surface or as a risk to pedestrian safety through a trip hazard. At these sites an approximation of the traffic flow and speed was determined from the video observations.

Using the data collected, the analysis focused on three main areas; the use of space by pedestrians, determinants of vehicle speed and analysis of encounters.

### Use of Space by Pedestrians

The statistical and descriptive analysis suggests that design characteristics intended to reduce the demarcation and physical barrier between the footway and carriageway do achieve a higher percentage of pedestrians using the carriageway then might otherwise be expected. Conversely, higher traffic flows are likely to discourage pedestrians using the carriageway. However, the extent that an individual characteristic can achieve more pedestrians using the entirety of the space was found to be limited and therefore Shared Space schemes are more likely to achieve the desired benefits if designed in totality, taking into account numerous site characteristics. Observing pedestrian movements indicated that pedestrians were more likely to follow their desire line in Shared Space environments compared with more conventional streets.

### Determinants of Vehicle Speed

The statistical analysis suggests that higher pedestrian volumes as well as reducing the demarcation between the footway and carriageway areas are likely to decrease the traffic speed. However, whereas implementing a selection of specific site characteristics to reduce the demarcation between the footway and carriageway spaces to encourage drivers to reduce speeds will have some impact, the analysis suggests that designing the space in totality is likely to be more influential in reducing traffic speed.

### Encounter Analysis

The rate of encounters is largely determined by the flow of vehicles and pedestrians, with higher vehicle and pedestrian flows resulting in higher numbers of encounters. Across all of the encounters, pedestrians tended to give way in pedestrian and vehicle encounters, however this differed significantly by site.

Drivers and pedestrians were found to equally give way to each other at the more Shared Space sites. The factors that appeared to encourage the driver to give way in a pedestrian-vehicle encounter included; lower vehicle speeds and flows, reducing the demarcation between the footway and the carriageway as well as encouraging pedestrians to use the carriageway. Drivers were fourteen times more likely to give way to pedestrians if pedestrians were present in the carriageway. However, the statistical analysis suggested that there are other factors influencing the propensity of a driver to give way, for example attitude to risk, journey purpose, which were not captured as part of the data gathering process.

### Design Considerations based on Conclusions

With this in mind it seems that the site characteristics having the greatest influence were those that reduced the demarcation between the footway and the carriageway, for example, the removal of kerbs, colour contrast between the footway and carriageway and bollards. This reduced demarcation encouraged pedestrians to use the carriageway, reduced vehicle speed and encouraged drivers to give way more frequently to pedestrians.

Implementing a limited number of site characteristics individually is however unlikely to achieve the full range of benefits. Schemes should be designed in their entirety, taking into account all of the site characteristics. In addition to this, sites with high vehicle flows and speeds together with low pedestrian flows are unlikely to achieve the full benefits.

# 1 Introduction

## 1.1 Introduction

1.1.1 The operational assessment of Shared Space schemes is part of a larger study which aims to provide design guidance on the development of Shared Space schemes. To ensure that the design guidance is comprehensive and robust, it needs to be evidence led and supported by knowledge from existing schemes.

1.1.2 As noted in the Appraisal Report[4], it is acknowledged that there is limited research available, particularly into the operation of Shared Space schemes in the UK. The Appraisal Report identified a number of knowledge gaps surrounding the understanding of the operation of existing Shared Space schemes in the UK, in particular the need to understand:

- when drivers are more likely to give way to pedestrians. The Appraisal Report concluded that there is anecdotal evidence that drivers tend to give way to pedestrians more readily in Shared Space schemes. However the specific speeds and flows below which drivers are likely to concede priority could not be identified through the literature review. In addition the existing evidence does not identify how voluntary speed control varies with pedestrian flows and other environmental factors, such as the site characteristics of the Shared Space scheme; and
- what happens to pedestrian behaviour? Although a high-level objective of many Shared Space schemes is to facilitate pedestrian movement, there is little data on how pedestrians actually move within the space. For example understanding how pedestrians move within Shared Space and to what extent this is related to factors such as traffic flow, traffic speed and pedestrian footfall.

1.1.3 The data collection process and subsequent statistical analysis described in this report was developed with the intention of addressing the knowledge gaps identified above by collecting observational data of driver and pedestrian behaviour and interactions at selected sites across the UK.

[4] DfT Shared Space Project PPRO 04/16/19, Stage 1: Appraisal of Shared Space, Report for Department for Transport, October 2009, MVA Consultancy

# 2 Methodology

## 2.1 Overview of Methodology

2.1.1 The methodology consisted of three distinct phases:

- Selection of appropriate sites to be included in the operational assessment;
- Collection of observational data of pedestrian and driver behaviour; and
- Statistical analysis of the data.

2.1.2 Each of these phases is described in Section 2 with results from the analysis being presented in Section 3.

## 2.2 Survey Site Selection

### Introduction

2.2.1 Shared Space describes a design approach rather than a design type characterised by 'standard' features. Because of this it was not possible to select a pure 'Shared Space' scheme and to analyse it against a similar control site. Therefore sites were selected across the UK, to ensure that across the sites a range of features were captured that were deemed to be the most influential on users' behaviour as identified through the Appraisal Report, in particular:

- Pedestrian and vehicle flow as well as vehicle speed (judged by the actual and estimated speed limit at the site). From the Appraisal Report, there appeared to be limited evidence as to how driver and pedestrian behaviour differed with different flows and speeds. Therefore, sites were selected to ensure that across the sites a range of pedestrian and vehicle flow and speeds would be captured;
- Footway characteristics, in particular whether the site had high, low or no kerbs. The Appraisal Report hypothesised that the reduction of demarcation between the footway and the carriageway may lead to greater interaction between the two sets of users: pedestrians and drivers. The most contentious method of reducing demarcation, due to the perceived potential for increased risk, is the removal of kerbs; hence sites were selected to ensure a range of high, low or no kerbs across the sites; and
- Site functions and land uses. The desire to which pedestrians use the carriageway will be determined, to some extent, by their need to cross the carriageway, which can, in turn, be influenced by the site function (link, square, junction) and land use (mixed, retail only). For example, junction sites are hypothesised to include more pedestrians using the carriageway at any given time than for a link site, driven by the need for pedestrians to cross the junction. Hence across the sites a range of functions and land uses was captured.

### Site Visits

2.2.2 Prior to the data collection exercise, a site visit was undertaken to determine the feasibility and viability of including the site in the research. From each site visit the following information was assembled:

- A site map, detailing the street layout and characteristics;
- Sample pedestrian and traffic counts to ensure that across the sites, high and low pedestrian and vehicle flows would be included; and
- Appropriate positions for the video and automatic traffic counters were identified.

2.2.3 From the site visits, the following ten sites (shown in Table 2.1) were selected. Table 2.1 provides the primary function of the site (junction, link or square as determined by the predominant use of space by the drivers) together with a screen shot from the video analysis of the site.

**Table 2.1 Selected Sites**

| Site Name | Function | Picture |
|---|---|---|
| Seven Dials, London | Junction |  |
| Elwick Square, Ashford | Junction |  |
| High Street, Godalming (Site A) | Link[5] |  |

[5] This site was classified as a link rather than a junction as there are no appreciable turning flows from either of the side streets onto the main street, classified as a link.

| Site Name | Function | Picture |
|---|---|---|
| High Street, Godalming (Site B) | Link |  |
| High Street, Shrewsbury | Link |  |
| London Road, Southampton | Link |  |
| Milsom Street, Bath | Link[6] |  |
| New Road, Brighton | Link |  |

[6] The Bath site was classified as a link due to the main flow of the traffic; however, it is a junction in some respects as the main desire lines for the pedestrians intersect the main traffic flows.

| Site Name | Function | Picture |
|---|---|---|
| St Johns Road, London | Link |  |
| Y Maes, Caernarfon, Wales | Square |  |

2.2.4 The site maps, completed as part of the site visits, are included in Appendix A.

### Site Classification

2.2.5 As mentioned previously, Shared Space describes a design approach rather than a design type characterised by 'standard' features. Hence, each site has different design characteristics, which together are likely to influence pedestrian's behaviour. Therefore a means of classifying the sites and rating them according to the characteristics envisaged to encourage sharing was developed based on a questionnaire designed by the University of London and Imperial College.

2.2.6 The questionnaire incorporates various design characteristics with each characteristic being given a weighting depending on how related it is to Shared Space schemes: the higher the weighting, the more 'shared' the site is deemed to be.

2.2.7 From these values a total score was calculated, which combined the characteristics to give an overall Shared Space score for each site. The Shared Space score therefore provides a general measure of how shared a site is, compared to the other sites, hence providing an ordinal value, not a cardinal value[7].

2.2.8 Figure 2.1 provides an overview of the questionnaire. First a filter is applied detailing if cars are allowed in the street and if street clutter (e.g. unnecessary road signs, bollards and bins) has been removed, a 'Yes' in the two boxes deems the space as shared, indicating that the rest of the questionnaire should be completed. Despite some sites not being deemed to be shared (Godalming High Street on the days it was pedestrianised (and therefore had limited traffic) and to some extent, the more conventional streets (St John's Road, London and

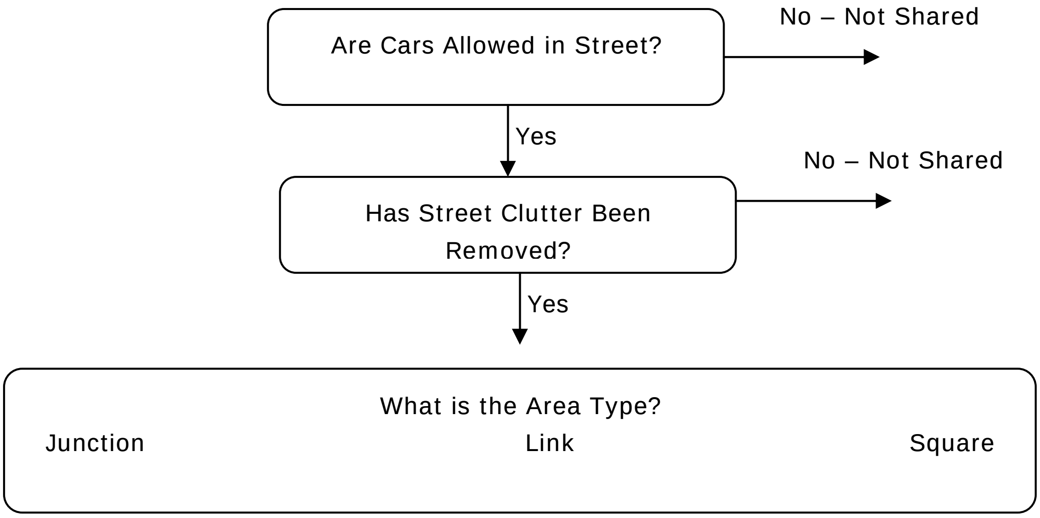
[7] The rating allows us to state that Site A is more shared than Site B but not to assume that an increase in the Shared Space rating from 25 to 30 is the same as an increase from say 15 to 20.

London Road, Southampton)) a rating was calculated for all sites as a means of comparing them.

2.2.9 Secondly, each site was assessed to determine what characteristics are present. In Figure 2.1 the values attributed to each characteristic are shown in bold. For example, for question 1: Are there kerbs? No kerbs received the highest score, meaning that sites with no kerbs are deemed to be more shared.

2.2.10 In the original questionnaire, pedestrian and vehicle flow were also included. However, in the classification used in the data analysis described below, these were excluded from the overall site classification score as vehicle and pedestrian flow were included as separate continuous variables in the data.

**Figure 2.1: Classification Questionnaire**




Are There:

Q1. Kerbs
- No kerb – **4** (go to 1b)
- Yes, but low – **2**
- Yes, full curb - **0**

Q1b. Other Demarcations present? E.g. Gully
- No – **4**
- Yes – **0**

Q2. Surface Colours?
- No Contrast - **4**
- Low Contrast - **2**
- High Contrast - **0**

Q3. Public Space Characteristics?
- Cafes/Markets - **1**
- Benches - **1**
- Greenery - **1**
- Art - **1**
- No Characteristics - **0**

Q4. Crossing Points?
- No – **4**
- Yes – **0**

Q5. Road Markings?
- No – **4**
- Yes – **0**

Q6. Traffic Lights?
- No – **4**
- Yes – **0**

Q7. Bollards?
- No – **4**
- Yes – **0**

Q8. Guard Rails?
- No – **4**
- Yes – **0**

Q9. Free Standing Street Lamps?
- No – **4**
- Yes – **0**

**Shared Space Rating= (Total Score)**

2.2.11 Table 2.2 presents the overall Shared Space ratings given to each site, based on the questionnaire in Figure 2.1. Note that this Shared Space rating is indicative only and is heavily dependent on the variables included in the questionnaire and the relative weights assigned to them. However, it does provide a useful means for classifying the sites (based on the assessment of the static infrastructure rather than observed behaviour), from which

New Road Brighton was deemed to be the most shared with a score of 35 and St Johns Road the least, with a score of 12.

**Table 2.2 Shared Space Rating**

| Site | Shared Space Rating | Rank (of all sites) |
|---|---|---|
| New Road, Brighton | 35 | 1 (Most Shared) |
| Elwick Square, Ashford | 32 | 2 |
| Seven Dials, London | 31 | 3 |
| Y Maes, Caernarfon, Wales | 30 | 4 |
| Milsom Street, Bath | 29 | 5 |
| High Street, Shrewsbury | 28 | 6 |
| High Street, Godalming (Site A) | 27 | 7 |
| High Street, Godalming (Site B)[8] | 25 | 8 |
| London Road, Southampton | 20 | 9 |
| St Johns Road, London | 12 | 10 (Least Shared) |

2.2.12 The completed questionnaire for each site is provided in Appendix A.

## 2.3 Data Collection

2.3.1 Two methods of data collection were used:

- Video data; and
- Automatic Traffic Counts (ATC).

### Video Data

2.3.2 Video Sites were installed at all ten sites at positions located during the site visits. Data on pedestrian, driver and cyclists behaviour was captured for a fifteen hour period (7am – 10pm) for one week day (Friday) and one weekend day (Saturday). The majority of the data collection took place in November 2009, with the exception of St John's Road, London where data was collected in March 2010.

2.3.3 Observers extracted the data by watching the video tapes for a sample period within selected hours on each day. Data on two types of user behaviour were collected:

[8] Difference between the two Godalming sites was the height of the kerb. Site A has a level surface between the footway and the carriageway and Site B, a low kerb.

- Static pedestrian counts; and
- Information about encounters.

### Static Pedestrian Counts

2.3.4 Within each selected hour (beginning in 7, 8, 9, 12, 13, 14, 16, 17, 18, 20 and 21)[9] across the two days, a random fifteen minute period was selected and within this ten static pedestrian counts recorded. Two methods were used as shown in Figure 2.2:

- The first was to record the number of pedestrians in a 1x1 metre squared zone on each of the footways and the carriageway (shown as zones 1, 2 and 3 in Figure 2.2). As the area of the zone is the same size this allowed for a comparison across all of the sites as well as within the site, of the number of people using the footway compared with the carriageway. However, the disadvantage of this method is that it only accounted for a small area of the total study area and therefore may be misrepresentative, particularly if the zones do not capture the most popular desire lines; and
- The second, to provide a complete snap shot of the number of pedestrians on each of the footways in comparison to the carriageway (shown as areas A (left hand side footway), B (carriageway) and C (right hand side footway) in Figure 2.2)[10].

2.3.5 With both of these methods, the carriageway was deemed to be the area used by the predominant traffic flow and the footways the areas generally not occupied by vehicles. This classification was particularly important for sites where there was less delineation between the footway and the carriageway, for example at New Road Brighton and Y Maes Caenarfon.

**Figure 2.2 Example Static Counts: High Street, Shrewsbury**


[9] Data for New Road, Brighton collected for 1900 instead of 2100 as video stopped recording at 2100 on the 14th November 20009

[10] Note that Seven Dials, London and New Road, Brighton contained four zones (an additional one on the road). For the majority of the data analysis, zones 1-3 were assumed to be comparable with the other sites.

2.3.6 The position of the zones and areas of the static counts for each of the sites are included in Appendix A.

### Encounter Information

2.3.7 Within each of the randomly selected fifteen minute periods, all encounters between users were recorded. An encounter was defined as 'an event when a pedestrian, cyclist or motor vehicle attempted to use the same space at the same time'. It could take several forms and be indicated by an action taken by the driver of a vehicle or by a pedestrian / cyclist or both. For each encounter data, the following data were recorded:

- Who the encounter was between: pedestrian / vehicle, pedestrian / cyclist, cyclist / vehicle or vehicle / vehicle;
- The direction of travel of participants involved in the encounter: whether they were travelling the same way, opposite ways or crossing paths;
- The type of encounter:
  - 1. Pedestrian or cyclist waits for vehicle;
  - 2. Pedestrian runs across carriageway;
  - 3. Pedestrian or cyclist continues travelling despite vehicle;
  - 4. Pedestrian alters direction on footway to avoid crossing carriageway at that point;
  - 5. Pedestrian or cyclist alters direction on carriageway;
  - 6. Vehicle brakes;
  - 7. Vehicle brakes hard; and
  - 8. Vehicle swerves.
- The severity of the encounter:
  - Level 1: one participant required to manoeuvre, stop or slow down to avoid one another, but with ample time;
  - Level 2: both participants required to manoeuvre, stop or slow down to avoid one another, but with ample time;
  - Level 3: one participant required to suddenly manoeuvre, stop or slow down to avoid one another, resulting in a near miss situation;
  - Level 4: both participants required to suddenly manoeuvre, stop or slow down to avoid one another, resulting in a near miss situation;
  - Level 5: light contact is made between the two parties, but no injuries;
  - Level 6: full contact is made between the two parties, requiring emergency action.
- The number of vehicles (if any) in front and behind of the encounter;
- The number of pedestrians (if any) in the carriageway and on the footway during the encounter together with the number of pedestrians in Areas A, B and C when the encounter took place;

- Who gave way in the encounter: pedestrian, vehicle or cyclist; and
- Whether the pedestrian involved in the encounter could be obviously seen to have a mobility or visual impairment or had a pushchair.

Additional Information

2.3.8 Information about the weather when the static counts were undertaken was also recorded, in particular whether it was raining or not.

**Automatic Traffic Counts (ATC)**

2.3.9 Automatic traffic counters were installed at six out of the ten sites. The counters provided, for each of the fifteen minute periods in which the pedestrian counts and encounter data was collected[11], the level of traffic flow, by class (car, buses[12], motorcyclists and vans / lorries) as well as the mean speed and 85$^{th}$ percentile speed.

2.3.10 At the other four sites (Seven Dials, Elwick Square, New Road Brighton, Y Maes Caernarfon), counters could not be installed due to concerns about damaging the surface or as a risk to pedestrian safety through a trip hazard. At these sites an approximation of the traffic flow and speed was determined from the video observations. The traffic flows by vehicle type were recorded for a ten minute period during which the static pedestrian counts took place. To be comparable with the ATC data, this was then factored by 15/10 to get an approximate 15 minute flow, rounded up to the nearest vehicle.

2.3.11 Vehicle speed was determined by identifying two reference points on the carriageway, approximately 50 metres apart. The speeds of a minimum of 15 random vehicles were then visually estimated based on the time taken to travel between the two reference points, providing a 'best guess' estimate. The vehicle speeds using this methodology were compared against ATC data for Elwick Square Ashford captured in June 2009, provided by Kent County Council. The average difference between the ATC and estimated speeds across the time periods was less than 10%, suggesting that the methodology for estimating speeds gave values representative of actual speeds.

## 2.4 Overview of Data Collected

2.4.1 Table 2.3 shows the total number of 'usable' static counts and encounters collected using the methodology. The aim was to collect a reasonable sample of a minimum of 100 static counts across the two days, which was generally achieved. In some cases, additional static count information was collected (Godalming High Street and London Road, Southampton).

2.4.2 Encounters were initially observed within the fifteen time periods for the static count analysis. However, this was later expanded for particular sites (High Street Godalming Site B, London Road Southampton, Seven Dials London and Y Maes Caernarfon) to ensure that a reasonable sample of encounters was recorded at each site (a minimum of 50 encounters) so

[11] For the Bath site, the ATC was not working on the Friday / Saturday that the video observations were collected, therefore traffic information for the following week was used instead, with the assumption that the traffic flows and speeds would be similar across the two weeks.

[12] Note that for St. Johns Road, vehicles that were classified as HGVs were reclassified as buses. This is a known issue specific to London where the axles of the buses are similar to HGVs.

that a robust estimation of the proportion of users giving way in an encounter could be calculated. However, despite watching all of the video analysis High Street Godalming Site B, the number was still lower than the intended sample of 50, partially due to low pedestrian and vehicle flows at Godalming.

**Table 2.3 Total Number of Observations: Static Counts & Encounters**

| Site | Date | Hours Covered | Number of Static Observations | Number of Encounters |
|---|---|---|---|---|
| High Street, Shrewsbury | 06-Nov-2009 | 9, 14, 16, 17, 18 | 50 | 56 |
| | 07-Nov-2009 | 7, 12, 13, 20, 21 | 49 | 57 |
| | **Sub-Total** | **7, 9, 12, 13, 14, 16, 17, 18, 20, 21** | **99** | **113** |
| Milsom Street, Bath | 06-Nov-2009 | 8, 9, 14, 16, 20, 21 | 59 | 65 |
| | 07-Nov-2009 | 7, 12, 13, 17, 18 | 50 | 49 |
| | **Sub-Total** | **7, 8, 9, 12, 13, 14, 16, 17, 18, 20, 21** | **109** | **114** |
| London Road, Southampton | 20-Nov-2009 | 7, 8, 9, 12, 13, 14, 16, 17, 18, 20, 21 | 110 | 51 |
| | 21-Nov-2009 | 7, 8, 9, 12, 13, 14, 16, 17, 18, 20, 21 | 110 | 129 |
| | **Sub-Total** | **7, 8, 9, 12, 13, 14, 16, 17, 18, 20, 21** | **220** | **180** |
| Seven Dials, London | 13-Nov-2009 | 7, 8, 12, 14, 16, 20 | 60 | 70 |
| | 14-Nov-2009 | 9, 13, 17, 18 | 40 | 2 |
| | **Sub-Total I** | **7, 8, 9, 12, 13, 14, 16, 17, 18, 20** | **100** | **72** |
| Elwick Square, Ashford | 13-Nov-2009 | 7, 8, 13, 17, 18, 20 | 60 | 27 |
| | 14-Nov-2009 | 9, 12, 14, 16, 20 | 50 | 19 |
| | **Sub-Total** | **7, 8, 9, 12, 13, 14, 16, 17, 18, 20** | **110** | **46** |
| New Road, Brighton | 13-Nov-2009 | 8, 9, 14, 16, 17, 18 | 60 | 30 |
| | 14-Nov-2009 | 7, 8, 12, 13, 19, 20 | 50 | 26 |
| | **Sub-Total** | **7, 8, 9, 12, 13, 14, 16, 17, 18, 19, 20** | **110** | **56** |

| Site | Date | Hours Covered | Number of Static Observations | Number of Encounters |
|---|---|---|---|---|
| Y Maes, Caernarfon | 20-Nov-2009 | 7, 8, 9, 12, 13, 14, 16, 17, 18, 20 | 100 | 57 |
| | 21-Nov-2009 | - | - | 4 |
| | **Sub-Total** | **7, 8, 9, 12, 13, 14, 16, 17, 18, 20** | **100** | **61** |
| St John's Road, London | 12-Mar-2010 | 7, 8, 16, 17, 18, 21 | 60 | 39 |
| | 13-Mar-2010 | 9, 12, 13, 14, 20 | 50 | 20 |
| | **Sub-Total** | **7, 8, 9, 12, 13, 14, 16, 17, 18, 20, 21** | **110** | **59** |
| High Street Godalming, Camera A (Cars) | 20-Nov-2009 | 7, 8, 9, 12, 13, 14, 16, 17, 18, 19, 20, 21 | 147 | 25 |
| High Street Godalming, Camera A (No Cars) | 21-Nov-2009 | 7, 8, 9, 12, 13, 14, 16, 17, 18, 19, 20, 21 | 147 | 14 |
| High Street Godalming, Camera B (Cars) | 20-Nov-2009 | 7, 8, 9, 12, 13, 14, 16, 17, 18, 19, 20, 21 | 149 | 45 |
| High Street Godalming, Camera B (No Cars) | 21-Nov-2009 | 7, 8, 9, 12, 13, 14, 16, 17, 18, 19, 20, 21 | 148 | 2 |
| Total | | | **1,549** | **787** |

# 3 Data Analysis

## 3.1 Introduction

3.1.1 The operational assessment was designed to address the existing knowledge gaps of the operation of Shared Space schemes, in particular to gain a greater understanding of pedestrian behaviour as well as the circumstances in which drivers are more likely to give way to other users.

3.1.2 This section provides the results from the analysis of the data, around these two key themes, using the two main datasets:

- Static Count Analysis
  - Overview of the data collected and the range within and across sites;
  - Investigating the use of space by pedestrians, how this differs by site and to what extent it is influenced by design characteristics, traffic flow and traffic speed; and
  - Investigating to what extent vehicle speed is influenced by design characteristics and other external factors.
- Encounter Analysis
  - Overview of the data collected and the range within and across sites; and
  - Investigating who is more likely to give way and in what circumstances.

## 3.2 Static Count Analysis: Overview of the Data

3.2.1 This section provides information about the specific attributes collected as part of the static data collection that were used in the statistical analysis, including vehicle flow and speed as well as pedestrian flows. It provides context in terms of the variation in the static counts both within and across the sites.

3.2.2 In each graph, the sites are ordered by their shared space rating with the most shared site (New Road, Brighton) on the left hand site of the graph to the least shared site (St Johns Road, London) on the right.

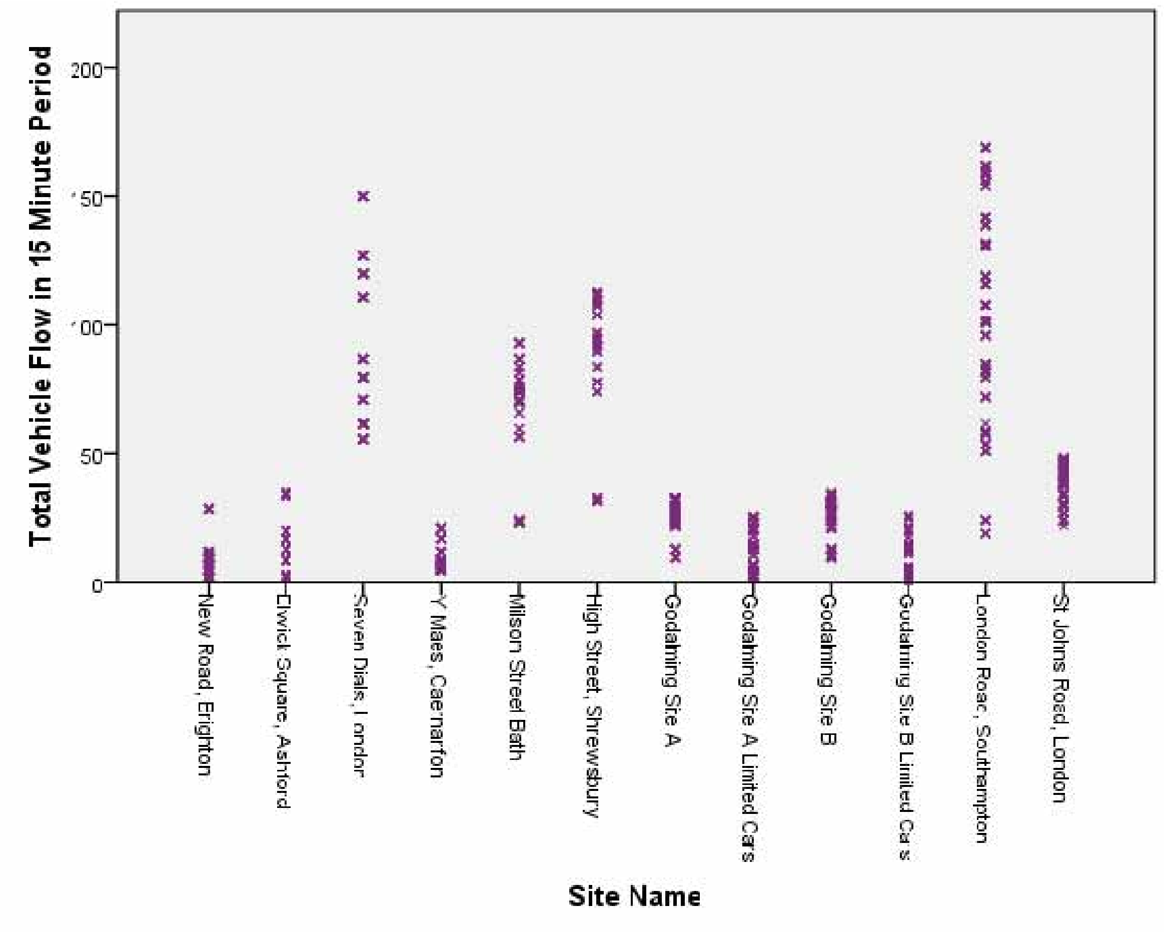
### Vehicle Flow and Speed

3.2.3 As it is hypothesised that vehicle flow and speed may influence pedestrian behaviour, it is important that a range of vehicle flows across and within sites were captured in order to test this hypothesis. Figure 3.1 shows the variation in total vehicles across the 15 minute periods at each site[13]. Both across and within each site, there is a range of vehicle flows. London Road, Southampton, the more conventional street, experiences the largest range of traffic flows as well as the highest. Despite St John's Road, London also being a more conventional street, the traffic flow is relatively low with minimal variation. This is predominately due to the carriageway being mainly accessed by buses, rather than general traffic. Across the

[13] Each 'X' represents the total vehicles in a 15 minute period, with the number of 'X's being equal to the number of observations per site as detailed in Table 2.3

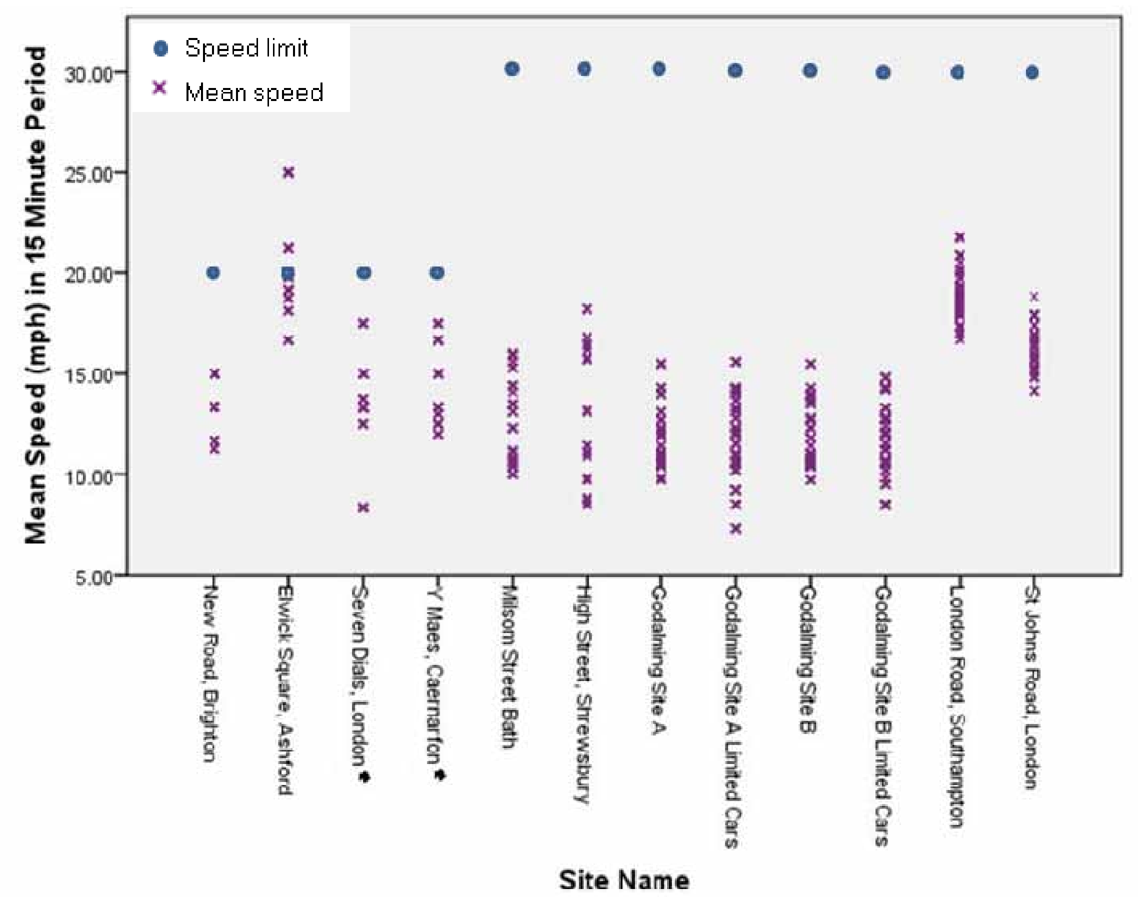
more shared sites, there is also significant variation in vehicle flow, with higher vehicle flows being observed at Seven Dials London, Milsom Street Bath and High Street Shrewsbury.

**Figure 3.1: Total Number of Vehicles in 15 Minute Period by Site**



3.2.4 Figure 3.2 shows the mean speed (and associated speed limits in blue) at each site. Irrespective of the speed limit, the majority of mean speeds are generally 15 miles per hour or less[14]. The higher speeds were observed at the more conventional sites (London Road Southampton and St Johns Road London) as well as Elwick Square Ashford. The higher speeds for Elwick Square are also supported by the June ATC data and could be potentially influenced by the fact that the site is the route of the previous ring road. It may therefore still be perceived by drivers as being a link from A to B, coupled with the low pedestrian flows (see Figure 3.4) meaning that drivers have the opportunity to travel faster than at the other sites.

**Figure 3.2: Mean Speed at each 15 minute period, by Site**

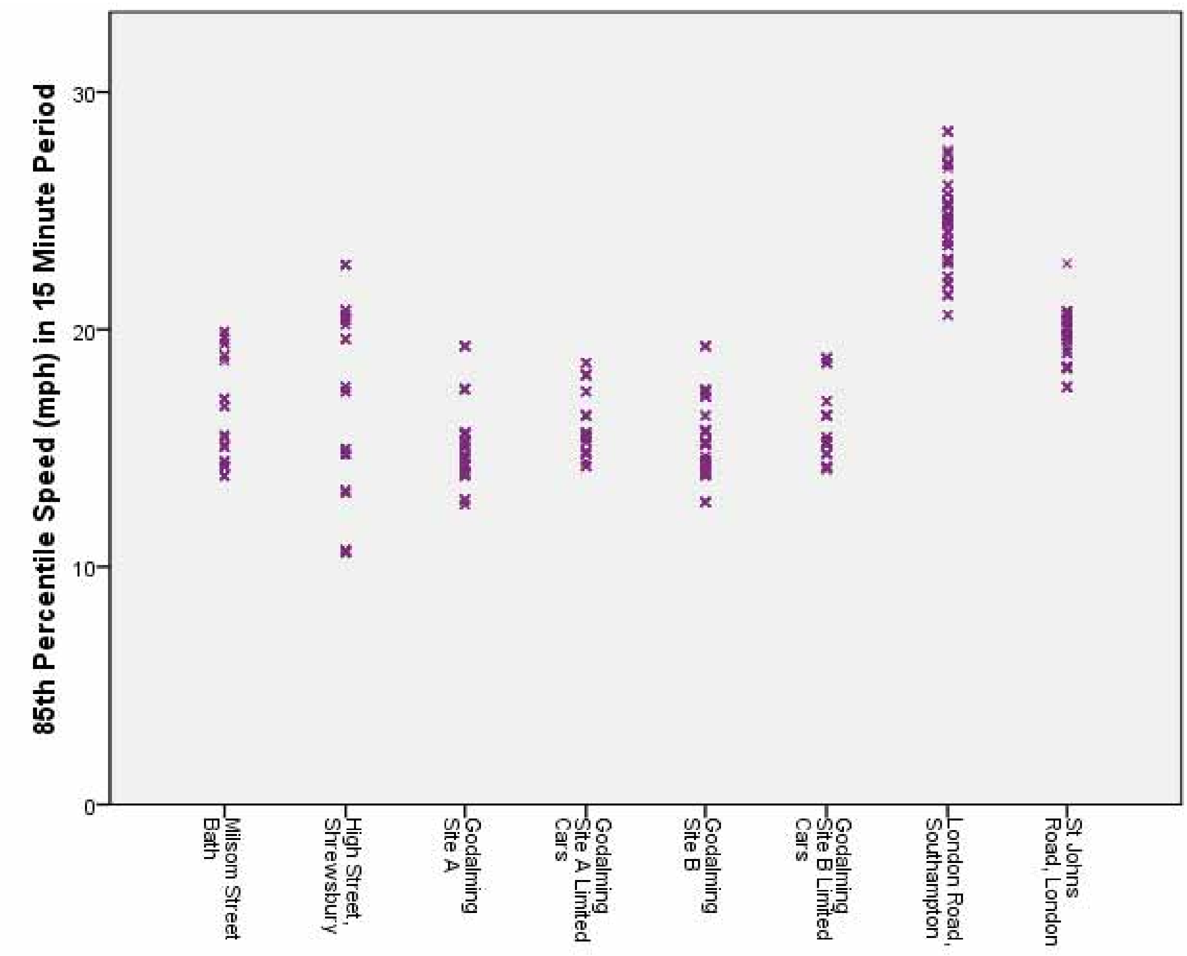



[14] Documentation for Seven Dials, London and Y Maes, Caernarfon suggests that there are no formal speed limits and drivers are encouraged to travel at the speed they feel comfortable with given the environment. However, for the purpose of the graph a limit of 20mph has been assumed.

Y Maes: http://www.caernarfonherald.co.uk/caernarfon-county-news/local-caernarfon-news/2009/06/11/controversy-over-y-maes-in-caernarfon-88817-23844877/

3.2.5 Comparing the 85th percentile speed for the six sites where ATC data is available (Figure 3.3) shows London Road Southampton to have the highest 85th percentile speed (28.4mph) and High Street, Shrewsbury to have the lowest (10.6mph): both with 30 mph speed limits. The least variation in the top 85th percentile speed is observed at St Johns Road with a minimum of 17.6mph and a maximum of 22.8mph. High Street, Shrewsbury has the most variation with a maximum of 22.7mph and a minimum of 10.6mph.

**Figure 3.3: 85th Percentile Speed at each 15 minute period, by Site Rating**




## Pedestrian Flows

3.2.6 As with vehicle flow and speed, in order to test whether pedestrian flows have a significant influence on pedestrian and driver behaviour, it is important that a range of flows are captured both within and across the sites. As described in paragraph 2.3.4 two different pedestrian counts were undertaken: one using zonal counts of equal size and the second using area counts covering the site area, but differing by size.

3.2.7 Figure 3.4 presents the total number of pedestrians for each 15 minute period at each site, based on the static area counts: Areas A, B and C. Similar information based on zones 1, 2 and 3 is provided in Figure 3.5.

3.2.8 Using the area count information, the highest pedestrian flows are observed at St Johns Road followed by Milsom Street Bath and High Street, Shrewsbury. Elwick Square has the lowest pedestrian counts because the site is on the periphery of the central shopping area within the town.

3.2.9 The static counts from the one metre squared zones show less variation than the comparable area information suggesting that the static area count information may be more representative of the level of pedestrian flows at the sites as it is capturing all pedestrian movements rather than just those that fall within a specific one metre squared area.

**Figure 3.4: Number of Pedestrians (Area) for each 15 minute period at each site by Shared Space Rating**

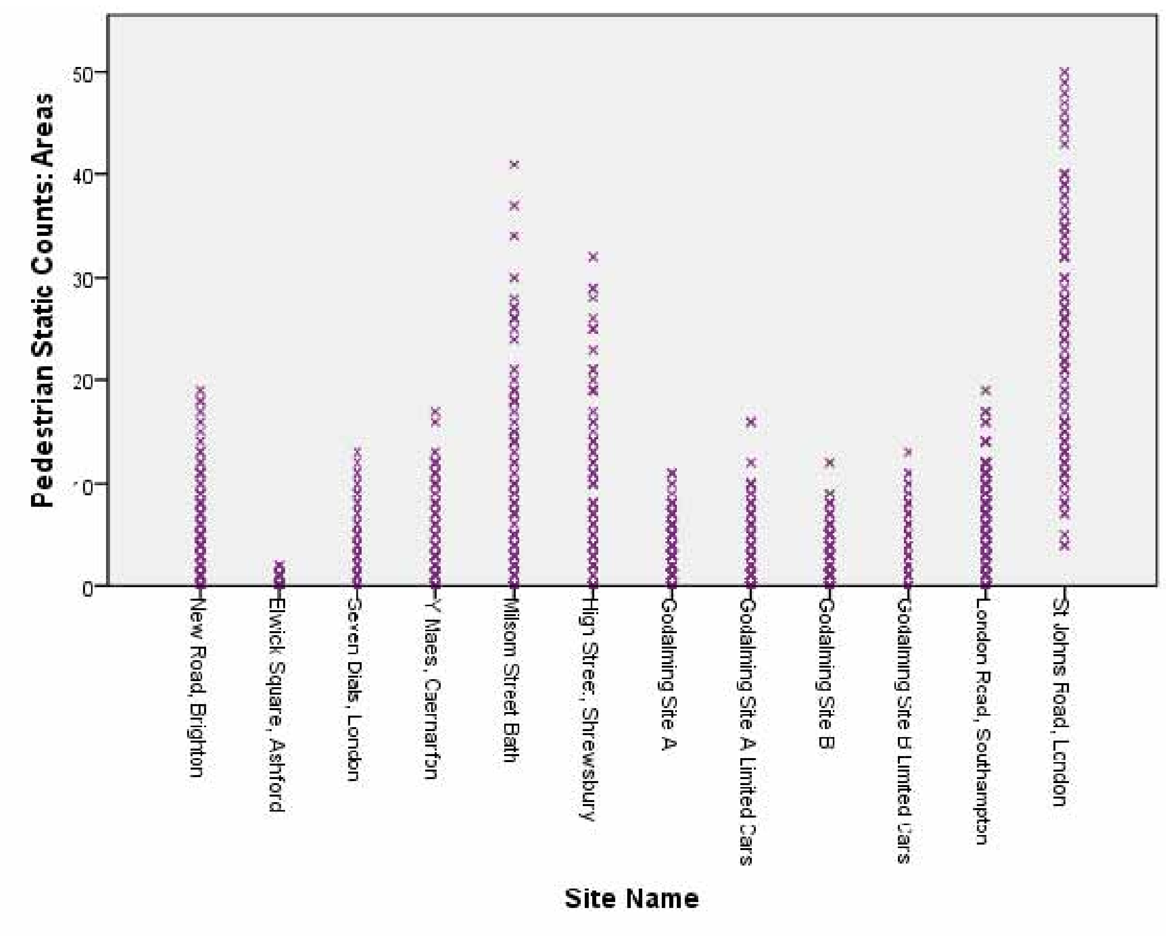
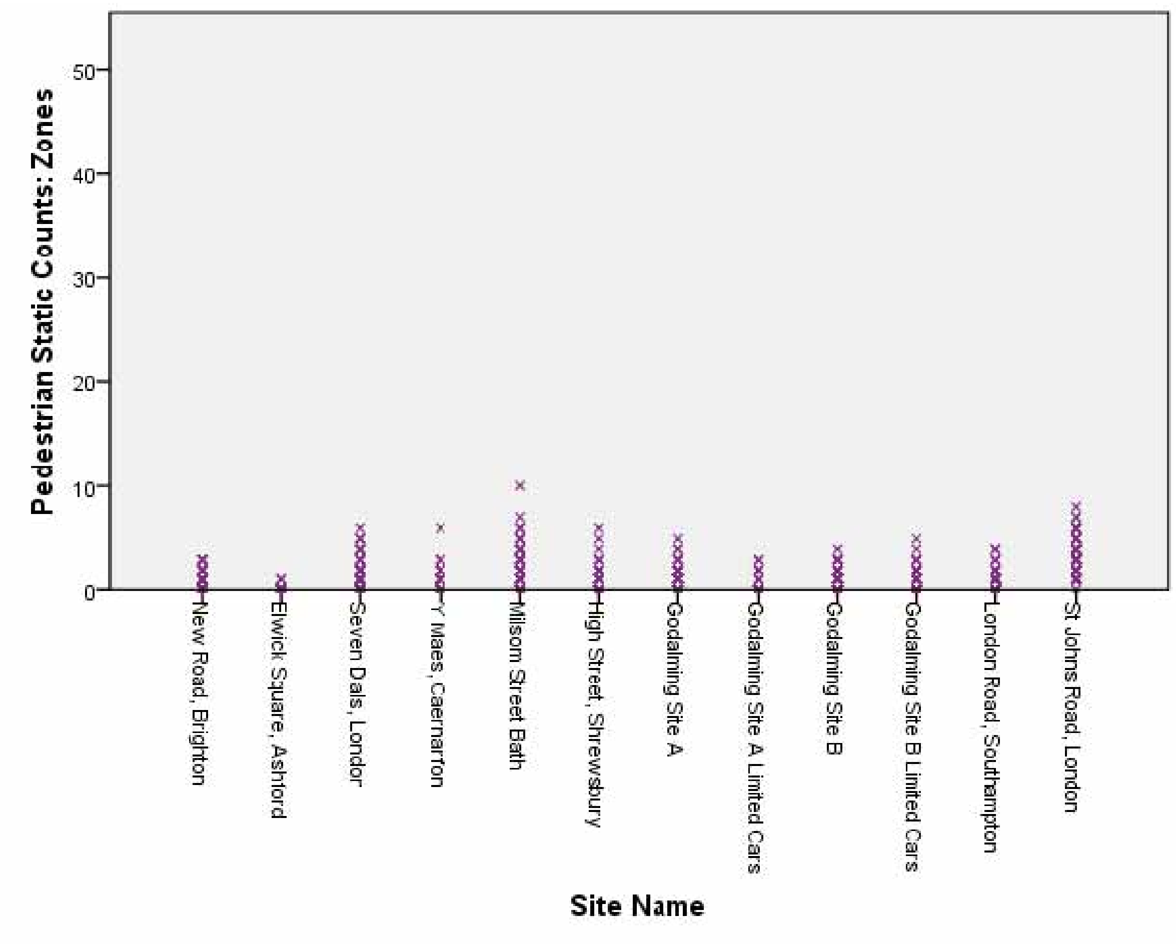


**Figure 3.5: Number of Pedestrians (Zone) for each 15 minute period at each site by Shared Space Rating**




3.2.10 Information about the weather was also recorded, in particular whether it was raining or not at each observation. Across all of the observations at all sites it was raining approximately 30% of the time and therefore a range of weather conditions were captured.

## 3.3 Static Count Analysis: Use of Space by Pedestrians

### Overview

3.3.1 One of the aims of Shared Space schemes is to encourage all users to 'share' the space. For pedestrians, this may be interpreted as being able to use the space as they intend, rather than being constrained by physical features, such as the carriageway.

3.3.2 Therefore the aim of this analysis was to explore the way pedestrians use the space at each of the sites and to determine to what extent this is influenced by factors such as the design characteristics, traffic flow and speed or pedestrian flow. Three strands of analysis were undertaken:

- Examining the relative densities of pedestrians on the footway and carriageway;

- Undertaking regression analysis to determine to what extent the proportion of pedestrians using the carriageway could be explained by observed features, such as site characteristics and vehicle and pedestrian flows; and
- Examining pedestrian's desire lines to determine to what extent pedestrians use their desire lines at each site.

### Pedestrian Behaviour: Relative Use of Footway and Carriageway

3.3.3 The aim of this analysis was to compare the relative densities of pedestrians using the footway and the carriageway. It may be expected that if pedestrians feel comfortable using the carriageway, then the same proportion of pedestrians will be observed using the carriageway as the relative space of the carriageway. For example, assuming the carriageway and the footway was the same size it may be assumed that equal numbers of pedestrians would be observed on the carriageway as on the footway. Note that this may be a conservative asssumption with regard to sharing because it ignores the possible tendency in any space for pedestrians to gravitate towards the edges where there are attractors such as shop fronts, etc.

3.3.4 Due to the zonal static counts providing limited pedestrian count information, the area counts were used for this analysis. However, as the relative areas of the footway and carriageway are different within each site, estimates of the relative sizes were calculated using screenshots from the video analysis. From the screen shots, the total area of the site and the carriageway was estimated and the difference between the total area of the site and the carriageway assumed to be the area of the footway.

3.3.5 Table 3.1 shows the estimated relative areas for each site. Note that these measurements give a general indication of relative area and do not represent actual site areas, as they are based on screenshots taken from video footage at each site.

**Table 3.1 Footway and Carriageway: Relative Size by Site**

| Site | Carriageway Percentage | Footway Percentage |
|---|---|---|
| New Road, Brighton[15], | 31% | 69% |
| Y Maes, Caernarfon | 35% | 65% |
| St Johns Road, London | 52% | 48% |
| Milsom Street, Bath | 55% | 45% |
| Seven Dials, London | 55% | 45% |
| London Road, Southampton | 57% | 43% |

[15] New Road Brighton is fully paved, therefore for the analysis the carriageway was deemed to be the central concourse, the predominant area used by vehicles (it was split by a drainage channel on one side and an imaginary line dictated by protruding columns on the other side).

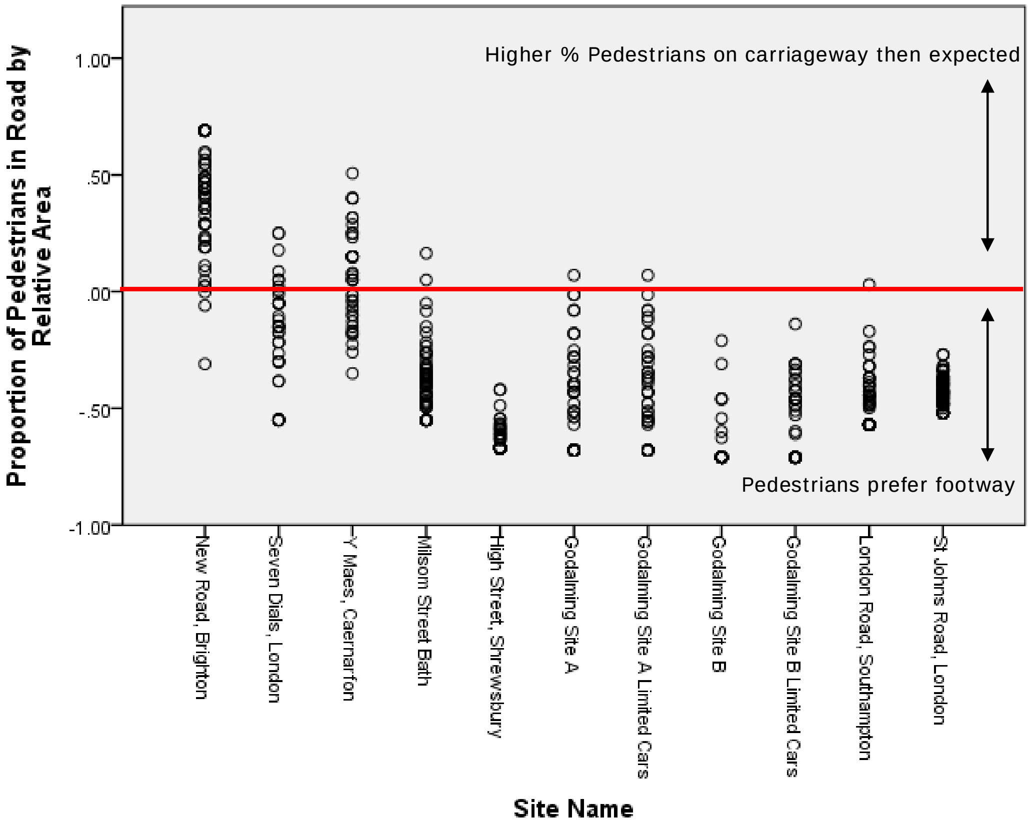
| Site | Carriageway Percentage | Footway Percentage |
|---|---|---|
| High Street, Shrewsbury | 67% | 33% |
| Godalming High St: Site A: Cars | 68% | 32% |
| Godalming High St: Site A: Limited Cars | 68% | 32% |
| Godalming High St: Site B: Cars | 71% | 29% |
| Godalming High St: Site B: Limited Cars | 71% | 29% |
| Ashford, Elwick Square | 72% | 28% |

3.3.6 The relative area of the footway and carriageway as shown in Table 3.1 was compared with the percentage of pedestrians observed in the carriageway as calculated from the area static counts. For example, for High Street, Godalming: Site B 29% of the area is carriageway, therefore if the percentage of pedestrians in the carriageway is greater than 29% it may be suggested that pedestrians feel comfortable in using the carriageway and interacting with the traffic. Conversely if the percentage of pedestrians in the carriageway is lower than 29% it suggests that they prefer to remain on the footways. .

3.3.7 Figure 3.6 shows the proportion of pedestrian's using the carriageway for each individual static count observation taking into account the relative area of the carriageway, calculated as the number of pedestrians in the carriageway (Area B) divided by the total number of pedestrians at the site (Areas A, B, C) minus the relative area of the carriageway as shown in Table 3.1[16]. Positive percentages indicate that there were a higher proportion of pedestrians than anticipated using the carriageway, whereas negative percentages indicate that pedestrians preferred to stay on the footway. Note that the results are dependent on the definition of the carriageway space during the video observations, which was assumed to the area capturing the dominant traffic flow.

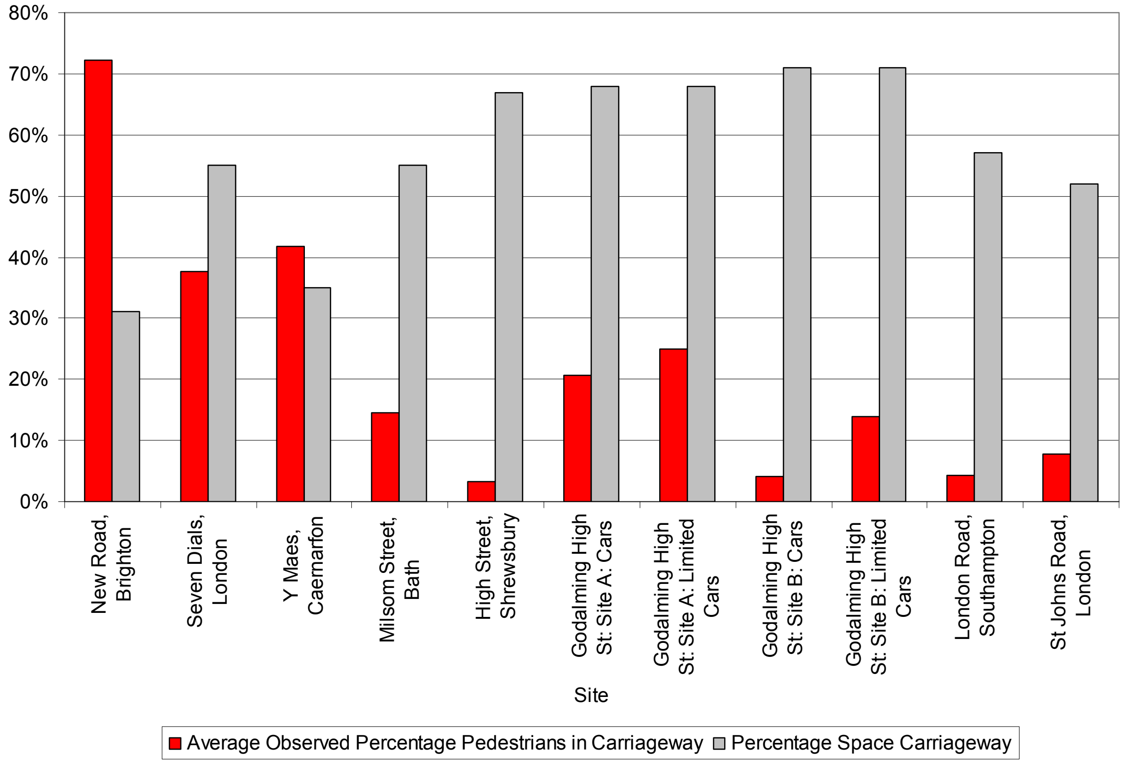
[16] Note that if the total number of pedestrians was less than three, these observations were excluded from the analysis as it was considered that a percentage of pedestrians in the carriageway would be unreliable. Due to this constraint, no values are shown for Elwick Square, Ashford as the pedestrian counts were extremely low.

**Figure 3.6 Pedestrian Use of Space: Individual Observations**



3.3.8 Figure 3.7 presents similar information but as an average by site across all of the observations.

**Figure 3.7 Pedestrian Use of Space: Average Across Site**




3.3.9 The two graphs together with supporting statistical analysis suggest:

- Generally, the more shared sites (New Road Brighton, Seven Dials London and Y Maes Caernarfon) have a higher proportion of pedestrians using the carriageway than the other sites;
- Chi-squared tests were undertaken to determine whether there was a statistical difference between the observed percentage of pedestrians using the carriageway and the expected percentage based on the relative area of the carriageway. These tests showed that at New Road Brighton more pedestrians were using the assumed carriageway space than its relative space and at Y Maes Caernarfon pedestrians were using the carriageway in the same proportion as its relative area[17]. At all of the other sites pedestrians preferred to use the footway spaces;
- Overall at the Godalming sites there was no statistically significant difference between the proportions of pedestrians using the carriageway with or with limited cars[18],

[17] The chi-square test statistic of 347 for New Road Brighton and 2.8 for Y Maes Caernarfon compared with a critical value with one degree of freedom at the 95% confidence level of 3.841. As 347 > 3.841, the results show that more pedestrians were observed using the carriageway at Brighton than would be expected. As 2.8 < 3.841 it suggests that there is an equal proportion of pedestrians using the carriageway at Caernarfon as would be expected.

[18] The Z statistic calculated for comparing the proportions of pedestrian using the carriageway with and with limited cars was 1.181, which is less than the critical z-value at the 95% confidence level of 1.96, implying that there is no statistical difference with and with limited cars.

suggesting that factors other than traffic flow influenced the pedestrian's propensity to use the carriageway[19]. However, a test of two proportions and the graphs suggest that overall a higher proportion of pedestrians were observed using the carriageway at Godalming Site A (without the kerbs) compared with Site B (with low kerbs)[20]. This suggests that designing the space appropriately can encourage pedestrians to use the carriageway.

### Pedestrian Behaviour: Use of Carriageway

3.3.10 The previous analysis examined the relative densities of pedestrians whereas this section seeks to identify the possible factors that influence the absolute percentage of pedestrians using the carriageway. For example to what extent is the proportion of pedestrians using the carriageway influenced by pedestrian flow (e.g. more pedestrians therefore more likely to be overcrowded on the footway, encouraging people to use the carriageway) and / or traffic speed and volume (e.g. the lower traffic speed or a reduced number of vehicles, the more likely that pedestrians are to use the carriageway). In addition to this, specific design characteristics may have a greater influence on the percentage of pedestrians using the carriageway.

3.3.11 In order to test these hypotheses the relationship between the percentage of pedestrians using the carriageway (as the number of pedestrians in the carriageway (Area B) divided by the total number of pedestrians (Areas A, B and C) against each of the individual attributes was investigated[21] using simple linear regression modelling estimating:

$$\%PedsCway = \beta_1 + \beta_2 Variable$$

where %PedsCway is calculated as the number of pedestrians using the carriageway (Area B) divided by the total number of pedestrians (Areas A, B and C). $\beta_1$ and $\beta_2$ are the parameters to be estimated from the linear regression model where $\beta_1$ is the constant or intercept and $\beta_2$ is the slope of the line. Variable represents the attributes tested in the model, for example this could be traffic flow or traffic speed.

3.3.12 For each of the models the:

- Relationship between the percentage of pedestrians using the carriageway and the attribute was considered. A positive relationship indicates that as the attribute increases so will the percentage of pedestrians using the carriageway and a negative relationship indicates that as the attribute decreases, the percentage of pedestrians using the carriageway increases;
- The value of the R-squared. The R-squared is a value between 0 and 1 that provides an indication of how strong the relationship is between the two variables. For example

[19] This is similar to York's findings (Public Transport in Pedestrian Priority Areas, Iain York, October 2003, unpublished) who concluded that the relative use of space was only determined by local attractors and not by traffic flow or the extent to which the site was crowded.

[20] The Z statistic calculated for comparing the proportions of pedestrian using the carriageway at Site A compared with Site B was 2.496, which is greater than the critical z-value of 1.96 at the 95% confidence level, implying that a greater proportion of pedestrians were observed to be using the carriageway at Site A compared with Site B.

[21] Note any percentages where the total number of observed pedestrians for the observation was three or less were excluded from the analysis.

an R-squared of 0.1 indicates that 10% of the variation in the percentage of pedestrians using the carriageway is explained by the attribute.

3.3.13 Table 3.2 shows the R-squared information and the relationship between the percentages of pedestrians using the carriageway at any given time against each of the attributes. The results indicate that the following encourage greater use of the carriageway space by pedestrians:

- The removal of physical barriers as well as demarcations (such as bollards, kerbs or colour contrast) encourages pedestrians to use the carriageway space; and
- The higher the traffic flow, the lower the percentage of pedestrians using the carriageway.

**Table 3.2 Relationship with Percentage of Pedestrians using the Carriageway**

| Attribute | R-squared | Relationship |
|---|---|---|
| Presence of bollards | 0.46 | Negative |
| No kerbs | 0.19 | Positive |
| Clear contrast between pavement & carriageway | 0.19 | Negative |
| Number of cars, vans/lorries, motorcyclists | 0.12 | Negative |

3.3.14 From the initial regression model, subsequent multiple regression models were developed to explain the percentage of pedestrians using the carriageway using multiple variables. As the dependent variable is a percentage, a log-odds ratio was used in order to constrain the dependent variable to be between 0 and 100%. The continuous independent variables were also logged.

3.3.15 A 'general to specific' regression approach was used, where all of the variables were used to start with and the insignificant variables removed one at a time to understand the effect they had on the predictive power of the model. In addition to this, the correlation between the attributes was also examined.

3.3.16 It was found that the total number of vehicles as well as site characteristics had an impact on the percentage of pedestrians using the carriageway; however, in all models the percentage of the variation in the dependent variable as explained by the attributes included in the model was low (between 30-50%). This indicates that there are other influences, not captured in the data that explain the pedestrian's propensity to use the carriageway, which could for example be the need / desire to use the carriageway as determined by the attractors on either side of the carriageway (shops etc).

3.3.17 In addition to this many of the site characteristics were correlated, meaning that only a limited number could be included in any one model. For example, bollards were correlated with no colour contrast between the footway and the carriageway (i.e. in most cases where there were bollards there was some or clear colour contrast at the selected sites) meaning that only one of these variables could be included in any one model.

3.3.18 The equation below shows a regression model including vehicles and uncorrelated site characteristics, with the results provided in Table 3.3.

$$Ln(P/(100-P)) = \beta_1 Ln(TotalVehicles) + \beta_2 NoKerbs + \beta_3 NoContrast + \beta_4$$

Where $\beta_1$, $\beta_2$, $\beta_3$ and $\beta_4$ are parameters to be estimated from the regression analysis and P is the percentage of pedestrians using the carriageway, ln(Total Vehicles) is the natural log of the total vehicles in the fifteen minute period, NoKerbs and NoContrast are binary variables, one indicating no kerbs and no colour contrast between the footway and the carriageway respectively.

3.3.19 Table 3.3 shows the coefficient of the parameter to be used in the equation, the standard error and the t-statistic. The standard error provides an indication of the spread of the coefficient. The t-statistic indicates whether the coefficient is statistically different from zero. If it is greater than 1.96, the parameter is significantly different from zero at the 95% confidence level.

**Table 3.3 Pedestrian Use of Space: Regression Model**

| Attribute | Coefficient | Standard Error | T-Statistic |
|---|---|---|---|
| Log Total Vehicles ( $\beta_1$ ) | -0.219 | 0.040 | -5.42 |
| No Kerb ( $\beta_2$ ) | 0.318 | 0.125 | 2.55 |
| No colour contrast between carriageway & footway ( $\beta_3$ ) | 1.678 | 0.162 | 10.35 |
| Constant ( $\beta_4$ ) | -0.803 | 0.178 | -4.51 |

Adjusted R-Squared: 0.34. Number Observations: 398

3.3.20 The R-squared is 0.34, suggesting that 34% of the percentage of the variation in the dependent variable (ln(P/(100-P)) in the carriageway is explained by the attributes included in the model.

3.3.21 The negative coefficient on total vehicles indicates that as the number of vehicles increases, the percentage of pedestrians using the carriageway decreases. Conversely, designing the space to encourage sharing, such as having no kerbs or colour contrast between the footway and carriageway, encourages pedestrians to use the carriageway[22]. It should be noted that St John's Road, London is adversely affecting the results, particularly for the impact of having no kerbs. Despite there being no kerb at St John's Road, there were few pedestrians observed to be using the carriageway. Excluding this site increases the R-squared value to 0.412.

[22] Note that the percentage of pedestrians using the carriageway will be dependent on the areas selected at each site. The carriageway area was selected as that capturing the dominant traffic flow. However, it is recognised that this may be more contentious in the more shared sites.

3.3.22 Table 3.4 shows the correlation between the coefficients. Generally values of greater than 0.5 indicate that there is correlation between the two coefficients meaning that both are explaining the same influence on the dependent variable, which should be avoided. In this case the correlation between the coefficients is low.

**Table 3.4 Pedestrian Use of Space: Correlation Matrix of Coefficients**

| Attribute | No colour contrast between carriageway & footway | Log Total Vehicles | No Kerb |
|---|---|---|---|
| No colour contrast between carriageway & footway | 1.000 | 0.277 | -0.168 |
| Log Total Vehicles | 0.277 | 1.000 | 0.051 |
| No Kerb | -0.168 | 0.051 | 1.000 |

3.3.23 The model results, although indicative only, can be used to estimate the potential impact changes in the traffic flow will have on the percentage of pedestrians using the carriageway by applying the elasticity estimated from the formula below:

$$P' = \beta_1(1-P)$$

Where $P'$ is the revised percentage of pedestrians using the carriageway to be calculated from an increase in one vehicle in a fifteen minute period $\beta_1$ and the existing percentage of pedestrians observed using the carriageway from the static counts $P$ .

3.3.24 For example, St John's Road London has an average of 10% of pedestrians using the carriageway at any one time, given the existing average traffic flow of 38 vehicles per fifteen minute period. If traffic flow were to increase by one vehicle in a fifteen minute period, the percentage of pedestrians using the carriageway would be expected to decrease by (-0.219*(1-0.1))=-0.197 percentage points 9.8% all else being equal

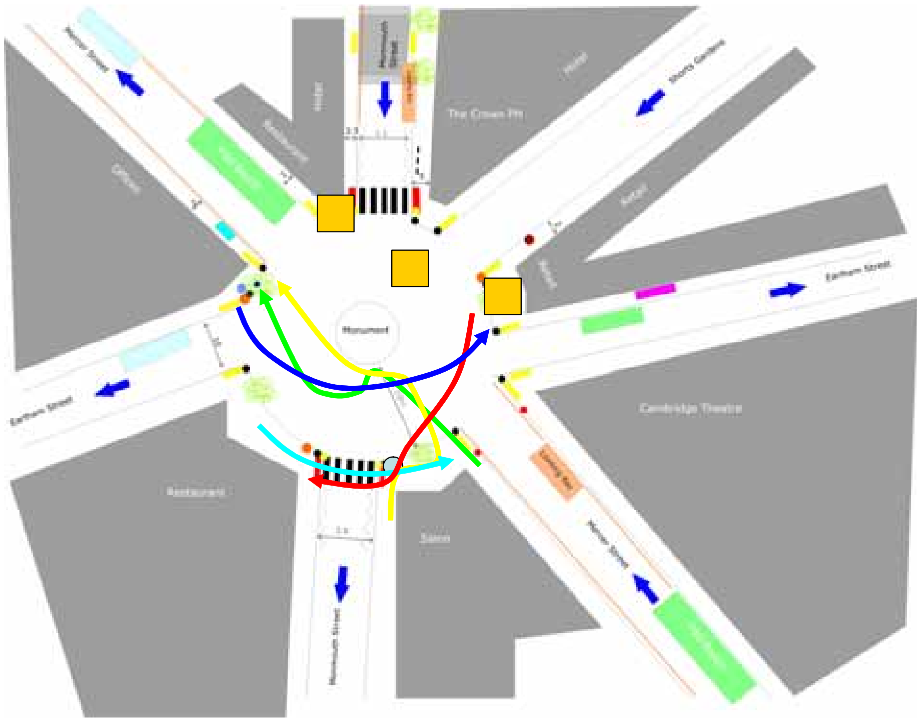
3.3.25 A similar model was run including bollards (as a binary variable) and the log of the total vehicle flow as independent variables. This gave a similar R-squared value of 0.331. Including the log of the shared space rating and the log of traffic flow as independent variables increases the R-squared value to 0.448. This suggests that schemes designed holistically incorporating a range of design characteristics are likely to better achieve the desired effect of more pedestrians using the entire space than schemes focusing on one or two specific design characteristics.

### Pedestrian Behaviour: Desire Line Analysis

3.3.26 In order to gain an appreciation of the extent to which pedestrians cross on their desire lines, an analysis of pedestrian movements was undertaken at all ten sites. At each site, thirty pedestrians were chosen at random from within the 15 minute sample periods, spread across the day. Pedestrians were either lone walkers or moving through the study area in small groups. The video was paused at a random point and a pedestrian was chosen from within the still. The video was then rewound to the point at which they entered the frame. The line on which they moved through the area was then plotted onto a base map or photograph of the area. Five desire lines were included per map.

3.3.27 Figure 3.8 shows an example of the desire lines plotted for a Seven Dials, London from data on the 13th November 2009.

**Figure 3.8 Desire Line Analysis: Seven Dials, 13th November 2009**




| Set 3 | Number Pedestrians | Time |
|---|---|---|
| | One pedestrian | 18:21:20 |
| | Two pedestrians | 18:48:13 |
| | One pedestrian | 20:10:10 |
| | Two pedestrians | 20:26:42 |
| | One pedestrian | 20:28:30 |

3.3.28 In order to compare the data across the sites, the pedestrian movements, particularly those that were crossing the carriageway, were classified into whether they appeared to move on their desire line or whether they took the shortest path across the carriageway.

3.3.29 The results are shown in Table 3.5, and although for a small sample, suggest that pedestrians are more likely to cross the carriageway based on their desire line in a Shared Space environment compared with a more conventional street. The percentage of pedestrians crossing the carriageway on their desire line is 80% or greater for sites with a shared space rating of 25 or greater, with the exception of High Street Shrewsbury where crossing pedestrian movements were largely influenced by an informal crossing point. However, sites that could be classified as more conventional streets (London Road, Southampton and St. John's Road, London) have significantly fewer pedestrians crossing on their desire lines (50-60%).

Table 3.5 Desire Line Analysis

| Site | Shared Space Ranking (1 is most shared, 10 is least) | Number Desire Lines Recorded | Number who moved along the building line | Number crossing at designated points | Number Crossing / Moving on Desire Line | % Desire / Total Lines | % Desire / Total Crossing |
|---|---|---|---|---|---|---|---|
| New Road, Brighton | 1 | 30 | 4 | 0 | 26 | 87 | 100 |
| Elwick Square, Ashford | 2 | 30 | 0 | 0 | 30 | 100 | 100 |
| Seven Dials, London | 3 | 30 | 9 | 1 | 20 | 67 | 95 |
| Y Maes, Caernarfon, Wales | 4 | 30 | 3 | 5 | 22 | 73 | 81 |
| Milsom Street, Bath | 5 | 30 | 12 | 0 | 18 | 60 | 100 |
| High Street, Shrewsbury | 6 | 30 | 17 | 5 | 8 | 27 | 62 |
| High Street, Godalming (Site A) | 7 | 30 | 18 | 0 | 12 | 40 | 100 |
| High Street, Godalming (Site B) | 8 | 30 | 26 | 0 | 4 | 13 | 100 |
| London Road, Southampton | 9 | 30 | 16 | 6 | 8 | 27 | 57 |
| St Johns Road, London | 10 | 30 | 18 | 4 | 8 | 27 | 67 |

### Use of Space by Pedestrians: Conclusions

3.3.30 The analysis suggests that design characteristics intended to reduce the demarcation between the footway and carriageway (such as the removal of kerbs and colour contrast between the footway and carriageway) do achieve a higher percentage of pedestrians using the carriageway then might otherwise be expected.

3.3.31 This is supported by the regression analysis that indicates that the removal of physical barriers as well as demarcations (such as bollards, kerbs or colour contrast) encourages pedestrians to use the carriageway space. Conversely, higher traffic flows are likely to discourage pedestrians using the carriageway.

3.3.32 However, the extent that an individual characteristic can achieve more pedestrians using the entirety of the space is limited, as observed in St John's Road, London where having no kerbs does not achieve a significant proportion of pedestrians using the carriageway. Sites that are designed holistically and incorporate a wide variety of shared space characteristics (such as New Road Brighton, Seven Dials London and Y Maes Caernarfon) were observed to have a larger proportion of pedestrians using the carriageway compared with the other sites.

3.3.33 The desire line analysis, albeit a small sample, also supports the fact that pedestrians are more likely to use more of the space, within Shared Space environments compared with more conventional streets. In shared space sites, the percentage of pedestrians crossing the carriageway on their desire line is between 80-100%. Whereas for sites classified as more conventional streets (London Road, Southampton and St. John's Road, London) between 50-60% of observed pedestrians were crossing on their desire lines.

## 3.4 Static Count Analysis: Determinants of Vehicle Speed

3.4.1 One of the cited benefits of Shared Space schemes is lower vehicle speeds. Therefore the aim of this analysis was to identify the key determinants of vehicle speed as suggested by the data.

3.4.2 As above, a similar process was followed, first identifying whether any linear relationships existed between each attribute and vehicle speed and then through the development of multiple regression models, using a 'general to specific' regression approach. The dependent variable was the 85$^{th}$ percentile speed, hence only the sites where the automatic traffic count data was collected were included in the analysis[23].

3.4.3 The linear regression analysis results shown in Table 3.6 suggest that:

- The higher the vehicle flow, the higher the speed (assuming that congestion is not a factor); and
- The less demarcation between the carriageway and the footway, the lower the traffic speeds, for example, reducing the height of the kerb reduces traffic speeds.

[23] Note that for all of these sites the speed limit was 30 miles per hour, therefore the impact of the speed limit on the 85$^{th}$ percentile speed could be not tested.

**Table 3.6 Relationship with 85th Percentile Vehicle Speed**

| Attribute | R-squared | Relationship |
|---|---|---|
| Total Vehicles | 0.27 | Positive |
| Shared Space Rating | 0.27 | Positive |
| Number of cars | 0.20 | Positive |
| No kerbs | 0.17 | Negative |
| Low kerbs | 0.09 | Negative |

3.4.4 From the simple linear regression models, multiple regression models were developed and Table 3.7 shows the coefficients, standard errors and t-statistics for the equation below using individual site characteristics:

$$85thPercentileSpeed = \beta_1 xTotalVehicles + \beta_2 xNoKerb + \beta_3 xClearContrast + \beta_4$$

Where $\beta_1$, $\beta_2$, $\beta_3$ and $\beta_4$ are parameters to be estimated from the regression analysis, Total Vehicles are as per the values in the dataset and NoKerb and ClearContrast are binary variables, one indicating the presence of the characteristic and zero otherwise.

**Table 3.7 Vehicle Speed: Regression Model 1 Results**

| Attribute | Coefficient | Standard Error | T-Statistic |
|---|---|---|---|
| Total Vehicle Flow in 15 Minute Period | 0.059 | 0.003 | 21.56 |
| No Kerb | -0.486 | 0.220 | -2.21 |
| Clear contrast between carriageway & pavement | 3.728 | 0.261 | 14.30 |
| Constant | 12.135 | 0.353 | 34.37 |

Adjusted R-Squared: 0.405. Number Observations: 993

3.4.5 The positive value on vehicle flow implies that as the number of vehicles increase, so does the speed. This assumes that there is no congestion at the sites and to some extent will reflect the purposes of the traffic using the sites. For example, high traffic flows and speeds are more likely on routes where the street has a high movement function.

3.4.6 The model also suggests that site characteristics associated with defining the footway and carriageway spaces also contribute to higher traffic speeds. For example, the positive coefficient for clear contrast and negative for no kerbs suggests that vehicle speed increases if there is clear contrast and a kerb between the footway and the carriageway.

3.4.7 A further model was estimated using the shared space rating as shown below:

$$85thPercentileSpeed = \beta_1 xTotalVehicles + \beta_2 xTotalPedestrians + \beta_3 xSharedSpaceRating + \beta_4$$

Where $\beta_1$, $\beta_2$, $\beta_3$ and $\beta_4$ are parameters to be estimated from the regression analysis and Total Vehicles, Total Pedestrians and Shared Space Rating are as per the values in the dataset.

**Table 3.8 Vehicle Speed: Regression Model 2 Results**

| Attribute | Co-efficient | Standard Error | T-Statistic | Mean Value |
|---|---|---|---|---|
| Total Vehicles $\beta_1$ | 0.048 | 0.002 | 25.54 | 55 vehicles |
| Total Pedestrians (Area) $\beta_2$ | -0.210[24] | 0.010 | -21.12 | 7 pedestrians |
| Shared Space Rating $\beta_3$ | -0.581 | 0.018 | -32.96 | 24 |
| Constant $\beta_4$ | 30.608 | 0.477 | 64.14 | |

Adjusted R-Squared = 0.654. Number Observations: 992

3.4.8 The R-squared is 0.654, suggesting that 65% of the variation in the 85th percentile speed data can be explained by the attributes included in the model, 25% percentage points more than the previous model in Table 3.7.

3.4.9 The negative coefficients on total pedestrians and Shared Space rating indicate that as the number of pedestrians or the Shared Space rating increases, the 85th percentile traffic speed will decrease. Conversely the positive coefficient for total vehicles indicates that as the number of vehicles increases, the 85th percentile speed will increase (based on the traffic flows observed in the dataset, which are likely to exclude extremely congested situations).

3.4.10 The correlations between the coefficients are provided in Table 3.9, suggest that there is limited correlation between the coefficients, with the possible exception of total pedestrians and Shared Space rating, which is borderline.

[24] Pedestrian flow was not included in the model shown in Table 3.7 as including the attribute resulted in the coefficient for no kerbs to become insignificant with no improvement in model fit (denoted by the R-squared value).

**Table 3.9 Vehicle Speed: Correlation Coefficient Matrix: Model 2**

| Attribute | Shared Space Rating | Total Vehicle Flow | Total Pedestrians (Area) |
|---|---|---|---|
| Shared Space Rating | 1.000 | .077 | .512 |
| Total Vehicle Flow | | 1.000 | -.106 |
| Total Pedestrians (Area) | | | 1.000 |

3.4.11 Model 2 suggests that whereas individual site characteristics can assist in reducing traffic speed (for example by the removal of kerbs) designing a space holistically, as determined by the shared space rating, has a greater influence on vehicle speed (as denoted by the increased R-squared value).

3.4.12 Unfortunately, due to the restrictions of ATC data, all of the sites included in the regression analysis had speed limits of thirty miles per hour and therefore the impact of the speed limit was not able to be tested in the statistical analysis. However, Figure 3.2 suggests that despite some sites having 30 mph limits, the average observed vehicle speed was 20 mph or less. The higher vehicle speeds were observed at the more conventional streets: London Road Southampton and St Johns Road London (despite St Johns Road having no kerb). This evidence further supports the need to develop a scheme holistically rather than implementing one design feature, which on its own is unlikely to deliver reductions in vehicle speeds.

### Determinants of Vehicle Speed: Conclusions

3.4.13 Although indicative only, the regression modelling suggests that higher pedestrian volumes as well as reducing the demarcation between the footway and carriageway areas (no kerbs and no clear colour contrast) are likely to decrease the traffic speed.

3.4.14 However, whereas implementing a selection of specific site characteristics to reduce the demarcation between the footway and carriageway spaces to encourage drivers to reduce speeds will have some impact, the analysis suggests that designing the space in totality (as captured by the shared space rating) is likely to be more influential in reducing traffic speed as suggested by the higher R-squared value.

## 3.5 Encounter Analysis: Overview of the Data

### Overview of the Data: Encounters

3.5.1 Shared Space sites are designed to encourage all users to move more freely and as part of the ‘sharing’ aspect it is expected that users may be more inclined to give way to each other during encounters. The propensity for a driver or pedestrian to give way may be influenced by a number of factors, for example design characteristics of the site, vehicle speed, vehicle and pedestrian flow as well as the number of people / drivers involved in the encounter.

3.5.2 The aim of this analysis was to determine to what extent drivers were giving way to pedestrians (in theory, if both were sharing across all encounters, it would be expected that in 50% of encounters drivers would give way) and what factors influenced the driver’s propensity to give way.

### Overall Level of Encounters

3.5.3 Figure 3.9 shows the overall number of encounters per 15 minute period per site. There appears to be no obvious pattern between the rate of encounters and site, suggesting that design characteristics are not significantly influential in the rate of encounters. However, not unsurprisingly, multiple regression analysis suggested that the rate of encounters was largely determined by the overall traffic and pedestrian flow[25] (Table 3.10), predicting over 70% of the variation in the rate of encounters.

[25] The pedestrian flow was estimated as the sum of the total static pedestrian counts in areas A, B and C. The equation estimated in Table 3.10 was $EncounterRate = \beta_1 xTotalVehicles + \beta_2 xTotalPedestrians + \beta_3$

**Figure 3.9 Rate of Encounters by Site**

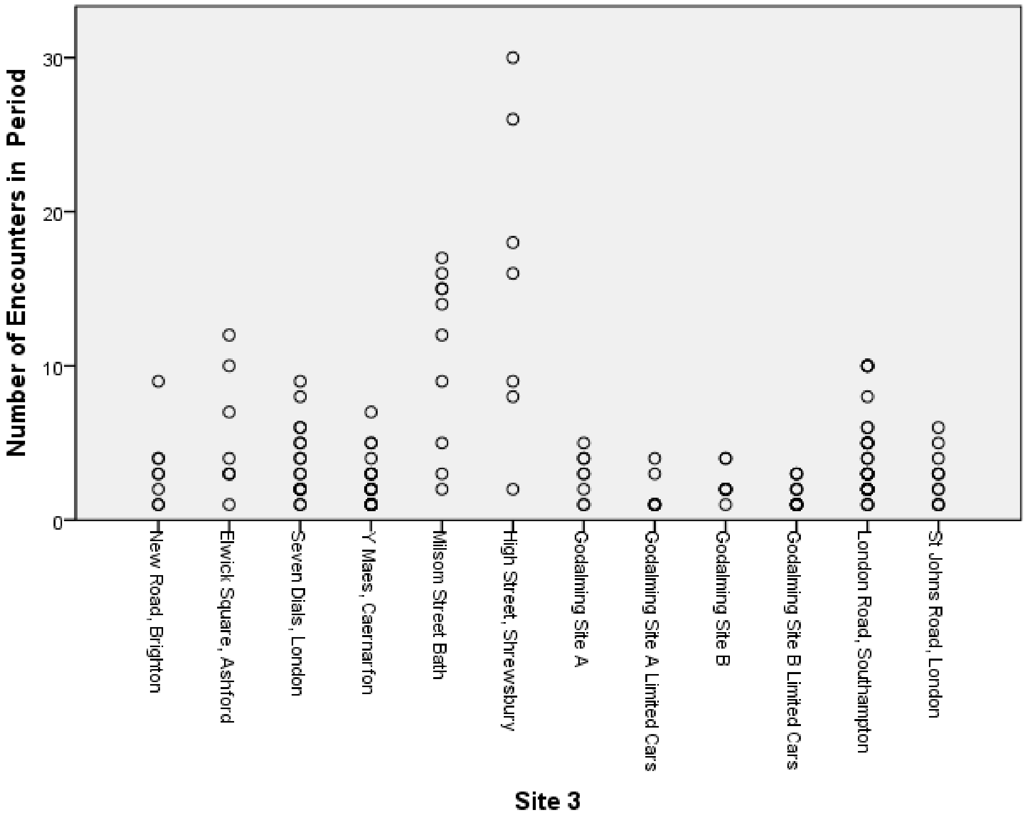



**Table 3.10: Encounter Rate: Multiple Regression Analysis**

| Attribute | Coefficient | Standard Error | T-Statistic |
|---|---|---|---|
| Total Vehicle Flow in 15 Minutes | 0.061 | 0.012 | 5.270 |
| Pedestrian Flow | 0.040 | 0.004 | 9.902 |
| (Constant) | 1.652 | 0.643 | 2.570 |

Adjusted R-Squared: 0.716 Number of Observations: 94

### Who Gave Way: Overall

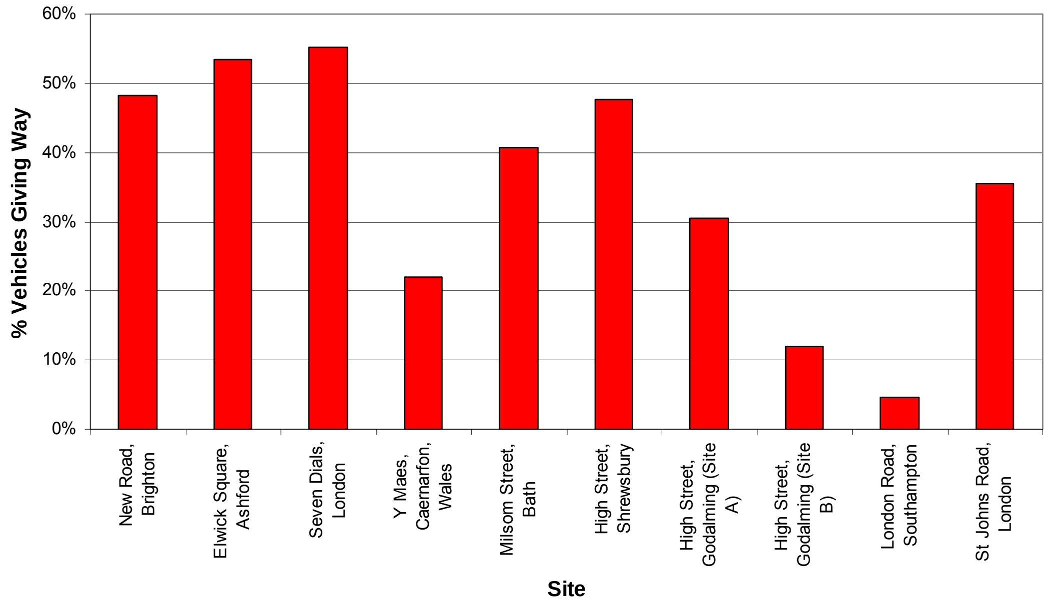
3.5.4 Table 3.11 shows the proportion of instances when pedestrians, drivers or cyclists gave way by different encounter types across the ten sites. Most encounters observed were between pedestrians and vehicles, where the majority (69%) of pedestrians gave way to vehicles. However, more cyclists gave way in encounters with pedestrians (65% compared to 35%). There was little difference in the tendency to give way in encounters between cyclists and vehicles, although this is a low sample size.

**Table 3.11 Percentage of Users Giving Way**

| | Who Gave Way | | | | |
|---|---|---|---|---|---|
| **Encounter Between** | **Pedestrian** | **Driver** | **Cyclist** | **Total %** | **No. Encounters[26]** |
| Pedestrian and vehicle | 69% | 31% | - | 100% | 692 |
| Pedestrian and cyclist | 35% | - | 65% | 100% | 48 |
| Cyclist and vehicle | - | 50% | 50% | 100% | 14 |
| Vehicle and vehicle | - | 100% | - | 100% | 14 |

3.5.5 However, the proportion of vehicles giving way to pedestrians differs significantly by site as shown in Figure 3.10.

**Figure 3.10 Proportion of vehicles giving way by Shared Space site**




[26] In 19 of the encounters, both the driver and vehicle gave way

3.5.6 A chi-squared test was undertaken to determine whether the proportion of encounters where drivers gave way was statistically significantly different from the expected 50% of encounters should the site be deemed to be truly shared. At New Road Brighton, Elwick Square Ashford, Seven Dials London and High Street Shrewsbury the chi-squared test showed that an equal proportion of drivers and pedestrians were giving way during encounters[27]. However, at all other sites, pedestrians tended to give way.

3.5.7 Of the sites where an equal proportion of pedestrians and drivers gave way, High Street Shrewsbury is perhaps the anomaly with the other three being the sites deemed to be the most 'shared'. However, there is a courtesy crossing at High Street Shrewsbury and because of this drivers appeared to be more willing to give way as perhaps they anticipated that pedestrians will be crossing at this point.

3.5.8 The propensity for drivers to give way also differed slightly by time period as shown in Table 3.12, with drivers being less likely to give way in the morning peak period (0700 – 0900) and the late evening (1900 – 2100).

**Table 3.12: Propensity of Drivers to Give Way: By Time Period[28]**

| Time Period | Pedestrian Gives Way (%) | Vehicle Gives Way (%) | Total Number of Encounters |
|---|---|---|---|
| Morning Peak (7 to 9) | 80% | 20% | 137 |
| Inter Peak (12 to 14) | 69% | 31% | 322 |
| Evening Peak (16 - 18) | 58% | 42% | 181 |
| Late Evening (19 – 21) | 79% | 21% | 52 |
| Total | 63% | 31% | 692 |

### Traffic Factors Influencing Propensity to Give Way

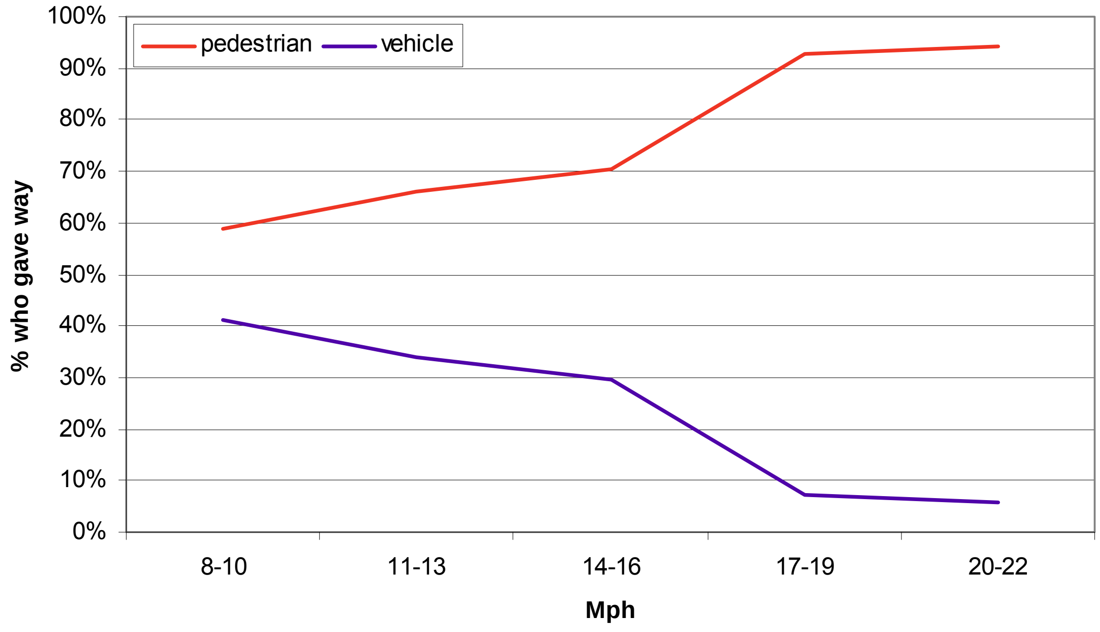
3.5.9 The propensity of drivers to give way to pedestrians may be influenced by vehicle and pedestrian factors, which are examined in this section.

3.5.10 A greater proportion of vehicles tended to give way at lower speeds. At speeds of more than 16 miles per hour, the proportion of drivers giving way to pedestrians decreased significantly as shown in Figure 3.11.

[27] The chi-squared calculated test statistics were 0 for New Road Brighton, 1.3 for Seven Dials, London, 0.5 for High Street, Shrewsbury and 0.4 for Elwick Square, Ashford, which were compared against a critical value for the 95% confidence level at one degree of freedom of 3.841. As the chi-squared test statistics for these sites were less than 3.841 it was concluded that there was no significant difference between the observed proportion of drivers giving way and the expected 50%.

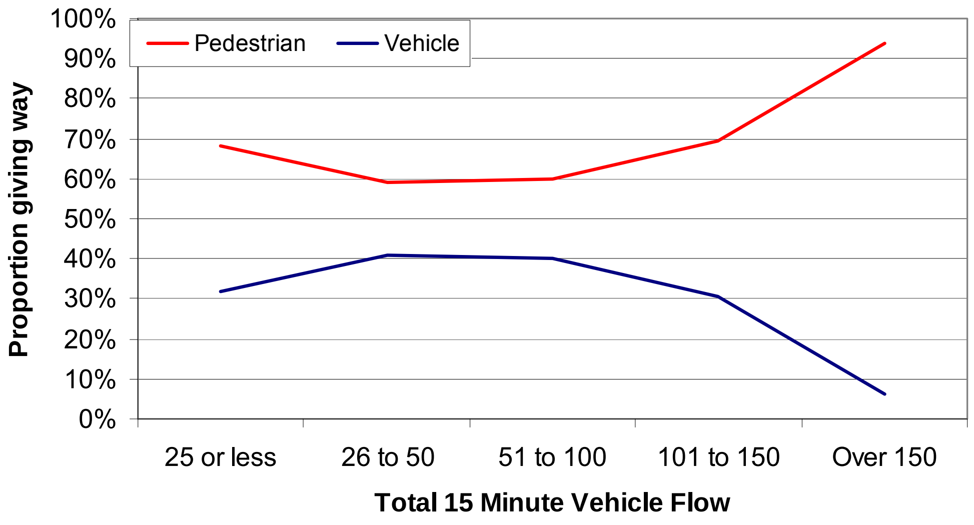
[28] Table shows the information for vehicle and pedestrian encounters only

**Figure 3.11 Proportion of carriageway users giving way by average speed**




3.5.11 Figure 3.12 shows the percentage of vehicles and pedestrians giving way taking into account the fifteen minute vehicle flow. At all levels of traffic flow, a higher proportion of pedestrians gave way compared to drivers; however when the vehicle flow reached more than 150 vehicles per fifteen minute period hardly any vehicles gave way. The high vehicle flows were generally recorded at one site: London Road Southampton.

**Figure 3.12 Who gave way by vehicle flow**

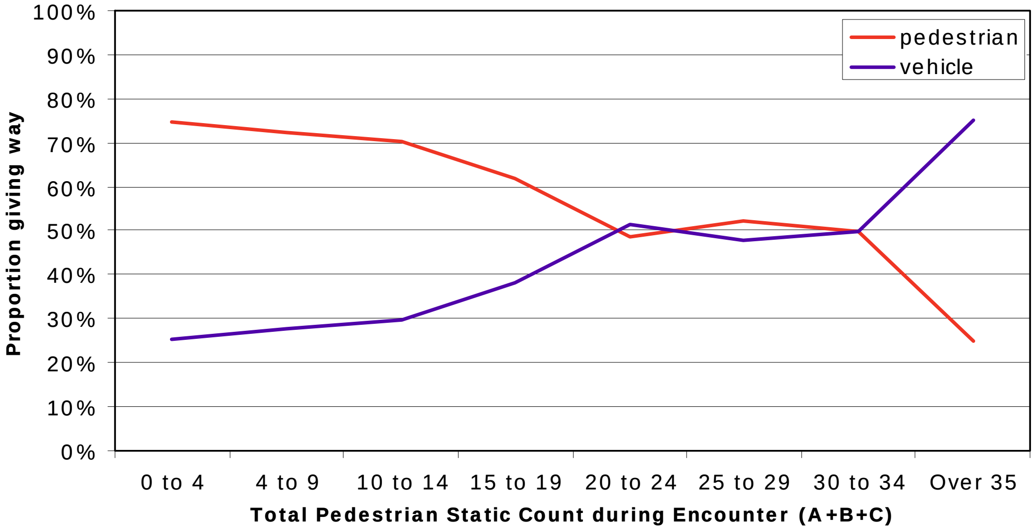


### Pedestrian Factors

3.5.12 From site visits undertaken as part one of the study, it was observed that group behaviour patterns appeared to be exhibited. In particular pedestrians moving in groups seemed to follow one another, rather than being aware of vehicles. Therefore the number of pedestrians and location of them during the encounter was investigated to understand the extent of these factors on the driver's propensity to give way.

3.5.13 Figure 3.13 shows the percentage of vehicles and pedestrians giving way taking into account the level of pedestrian flows, based on a static count of pedestrians in areas A, B and C at the time of the encounter. The graph, although indicative only, suggests that at higher pedestrian flows (when there are more than 30 pedestrians in the area), drivers are more likely to give way.

**Figure 3.13 Who gave way by pedestrian flow**




3.5.14 In general it seems that drivers are more likely to give way if there are a higher number of pedestrians in the carriageway (Table 3.13). If the pedestrian is waiting to cross on the footway (e.g. there are no pedestrians in the carriageway) only 4% of drivers gave way. However, as soon as there were pedestrians in the carriageway, the percentage of drivers giving way notably increased to 56% of encounters. The percentage of drivers giving way in encounters continued to increase as the number of pedestrians in the carriageway increased, suggesting that the number of pedestrians in the carriageway is an influencer on the propensity of drivers to give way in an encounter.

**Table 3.13 Who Gave Way by Number of Pedestrians in Encounter in Carriageway**

| | Pedestrian gave way | Driver gave way | Total (%) | Number Obs. |
|---|---|---|---|---|
| No Pedestrians | 96% | 4% | **100%** | **352** |
| 1 to 2 Pedestrians | 44% | 56% | **100%** | **271** |
| 3 to 4 Pedestrians | 25% | 75% | **100%** | **51** |
| Over 5 Pedestrians | 39% | 61% | **100%** | **18** |
| **Number Observations** | **478** | **214** | | **692** |

3.5.15 However, the propensity of a driver to give way did not appear to be influenced by the number of pedestrians on the footway in the encounter as shown in Table 3.14.

**Table 3.14 Who Gave Way by Number of Pedestrians in Encounter on Footway**

| | Pedestrian | Driver | Total (%) | Number Obs. |
|---|---|---|---|---|
| No Pedestrians | 42% | 58% | **100%** | **312** |
| 1 to 2 Pedestrians | 94% | 6% | **100%** | **327** |
| 3 to 4 Pedestrians | 88% | 13% | **100%** | **32** |
| Over 5 Pedestrians | 52% | 48% | **100%** | **21** |
| **Number Observations** | **478** | **213** | | **692** |

### Encounter Severity

3.5.16 The severity of each encounter was recorded, based on the required action required by one or both parties to avoid contact. Table 3.15 presents the encounter severity by vehicle flow across all sites. The vehicle flow (low, medium or high) was attributed to each site based on the mean vehicle flow across all observations for each site. Sites were classified as low traffic flow if they had a mean of less then 50 vehicles per hour, as medium flow if they had a mean hourly flow of between 50 and 200 vehicles and as high vehicle flow with over 200 vehicles per hour.

3.5.17 In the majority of encounters only one participant moved (88% encounters). The level of encounter severity did not seem to differ significant by traffic flow or speed; however, due to the low number of more severe encounters, it was not possible to estimate from the data the factors influencing encounter severity.

**Table 3.15 Encounter Severity by Vehicle Flow**

| | Vehicle Flow | | | | |
|---|---|---|---|---|---|
| | **Low** | **Medium** | **High** | **Total** | **Total Obs.** |
| Level 1: 1 participant moves | 95% | 77% | 90% | 88% | 692 |
| Level 2: Both participants move | 2% | 11% | 3% | 5% | 36 |
| Level 3: 1 participant suddenly moves | 2% | 11% | 7% | 7% | 55 |
| Level 4: both participants suddenly move | 0% | 1% | 1% | 1% | 4 |
| **Total** | **100%** | **100%** | **100%** | **100%** | **787** |
| **Number Observations** | **133** | **175** | **479** | **787** | |

### Linear Regression Analysis

3.5.18 As with the previous data, regression analysis was undertaken to attempt to explain the propensity of drivers to give way by other variables within the dataset.

3.5.19 In order to calculate the percentage of vehicles giving way a new dataset was created. The dataset only included encounters between vehicles and pedestrians, where either party gave way. This method produced 692 observations, which were then grouped by hour and site to produce 96 observations, specifying for each fifteen minute period by site, the percentage of pedestrians and vehicles giving way in pedestrian and vehicle encounters. Averages of pedestrian and vehicle flow were calculated for each observation, along with the site characteristics.

3.5.20 Linear regression was carried out on each of the variables, with the percentage of vehicles giving way as the dependent variable. Table 3.16 shows the most significant results; where R-squared was over 0.06 and suggests the following:

- Vehicles are more likely to give way as the number of pedestrians in the carriageway increases;
- Lower kerbs and less definition between surface colours make it more likely for vehicles to give way. More specifically; no kerbs, a subtle surface contrast and traffic calming measures;
- Vehicles are also more likely to give way when there are a higher number of vehicles behind or in front of them[29]; and

[29] Potentially this could be due to congestion

- The more 'shared' a space was deemed to be, the more likely vehicles were to give way.

**Table 3.16 Relationship with Percentage of Vehicles Giving Way**

| Attribute | R-squared | Relationship |
|---|---|---|
| Number of pedestrians in encounter in carriageway | 0.22 | Positive |
| Number of vehicles behind encounter vehicle | 0.17 | Positive |
| Number of pedestrians in Carriageway (Area B - Average Static Count) | 0.14 | Positive |
| Traffic calming measures present | 0.12 | Positive |
| Shared Space Rating 2 | 0.10 | Positive |
| No Kerb | 0.09 | Positive |
| Subtle Contrast | 0.09 | Positive |

3.5.21 As the depended variable is a percentage, a log-odds ratio was calculated and multiple regression undertaken. However, using the log-odds ratio gave very small R-squared values (less than 0.1) and the coefficients were not significant. This could be due to the relatively low number of observations used in the multiple regression analysis (approximately 49) as well as the fact that other factors are influencing the pedestrian and driver's propensity to give way that were not captured from the video analysis, for example the pedestrian's/driver's attitude to risk.

3.5.22 However, an indicative model was estimated using the percentage of divers giving way without the log-odds ratio. This model is indicative only as the results will not be constrained to 0% to 100%. Instances where the total numbers of encounters in the 15 minute period were less than three were also excluded due to the unreliability of the percentage of drivers giving way due to the low sample size.

3.5.23 Although indicative only and estimating just 46% of the variation in the data, the model suggests that the number of pedestrians in the carriageway in the encounter and the number of vehicles behind the encounter vehicle together with specific site characteristics are likely to influence the propensity of a driver to give way.

3.5.24 Unlike the other multiple regression models, using the shared space rating as an independent variable did not significantly improve the model fit and the coefficient was insignificant suggesting that the shared space rating was not a key determinant of the driver's propensity to give way. The propensity was more determined by specific characteristics; particularly the presence of a high kerb and clear colour contrast between the footway and the carriageway. In these instances, drivers were less likely to give way.

3.5.25 As the model only explains 46% of the variation this suggests that there are other non-observed factors that are influencing the driver's propensity to give way, which may include attitudinal influences (such as attitude to risk) as well as situation specific influences, such as at that time the driver was running late for a meeting.

**Table 3.17: Propensity of Drivers to Give Way: Multiple Regression Model**

| Attribute | Coefficient | Standard Error | T-Statistic |
|---|---|---|---|
| Number Vehicles Behind Encounter Vehicle | 3.13 | 0.77 | 4.08 |
| Number Pedestrians in Encounter in Carriageway | 13.96 | 3.17 | 4.41 |
| High Kerb | -25.21 | 6.83 | 3.69 |
| Constant | 18.04 | 4.30 | 4.20 |

Adjusted R-Squared: 0.463 Number of Observations: 70

### Encounter Analysis: Conclusions

3.5.26 The rate of encounters is largely determined by the vehicle and pedestrian flow, rather than specific fixed site characteristics. Higher vehicle and pedestrian flows result in higher numbers of encounters.

3.5.27 Across all of the encounters, pedestrians tended to give way in pedestrian and vehicle encounters (69%). However, this differed significantly by site with an equal proportion of drivers and pedestrians giving way at New Road Brighton, Elwick Square Ashford, Seven dials London and High Street Shrewsbury. The lowest percentage of vehicles giving way was observed at London Road Southampton, one of the more conventional streets.

3.5.28 The factors that appeared to influence the propensity for a driver to give in a pedestrian vehicle encounter as determined from the descriptive and statistical analysis included:

- If the traffic speed increased above 15 mph, the percentage of drivers giving way reduced significantly;
- The number of pedestrians in the carriageway; as the number of pedestrians in the carriageway increases, so does the likelihood of the driver giving way. The number of pedestrians on the footway waiting to cross, does not significantly influence the likelihood of the driver giving way; and
- The greater the demarcation between the footway and the carriageway, the less likely the driver is to give way.

3.5.29 However, the multiple regression analysis showed that there are other factors influencing the propensity of a driver to give way (as indicated by the relatively low R-squared value), which were not captured as part of the data gathering process. These are likely to include attitudinal and situational influences.

# 4 Conclusions

## 4.1 Introduction

4.1.1 The operational assessment of the selected Shared Space schemes assisted in addressing the knowledge gaps highlighted in the Appraisal Report of understanding:

- the changes to pedestrian's behaviour; and
- the changes to driver's behaviour, in particular when drivers are more likely to give way to pedestrians.

## 4.2 Key Findings

### Changes to Pedestrian's Behaviour

4.2.1 The data suggests that the more shared a site is, the more likely pedestrians will use the entirety of the space, in particular the carriageway. Shared Space sites also had a higher proportion of pedestrians observed to be using their desire lines when crossing the carriageway as opposed to more conventional streets where pedestrians tended to cross at designated crossing points or take the shortest path.

4.2.2 Specific site characteristics were found to encourage pedestrians to use the carriageway. In particular those that were intended to reduce the demarcation between the footway and carriageway (such as the removal of kerbs, colour contrast between the footway and carriageway and bollards). However, the implementation of just one of these characteristics is unlikely to achieve a significant change in the behaviour of pedestrians; rather the data suggests that schemes should be designed in their entirety to deliver the desired benefits.

4.2.3 As well as site characteristics, traffic flow was also a key determinant in the propensity of pedestrians to use the carriageway, with a high traffic flow discouraging pedestrians from using the carriageway.

### Changes to Driver Behaviour

4.2.4 Vehicle speed was found to be influenced by the number of vehicles, pedestrians and site characteristics. Although indicative only, the analysis suggests that higher pedestrian flows and specific site characteristics, in particular those reducing the demarcation between the footway and the carriageway, are likely to decrease the speed of the traffic. As with the pedestrian behaviour, the data suggests that the implementation of just one of the site characteristics is unlikely to achieve a significant change in vehicle speed and therefore schemes should be designed in their entirety.

4.2.5 The descriptive analysis suggests that the mean speeds across the majority of the Shared Space schemes were 15 miles per hour or less, despite differences in the legal speed limit. This suggests that at the selected sites other factors (such as the site characteristics and pedestrian behaviour) also influence the speed.

4.2.6 Drivers and pedestrians were found to equally give way to each other at the more Shared Space sites. The factors that appeared to encourage the driver to give way in a pedestrian-vehicle encounter included lower vehicle speeds and flows, reducing the demarcation between the footway and the carriageway as well as encouraging pedestrians to use the carriageway. Drivers were fourteen times more likely to give way to pedestrians if there was a pedestrian in the carriageway during the encounter.

### 4.3 Shared Space Schemes: Design Considerations

4.3.1 The site characteristics having the greatest influence were those that reduced the demarcation between the footway and the carriageway, for example, the removal of kerbs, colour contrast between the footway and carriageway and bollards. This reduced demarcation encouraged pedestrians to use the carriageway, reduced vehicle speed and encouraged drivers to give way more frequently to pedestrians.

4.3.2 However, implementing a limited number of site characteristics individually is unlikely to achieve the full range of benefits (as observed at St John's Road London where there are no kerbs, but limited sharing was observed). Therefore schemes should be designed in their entirety, taking into account all of the site characteristics. In addition to this, sites with high vehicle flows and speeds together with low pedestrian flows are unlikely to achieve the full benefits. Therefore the selection of future Shared Space schemes should take into account the purpose of the space for pedestrians and drivers to ensure that they are implemented successfully.

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