# Reducing Conflict through Improved Design of Pedestrian–Vehicle Spaces

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## An Important Note for the Reader

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## Introduction

Pedestrian–vehicle spaces, such as paved malls or elevated traffic-calming speed humps, are popular internationally and have been shown to improve road safety by reducing vehicle speeds. While shared spaces and traffic calming clearly do increase safety overall, other studies have shown that poor design and understanding may reduce the potential safety benefits.

Safety issues such as conflict for use can occur in pedestrian–vehicle spaces when a pedestrian and a driver both believe they have right of way, or when there is confusion over who has priority. An example of a confusing layout is where a traffic-calming speed hump or platform looks like a continuation of the footpath because it is set at footpath height. To reduce this confusion the features that are responsible for giving pedestrians and drivers conflicting messages about priority need to be identified. Also needed is to identify which features are giving clear messages about priority to both pedestrians and drivers. In this way features can be identified as either increasing or reducing conflict between the users of that same space.

This study carried out in 2003 in New Zealand was to identify the common design features of pedestrian–vehicle spaces that:

1. Give priority to pedestrians and drivers simultaneously;
2. Cue pedestrian priority from both user perspectives;
3. Cue driver priority from both user perspectives;
4. Alter the clarity of right of way and the feeling of comfort.

## Method

Seventy-five participants from local community groups were split into two groups: a pedestrian perspective group which viewed images of shared spaces from a pedestrian perspective only, and a driver perspective group which viewed only driver perspective images of the same shared spaces.

Each group was presented with a randomly ordered set of 33 different photographs of pedestrian–vehicle spaces, followed by 3 short video clips of pedestrian–vehicle spaces. Participants were given approximately 2 minutes to rate each piece of video, using scales to measure whether drivers or pedestrians have priority, clarity of right of way, and how comfortable they would feel about entering the space. A partial survey design was used, where the individual features were added and removed graphically from selected scenes. The graphical alteration of the photographs enabled any variation caused by an individual feature to be isolated.

Nine key design features were selected for investigation based on a review of the literature, the findings of a focus group consisting of members of the public, and the recommendations of a consultation group consisting of end users of the research, such as urban planners and road safety co-ordinators (see Table 1).

**Table 1. The nine design features used in pedestrian–vehicle spaces, and their descriptions, employed in the final questionnaire about conflict between pedestrian and driver user groups.**

| List of features used in final questionnaire | Description of feature |
|---|---|
| 1. Paving/Texture | Paving used to represent a texture change, as this is already associated with pedestrian spaces. |
| 2. Elevation | A raised platform or speed hump that is level with the footpath, but creates elevation from a driver perspective. |
| 3. Colour | Fading of colour from any paving or line markings resulting from normal wear caused by the passage of vehicles. |
| 4. Driver lines | Three white driving lane markings: of 2 edge-lane and 1 centreline. |
| 5. Gap | A gap in the centreline marking. |
| 6. Width/Throttle | A reduction of the path from both perspectives, created by addition of bollards. |
| 7. Island/ Refuge | A traffic island with a pedestrian refuge (a gap in the island for pedestrians), placed in centre of road between driving lanes. |
| 8. Tactile | A small tactile surface consisting of small raised studs, used to signal the presence of a kerb to blind or partially sighted pedestrians. |
| 9. Pedestrian lines | Two white pedestrian lane markings, to create a path for pedestrians that is perpendicular to the driver lines. |

## Conclusions

- When attempting to enhance the pedestrian priority of a space, the use of single features in isolation sends conflicting messages to both pedestrians and drivers. Minor changes to a space enhance pedestrians' sense of priority but do not impact on drivers' perceptions of priority.
  Therefore, the use of single features should be avoided, as drivers are not sensitive to the single feature change, and conflict may arise.

- Altering a driver's perceptions of priority is difficult, and may require a large change in the driving environment.
  Multiple features should be used to clearly signal an increase in the pedestrian priority of a space to both driver and pedestrian user groups.

- The use of visually conspicuous tactile features in a pedestrian–vehicle space gives conflicting visual cues to driver and pedestrian groups. One solution is to use visually inconspicuous tactile surfaces that may not send conflicting messages, and will still provide non-sighted pedestrians the tactile cues required to indicate the presence of a road.

- The use of pedestrian lines in a pedestrian–vehicle space clearly signals pedestrian priority to both drivers and pedestrians. Pedestrian lines should be used when attempting to enhance the pedestrian priority of a pedestrian–vehicle space.

- Pedestrians feel less comfortable, and believe they receive lower clarity over right of way, when entering a pedestrian–vehicle space.

- The fading of colour in paving and line markings caused by wear may lead to conflict. This finding should be treated with care, and further investigation is needed to warrant more stringent regulation over the maintenance of pedestrian–vehicle spaces.

## Recommendations

- Avoid using single features in isolation when attempting to increase the pedestrian priority of a pedestrian–vehicle space. Drivers may not perceive such minor changes.

- To clearly enhance the pedestrian priority of a shared pedestrian–vehicle space, a combination of features should be used. Multiple features have the ability to clearly signal a change in priority to both drivers and pedestrians.

- Pedestrian lines should be used in the design of pedestrian–vehicle spaces when attempting to enhance pedestrian priority. Pedestrian lines were the only feature that clearly signalled pedestrian priority to both drivers and pedestrians.

## Abstract

The aim of this study, carried out in 2003, is to provide information to improve the design of pedestrian–vehicle spaces used on New Zealand roads, so that pedestrian–vehicle conflicts are reduced. It examines the cues to priority given to both drivers and pedestrians using nine design features that are commonly used in pedestrian–vehicle spaces. Seventy-five participants were split into two groups to form a driver perspective group and a pedestrian perspective group. The groups received a series of randomly ordered photographs, taken from driver and pedestrian perspectives, where the nine features were graphically removed or added.

Results provide some evidence that tactile features send conflicting visual messages to pedestrians and drivers, whereas pedestrian lines send clear visual signals. Features in isolation enhance pedestrians' sense of priority but do not impact on drivers' perceptions. Multiple features should be used when designing shared pedestrian–vehicle spaces so that a clear change in the environment is signalled from both perspectives.

# 1. Introduction

Pedestrian–vehicle spaces, such as paved malls or raised traffic-calming speed humps, are popular internationally and have been shown to improve road safety by reducing vehicle speeds (Elvik 2001). While shared spaces and traffic calming clearly do increase safety overall, other studies have shown that poor design and understanding may reduce the potential safety benefits (James 1995; Sarkar et al. 1999; Sarkar 1995).

The overall goal of this research, carried out in 2003 in New Zealand, is to improve safety through the improved design of pedestrian–vehicle spaces. For the purposes of this study, a pedestrian–vehicle space is any space that could potentially be occupied by both a pedestrian and a motor vehicle simultaneously, therefore causing traffic conflict. Traffic conflict can be defined as a measure of the potential for a traffic accident, and occurs when a driver takes evasive action to avoid collision with a pedestrian (Cynecki 1980). Signalised crossings (such as those present at traffic lights) are not included in the scope of this research, because conflict at these crossings should not occur as a consequence of mixed messages over right of way.

Conflict can occur in pedestrian–vehicle spaces when a pedestrian and a driver both believe they have right of way, or when confusion exists over who has priority. An example of a confusing layout is where a traffic-calming speed bump or platform looks like a continuation of the footpath because it is set at footpath height. In such situations pedestrians may receive signals from the infrastructure that they have both a clear path and a right of way, while a motorist approaching from another direction sees the road as their path and that they have right of way. The result is a pedestrian–vehicle conflict. Figure 1.1 presents a good example of a pedestrian-vehicle space with conflicting perceptual cues. The confusion of the space has been addressed by the erection of a sign (Figure 1.2) which, being a post-hoc addition, suggests that the initial design of this space was problematic.

**Figure 1.1 An example of a pedestrian–vehicle space with conflicting perceptual cues.**

**Figure 1.2 A sign added to this pedestrian–vehicle space to alleviate confusing design.**

To reduce this confusion the features that are responsible for giving pedestrians and drivers conflicting messages about priority need to be identified. Also the features that are giving clear messages about priority to both pedestrians and drivers need to be known. In this way features can be identified as either increasing or reducing conflict between the users of the same space.

The aim of this research is to identify and evaluate the urban traffic design features responsible for giving various users of the road the impression of a path and right of way, and which design features clearly signal changes in the road environment and responsibility. More specifically, the research will identify which features promote pedestrian spaces, vehicle spaces, and neutral or shared spaces. This information will be particularly useful to anyone involved with urban design, as it will improve the quality and "fitness of use" of the roading infrastructure.

# 2. Background

## 2.1 From Woonerf[1] to Traffic Management

The concept of slowing motorised traffic to increase pedestrian safety has been around since private motor vehicle ownership gained popularity in the 1920s (see Stillings & Lockwood, 1999, for an early history). The increasing interaction between vehicles and pedestrians became a safety issue, and suggestions were made to implement physical modifications to the street to impede the speed of drivers and increase the focus on pedestrian traffic (Stillings & Lockwood 1999). Practical implementation was realised in The Netherlands in the late 1960s, where residential streets were modified so that features of the yard such as tables and planters interrupted the flow of cars, causing reduced vehicle speeds and a sense of pedestrian dominance (Kraay 1986). The concept of "Woonerven" or "living yards" was formed, where the home expanded into the street, and the street became a place where children could play and people in the neighbourhood could meet.

The areas of pavement and streetscape of the Woonerf signalled a change in environment. The large brick-paved areas, raised areas, and street furniture reduced vehicle speeds, typically to 15 kph, and signalled a pedestrian-friendly area that may be used by traffic as well as for playing, walking and parking. Traffic was calmed through mutual respect and courtesy for the other, more vulnerable, users of the space.

The resulting reductions in vehicle speeds and the overall change in environment greatly enhanced safety with injury-related collisions reducing by 15% (Elvik 2001). The lower vehicle speeds also contributed to a decline in the severity of the remaining crash-related injuries. Additionally, Woonerven were considered an attractive environment.

In 1976 the Dutch government formally endorsed the concept of Woonerven and, over the next decade, the idea spread to many other countries. Laws and regulations were changed to permit Woonerf designs in Germany, Sweden, Denmark, England, France, Japan, Israel, Austria, and Switzerland. By 1990, there were more than 3,500 shared streets in the Netherlands and Germany, 300 in Japan and 600 in Israel (Ben-Joseph 1995).

While Woonerven are the definitive shared space, providing improved road safety and quality of life, they are not a panacea. The extensive use of street furniture and paving meant that Woonerven were approximately 50% more costly to construct than normal street reconstruction. Also the reduction in vehicle speeds was typically only sustainable over short distances. This limited the application of Woonerven to local access streets with low traffic volumes. However, the safety benefits of Woonerven were desirable and the desire was to extend the concepts of Woonerven to a wider range of streets, at a lower cost.

[1] Woonerf (s), woonerven (pl) – from the Dutch meaning 'living yard(s)'

The creation of Woonerven is a complete "make-over", a package deal that is designed to change drivers' perceptions and behaviour to suit the environment through which they are travelling. To expand the concept to other road environments it was necessary to extract the essence of Woonerven, of their key components which are to slow down vehicle speeds, increase journey times and discourage through-traffic. Alternatives that offered similar benefits included the creation of circuitous routes by means of street closures and one-way streets (diversions), or the periodic use of speed-reduction features such as speed humps, slow points (chicanes[2]) and other physical measures (traffic calming).

Trials of each approach identified that, while circuitous routes may reduce through-traffic, these diversions had little impact on vehicle speeds. The traffic calming approach provided the most cost-effective means of treating neighbourhood streets. The Dutch government formerly endorsed the concept of traffic calming for neighbourhood streets in 1983 and other nations followed suit with: "stille reje" (silent roads) in Denmark; "Tempo 30" zones in Germany; and 20 mph zones in Britain. The immediate purpose of this neighbourhood traffic calming was to reduce traffic volumes and speeds to acceptable levels to improve road safety.

The primary function of distributor roads and arterials is to provide for the efficient movement of motor vehicles. Consequently the suppression of speed and reduction of traffic volumes is essentially incompatible with the function of arterial roads. However vehicle/vehicle and vehicle/pedestrian (and cyclist) safety issues are identifiable. While the traditional speed hump is not a suitable calming device, surface treatments, paving, flush medians, gateway treatments and refuges can all be used to order users' behaviour and to focus attention at specific locations in arterial roads.

The overall result has been the development of a hierarchy of treatments under the general heading of traffic calming (Austroads 1989) and a more generalised definition of traffic calming. "The combination of mainly physical measures that reduce the negative effects of motor vehicle use, alter driver behaviour and improve conditions for non-motorized street users" (Lockwood 1997) was the ideal.

This potted summary of the extensive body of literature on the development of traffic calming highlights a number of important issues related to the traffic-calming hierarchy:

- A progression ranging from an overall integrated concept (Woonerf) through groups of features (neighbourhood traffic calming) to essentially isolated features, already exists;
- This progression signals a shift in philosophy from safety based on mutual respect, through to the control of vehicle numbers and speeds;
- The progression reflects a shift in focus from pedestrians to vehicles;
- The progression highlights the trade-off required between pedestrian safety and traffic management.

[2] An artificial obstacle used in traffic planning.

**Figure 2.1 An example of a paved space that is shared by both pedestrians and vehicles.**

**Figure 2.2 Pedestrian's view of a paved traffic-calming speed hump.**

**Figure 2.3 Driver's view of a paved traffic-calming speed hump.**

Essentially the same features are used at each of these levels and as a result are required to transmit different messages regarding priority. A simplistic example would be the use of brick-paved surfaces. Within the Woonerf these paved surfaces are associated with pedestrian priority as shown in Figure 2.1. However, the same paving may be used to highlight a recommended crossing point on a distributor road as in Figure 2.2. In this situation the intention is to direct pedestrians to a crossing location and to warn drivers that pedestrians may be crossing the road at that point.

Unlike the Woonerf, in this kind of traffic calming, intuition to re-allocate priority in favour of the pedestrian is not explicit. Consequently in viewing the same situation but from the driver's view (Figure 2.3) you may rightly assume drivers retain priority.

The key issue is that individual features and groups of features may send different messages to different groups of road users and that these messages may well differ from those intended by the designer. The messages received by the two groups of road users are in conflict with each other. The objective of this research is to reduce such pedestrian–driver conflicts that occur as a result of the mixed messages conveyed by the features used in the design of shared spaces and traffic-calming schemes.

## 2.2 Features of Shared Spaces

Although a considerable volume of literature exists regarding shared spaces and traffic calming, the focus is mainly on the:

- Philosophy of shared spaces and traffic calming;
- Development of the concept of shared spaces;
- Design of the physical features that may be used;
- Role of included features and, in particular, the impact these features have on vehicular traffic.

Shared spaces and traffic calming have been effective in increasing safety, but this may just be the side effect of the reduction in vehicle speeds. Beyond the scope of speed reductions, little has been done to examine the physical, perceptual and psychological effects of:

- The elements used in the design of shared spaces;
- The impact on different user groups.

An examination of examples of traffic calming and shared space designs suggests common features may be grouped under the broad categories of:

- Vertical features – speed humps, platforms, kerbs and ramps;
- Horizontal features – such as chicanes or bends;
- Furniture – bollards, trees, street planters, lamp posts and/or posts;
- Surface features – pavement texture, colour surfacing and line markings;
- Controls – regulatory markings and signage.

The above categories describe the physical nature of the features. It does little to help designers understand how these features impact on users. In this respect the literature is disjointed and appears to focus on two issues:

- The role of physical features to control traffic speeds;
- The ideal qualities of pedestrian areas.

For example, Sarkar (1995) refers to the "soft separation" of traffic using three common physical measures:

- vertical changes in the road surface, such as raising the road to the level of the footpath;
- roadway construction, through the use of chicanes or bends; and
- traffic throttles, such as bollards, trees, street planters, barrels, lamp posts and other obstacles.

The intention of such features is to slow and calm the traffic. The alternative is a focus on the ideal qualities of pedestrian spaces such as directness of movement and path continuity (Braun & Roddin 1978). However, only a very limited number of studies have ever broached the issue of priority directly.

A change in vertical profile is a physical change that may influence the perceived user priority of a pedestrian–vehicle space. If the user of a space goes through a change in the vertical profile such as a raised profile like a speed hump, or a lowered profile like a kerb, priority may be reduced for that user. Dixon & Jacko (1998) found that vehicles are more likely to yield to pedestrians in the presence of a speed hump.

Sarkar (1995) mentions the use of psychological effects in the design of pedestrian–vehicle spaces, so that the entrances to a pedestrian–vehicle space can be emphasised through gateway effects created by vertical features such as pergolas, barriers, or planters. This gateway signals a change in the user's pathway, but the effect of a gateway on user priority is not established. Haus-Klau et al. (1992) also identify other physical elements that influence priority. They suggest that vertical elements such as trees, bollards and lamp posts emphasise the site and reduce traffic speed.

The use of line markings and texture changes can signal user priority either by creating clear user pathways or creating signals to yield, such as horizontal lines. The use of pavers has been strongly associated with pedestrian spaces, but this association may also transfer to any change in texture. Van Houten (1988) found that horizontal stop lines on the road were more likely to increase driver-yielding behaviour towards pedestrians and reduce pedestrian–vehicle conflicts and near-collisions. In a follow-up study Van Houten & Malenfant (1992) also found that "stop here for pedestrians" signs increased the likelihood of drivers yielding to pedestrians. Such informational signage (i.e. yielding signage and speed signage) will hold some influence over yielding behaviour depending on the nature of the sign.

Of importance is to note that the influence of signage, line markings, and vertical changes has been studied for vehicles yielding to pedestrians, but not vice versa. It should follow therefore that these features will also influence the yielding behaviour of pedestrians. However, drivers are faced with a barrage of signage and line markings that usually associate with stopping and yielding behaviour (such as give ways and stops at intersections), and pedestrians are not. Thus, the same features may not influence pedestrians. Both pedestrian and driver may have been exposed to the same visual stimuli, but may have been attending to different features of the environment because they had different uses for that environment at the time (Skinner 1976).

Cynecki (1980) identifies several features that have been implicated in altering the frequency of pedestrian–vehicle conflicts. Features associated with reduced conflict were: narrow road widths, pavement markings, pedestrian refuges/islands, pedestrian barriers, signage, and grade separation.

The key common features of pedestrian–vehicle spaces that may hold some influence over priority and conflict are: signage, presence of a gateway effect, line markings, texture changes, vertical changes, traffic throttles, width constrictions, and pedestrian refuges/islands. Previous research suggests that signage, line markings and vertical changes do influence yielding behaviour, but little is known about the affect of texture changes, traffic throttles, width constriction, and path continuity on user priority. These measures need to be examined from the different user perspectives.

## 2.3 Pedestrian–Vehicle Conflict Study

The current study presented footage[3] of pedestrian–vehicle spaces from both driver and pedestrian perspectives. The footage were primarily photographs, presented in a random order.

The independent variables examined were derived from the list of features implicated in the review of the literature (Table 2.1).

The *independent variables* examined were derived from the list of features implicated in the review of the literature, and are:

- Paving
- Elevation
- Texture
- Signage
- Tactile surface
- View through
- Colour
- Width
- Traffic throttle
- Driver lines
- Pedestrian lines

[3] Footage: used in this report as a collective term for still photos and video clips.

The *dependent variables* were:

- perceived priority (or right of way) of the user,
- clarity of right of way, and
- perceived level of comfort.

These features, dependent measures, and method of presentation were tested first on a focus group of public users of pedestrian–vehicle spaces, and second on a consultation group of architects, planners, and urban designers.

After thorough review of the features, footage was and graphically altered to provide a mixed presentation of all key features. Participants then rated each photograph in terms of perceived priority, clarity, and comfort.

This study aimed to identify the common features of pedestrian–vehicle spaces that:

1. Give priority to pedestrians and drivers simultaneously;
2. Cue pedestrian priority from both user perspectives;
3. Cue driver priority from both user perspectives;
4. Alter the clarity of right of way and the feeling of comfort.

# 3. Development of Method

To further validate the features identified by the review of the literature, and to examine the usefulness of the proposed tools used to measure pedestrian and vehicle driver priority, both a focus group and a consultation group met to test the method.

## 3.1 Focus Group

The purpose of the focus group was to test the measures of priority, and identify which features of pedestrian–vehicle spaces were important for cueing right of way for users. It was particularly important for the focus group to consist of members of the public who were normal users of such shared spaces.

Eight people of different ages and gender were selected to participate in the focus group. Participants' ages ranged from 16 to 72 ($M = 40.88$, $SD = 19.8$), six of them were male, and two were female.

Participants were given a description of the project, and pedestrian–vehicle spaces were defined, with examples. Participants were then given three sections in a questionnaire to work through. First, they were presented with questions to evaluate; second, they were asked to identify the ***key features*** apparent in pedestrian–vehicle spaces; and third, they were presented with a list of features to evaluate.

### 3.1.1 Evaluation of Questionnaire

Participants evaluated the 11-item scale, after which changes to the questionnaire were implemented. Appendix 1 provides more information regarding the questionnaire and logic behind the changes that were implemented to give the final version of the questionnaire that is given in Appendix 2.

### 3.1.2 Perceived Key Features

In the second phase of the focus group, participants were asked to identify what they thought were the key features that suggested either right of way or giving way. Participants were shown a mosaic of photographs first from pedestrian and then from driver perspectives to cue them to the types of features present at pedestrian–vehicle spaces (Figure 3.1). They were then asked to write down what they thought were the key features. They were not yet aware of the 11 key features that had already been identified by the researchers.

The features that participants observed aligned well with the features selected by the researchers. Both view-through and tactile features were the only features not reported by participants, though they identified two novel features: pedestrian refuges/islands, and triangular road markings (that are used to indicate a vertical change in the road surface to drivers).


**Figure 3.1 Mosaics of perceived key features for defining right of way or give way, from pedestrian (left) and driver (right) perspectives.**

### 3.1.3 Evaluation of Key Features

The third phase of the focus group involved presenting participants with the proposed 11 key features of pedestrian–vehicle spaces that had been identified by the researchers as having the ability to influence priority. These were:

- width change,
- driver lines,
- pedestrian lines,
- change in elevation,
- paving,
- change in surface texture,
- change in surface colour,
- traffic throttle (e.g. bollard, tree),
- signage,
- tactile feature, and
- view-through.

Removing signage and view-through from this feature list was recommended but driver lines, elevation and paving were identified as important to cueing a change in the environment and right of way. Appendix 3 gives for more information regarding the focus group's evaluation of features.

## 3.2 Consultation Group

The purpose of the consultation group was to identify and confirm which features of pedestrian–vehicle spaces were important for cueing right of way, and to examine the proposed method of presentation. It was particularly important for the consultation group to involve potential end users of this research.

Participants were made up of eight end users, including planners, road safety co-ordinators, traffic engineers, architects, and psychologists from Wellington City Council, Hutt City Council, Porirua City Council, LTSA, and Opus.

Participants were given an outline of the project and a description of the initial features that are common to pedestrian–vehicle spaces. They were also presented with some of the findings from the focus group.

The consultation group agreed that the medium of photographs was suitable, especially as the focus was on the specific features of the pedestrian–vehicle space. The medium of video footage includes the context surrounding the shared space which is likely to add to extraneous variables.

The method of graphically altering the photographs by adding and removing key features was appropriate, as it kept everything else constant and allowed a high level of control over extraneous variables.

The group also agreed that Signs, View-Through, and Triangular Markings should be removed from the feature list. Texture and Paving could be combined, but Colour should be kept separate. Tactile features should remain in the feature list, and a break or Gap in Driver Lines could be a very important cue, so should be added to the feature list.

### 3.3 Summary of Method Development

From the focus group discussions and responses, the 11 potential questions were narrowed down to 8 and reworded for clarity (Appendix 2). Several minor wording changes were implemented, and the scale itself was altered to change the semantic anchors to 'Strongly Agree' and 'Strongly Disagree'.

Driver lines, Elevation and Paving varied between the driver and pedestrian perspectives in terms of their ability to cue a change in the environment and right of way. These features initially appeared to be the most important to examine more closely.

The features that were discarded in the end were View-Through, Signs, and Triangular Markings. Texture was combined with Paving, and Traffic Islands and Gap were added to the feature list to leave the nine key features listed here:

- Paving/Texture
- Elevation
- Colour
- Driver lines
- Gap
- Width/Throttle
- Island/Refuge
- Tactile
- Pedestrian lines

The methodology was seen as appropriate, as was the use of control over the locations using the graphical addition and removal of features. This meant that the use of photographs was preferable to videotape, as adding and removing features to still photographs was easier than altering video clips.

# 4. Method

## 4.1 Participants

The sample was made up of 75 participants. Samples of convenience taken from two local community groups were used. Participants were chosen primarily to obtain a mix of different age groups and gender, because gender and age have been shown to influence the likelihood of pedestrians conflicting with vehicles (Dixon & Jacko, 1998; Khan et al. 1999; Kingma 1994; Connelly et al. 1998). Ages ranged between 8 and 85 ($\underline{M}$ = 33.5, $\underline{SD}$ = 21.4), and the sample was 54% male.

Participants in both these samples were given a brief description of the project aims before being split into two groups, each of which was to consider the key features from the two different perspectives of pedestrians and of drivers.

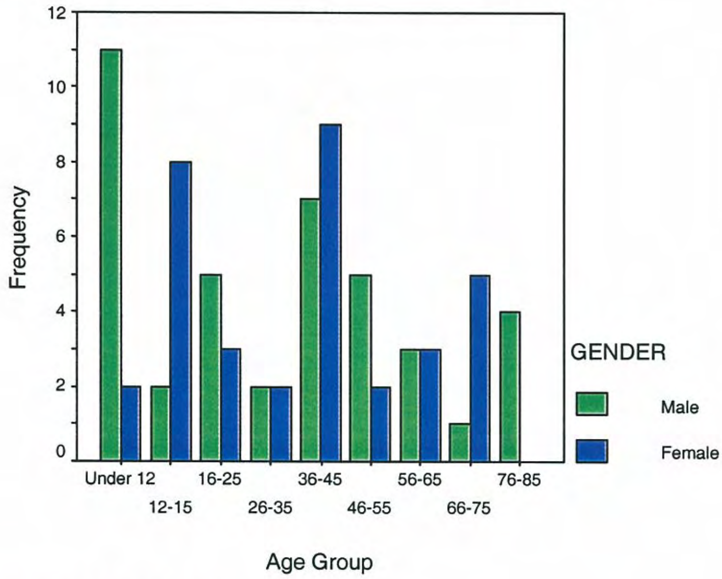



**Figure 4.1 Frequency of age groups by gender.**

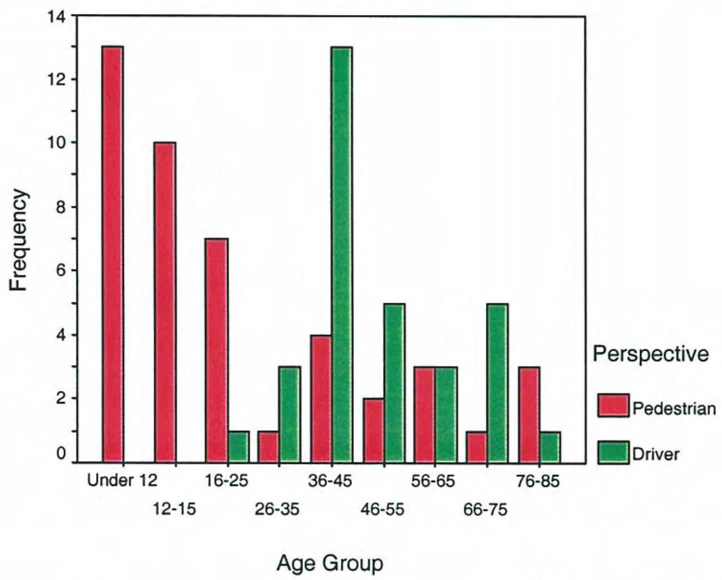



**Figure 4.2 Frequency of age groups for pedestrian and driver perspective groups.**

## 4.2 Key Features Examined

The nine key features to be examined are listed in Table 4.1 with a short written description of each feature.

**Table 4.1 The nine types of key features and their descriptions, used in the final questionnaire.**

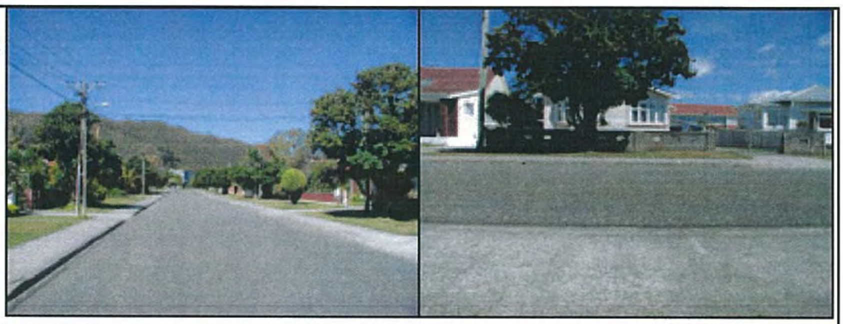
| List of features used in final questionnaire | Description of feature |
|---|---|
| 1. Paving/ Texture | Paving used to represent a texture change, as this is already associated with pedestrian spaces. |
| 2. Elevation | A raised platform or speed hump that is level with the footpath, but creates elevation from a driver perspective. |
| 3. Colour | Fading of colour from any paving or line markings resulting from normal wear caused by the passage of vehicles. |
| 4. Driver lines | Three white driving lane markings: of 2 edge-lane and 1 centreline markings. |
| 5. Gap | A gap in the centreline marking. |
| 6. Width/ Throttle | A reduction of the pathway from both perspectives, created by addition of bollards. |
| 7. Island/ Refuge | A traffic island with a pedestrian refuge (a gap in the island for pedestrians), placed in centre of road between driving lanes. |
| 8. Tactile | A small tactile surface consisting of small raised studs, used or signal presence of a kerb to blind or partially sighted pedestrians. |
| 9. Pedestrian lines | Two white pedestrian lane markings, to create a path for pedestrians that is perpendicular to the driver lines. |

To identify the impact of each individual feature as well as all combinations of features using a full factorial design was not envisaged, as it would require an excessive number of photographs of scenes. Rather a partial design was used, where the individual features were added and removed graphically from four selected scenes. The four baseline sites had zero features, four features, five features, and eight features (Figure 4.3).

Colour was not examined at the Zero-feature site because colour removal or fading in the photograph focuses on the fading of other features such as paving and pedestrian lines that in reality may fade over time if not maintained. This would require adding more than one feature at a time and, as only one feature could be added to the Zero-feature site at a time, colour could not be examined. Gap was not examined in the 8-feature site as it could not be viewed from the driver perspective because an island was present.

**Figure 4.3 The photographs of the four baseline sites (with Zero-, 4-, 5-, 8-features) taken from driver (left) and pedestrian (right) perspectives.**

Zero-feature site (Lower Hutt): to which 8 features will be added by graphical alteration. Colour was not examined at this site.



4-feature site (Petone): from which four features (Tactile, Elevation, Island, and Width Reduction) will be removed.

5-feature site (Porirua): from which five features (Paving, Pedestrian Lines, Driver Lines, part of the Driving line to create a Gap, and Colour) will be removed.

8-feature site (Wanganui): from which eight features will be removed. Gap was not examined at this site.

The graphical alteration of the photographs enabled any variation caused by the individual feature to be isolated. An example of removing a Tactile feature is shown by the scene in Figures 4.4 and 4.5. Appendix 4 gives pictorial examples of each of the nine feature-type alterations.

In addition, the use of the four baseline sites allowed examination of whether the number of features present in a pedestrian–vehicle space had effects on priority, clarity, or comfort.

A typical New Zealand pedestrian crossing site (i.e. a zebra crossing) was also used to test the sensitivity of the scales to variation in priority. If there were no differences in priority-scale scores between a Zero-feature road (where priority should favour the driver) and a pedestrian crossing (where priority should favour a pedestrian), then the usefulness of the scales as a predictor of priority may be questionable. In addition three photographs of existing scenes and three sets of video footage were included to examine contextual effects.

**Figure 4.4 Pedestrian–vehicle space with tactile surfaces.**

**Figure 4.5 Pedestrian–vehicle space with tactile surfaces removed.**

## 4.3 Questionnaire

The questionnaires measured three primary dependent variables: priority, clarity, and comfort of right of way. These measures were given to both the driver and pedestrian groups for each presented photograph or video presentation through a series of eight items (Appendix 2).

Six items out of eight focused on priority such as *"Whose space is this"* or *"A pedestrian/driver will stop for me if I move to cross this space."* These combined to form a priority scale.

One item examined the clarity of the cues to right of way *"I am not sure who has right of way"*.

One item examined the level of comfort when entering the pedestrian–vehicle space, *"How comfortable do you feel driving into this space?"*

All eight items used a continuous scale numbered from 0 through to 10 with semantic anchors at the ends and middle of the scale. The same eight items were presented for each group but worded differently to take into account the different perspective. The survey was made up of thirty-three different pictures and three video clips.

Six items were also used to identify driving experience, exposure to pedestrian–vehicle spaces from both driving and walking perspectives, as well as demographic information regarding age, gender, and locality type.

After assessing the results, items 1, 2, 3, 5, and 8 were combined and averaged to form a priority scale. Item 4 was deemed too inconsistent to be used within the scale. Item 5 was reversed from the pedestrian perspective, and items 1, 2, 3 and 8 were reversed from the driver perspective to form the scale of priority.

The priority scale ranged from 0 to 10, with high scores on the priority scale indicating driver priority, scores around 5 indicating neutral/no clear priority, and low scores indicating pedestrian priority.

## 4.4 Procedure

The participants in the two samples of convenience taken from local community groups, were given a brief description of the project aims before being split into two groups. One group was asked to put themselves in the mindset of a pedestrian and viewed only pedestrian perspective footage. The other group did likewise, but from the mindset of a driver, and viewed only driver perspective footage.

Each group was presented first with the pedestrian crossing site followed by the no-feature road site to give them an idea of the parameters of the pedestrian–vehicle spaces they would be presented with. They were then presented with a randomly ordered set of 31 different photographs, followed by the three video presentations. One randomly selected photograph was repeated so that it was placed early and late in the presentation to check for fatigue effects and internal consistency.

In the initial presentations the slowest participants took about 4-5 minutes to answer the set of 8 items for each photograph. Once participants became familiar with the task they were all able to answer the sets of questions in approximately 1.5 minutes. The entire process, including the introduction and splitting into groups, took approximately 1.5 hours.

# 5. Results

For all statistical analysis an alpha level was set at .05. The priority scale ranges from 0 to 10, with high scores on the priority scale indicating driver priority, scores around 5 indicating neutral/no clear priority, and low scores indicating pedestrian priority.

## 5.1 Differences between Perspective Groups

Differences between the driver and pedestrian perspective groups were examined using independent samples t-tests. Perspective groups varied in average comfort ($t$ (73) = –4.277, $p < .001$) and average clarity ($t$ (73) = –3.305, $p > .05$). Those in the driver groups were on average more comfortable and received clearer cues to right of way than the pedestrian groups. A difference related to age was identified between the perspective groups ($t$ (73) = –4.929, $p < .001$), with the pedestrian group being younger as expected. A Pearsons correlation found no gender difference between the groups ($r$ (74) = 0.067, $p > .05$).

All significant differences on the priority scale between groups found the pedestrian group giving higher priority ratings to vehicles (Appendix 5). This may indicate more caution by vulnerable pedestrians.

### 5.1.1 Zero-feature Site

For the Zero-feature site the average priority for both pedestrians and drivers is well over 5, suggesting that both perspective groups believe drivers have priority (Figure 5.1). The Zero-feature road with no features added, the Zero-feature road with the addition of an island, and the Zero-feature road with a width reduction were all rated higher by the pedestrian group in terms of driver priority.

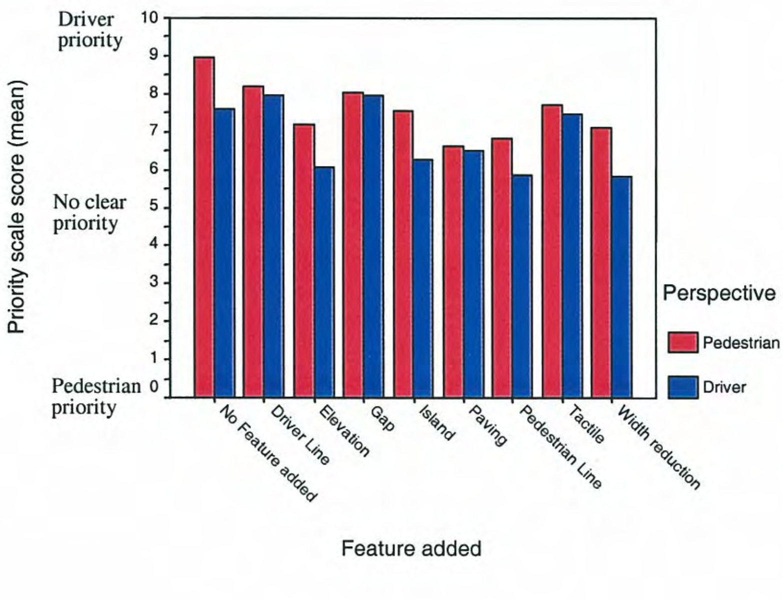



**Figure 5.1 Priority scale score means for the Zero-feature site after addition of each of the eight different feature types, for the pedestrian and driver perspective groups.**

### 5.1.2 8-feature Site

For the fully developed 8-feature site with all eight design features present, pedestrians rate priority as over 5 but drivers rate priority as under 5, suggesting that each group is in favour of giving way to the other group (Figure 5.2). The only feature not rated significantly higher in terms of driver priority by pedestrians was the removal of Elevation. Gap is not included.

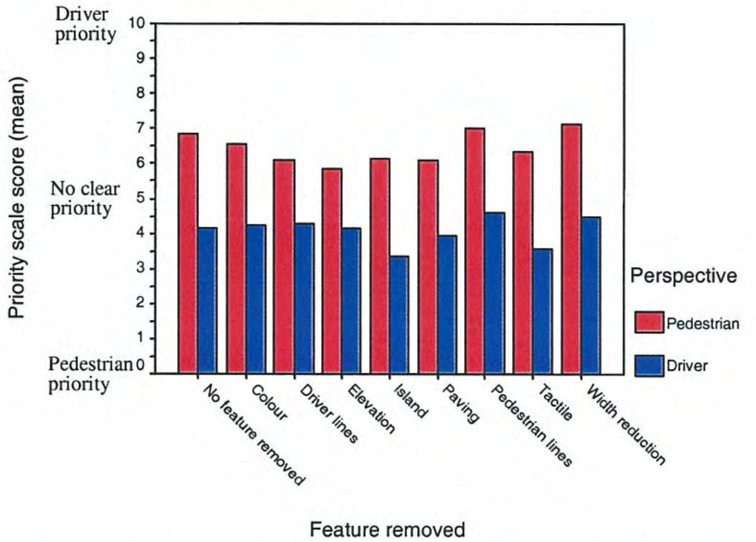



**Figure 5.2 Priority scale score means for the 8-Feature Site after removal of each of the eight different feature types, from both pedestrian and driver perspectives.**

### 5.1.3 5-feature Site

The 5-feature site, with Colour, Driver lines, Gap, Paving and Pedestrian lines, had priority scores over 5 from a pedestrian perspective and under or around 5 from a driver perspective (see Figure 5.3). The removal of Paving, placing a Gap in the driver line, fading the Colour of the pedestrian–vehicle space, and removing nothing, all found the pedestrian group rating driver priority significantly higher than the driver group.

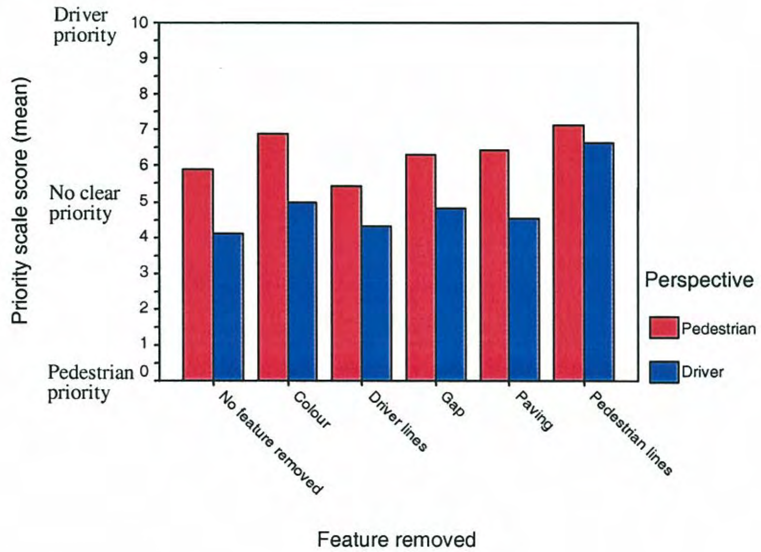



**Figure 5.3 Priority scale score means for the 5-Feature Site after removal of each of the five different feature types, from both pedestrian and driver perspectives.**

### 5.1.4 4-feature Site

The 4-feature site, with Elevation, Island, Width reduction, and a Tactile feature, was rated as over 5 on average, for both groups meaning that they still believe drivers have priority at this site (Figure 5.4). The removal of the Tactile feature, an increase in Width, and no removal of features all showed the pedestrian group to give significantly higher driver priority rating than the driver group at this site.

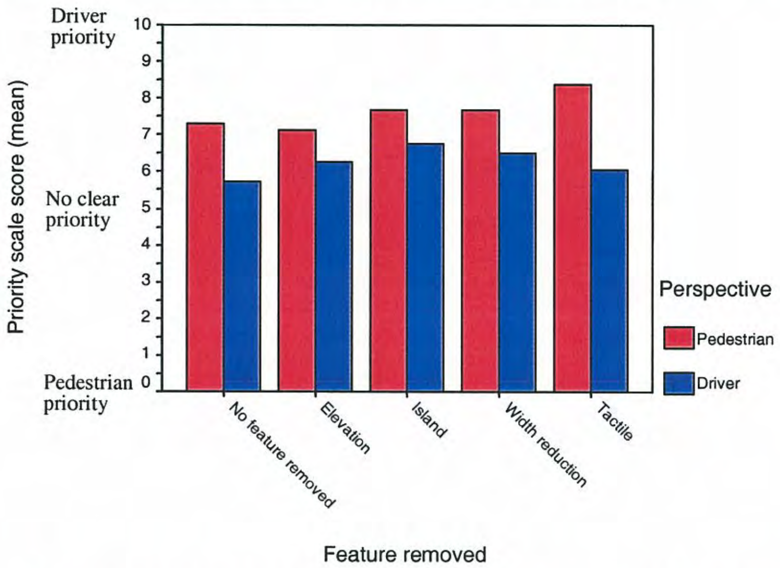



**Figure 5.4 Priority scale score means for the 4-Feature Site after removal of each of the four different feature types, from pedestrian and driver perspectives.**

## 5.2 Differences within Sites

Repeated measures multivariate analyses of variances (MANOVAs), with age as a covariate, were used to examine differences in priority, comfort and clarity within each site. No differences were found in measures of comfort or clarity when a feature was either added to the blank road, or removed from the 8-feature, 5-feature and 4-feature sites, from either pedestrian or driver perspective ($p > .05$).

### 5.2.1 Zero-feature Site

A repeated measures MANOVA, with age as a covariate, found significant differences in ratings of priority between the Zero-feature pictures from both pedestrian ($F(5,207) = 13.455$, $p < .001$) and driver perspectives ($F(5,207) = 13.455$, $p < .01$). The only feature added to the blank road from the pedestrian perspective pictures that did not significantly increase pedestrian priority was Driver lines (Figure 5.5). Significant reductions in priority scores were obtained when any one of Elevation, Gap, Island, Paving, Pedestrian lines, Tactile, or Width reduction, were added to the blank road. When adding one feature to the blank road from the driver perspective, none of the features significantly altered priority (Figure 5.5). These findings suggest that pedestrians may be more sensitive to the common features of pedestrian–vehicle spaces than are drivers.

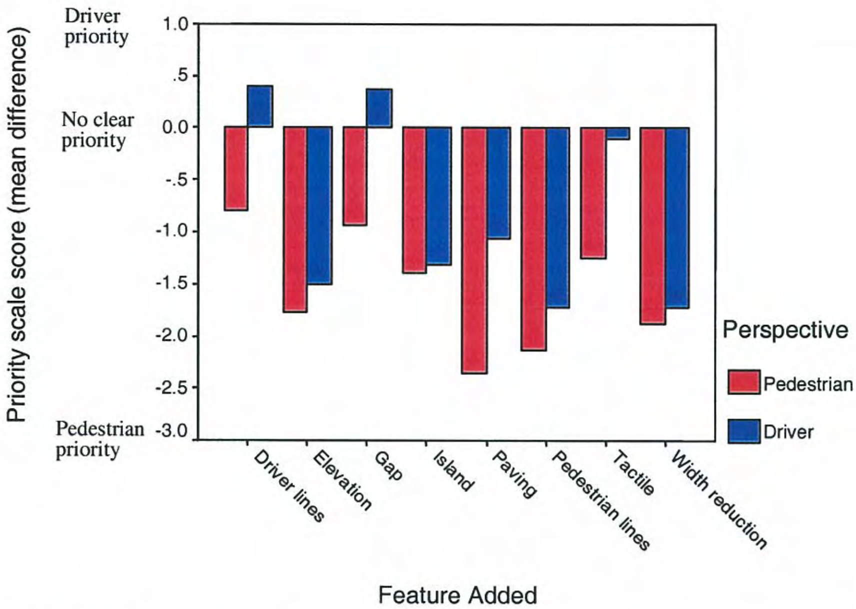



**Figure 5.5 Mean change in priority when adding each of eight features to the Zero-Feature Baseline Site for pedestrian and driver groups.**

### 5.2.2 8-feature Site

The 8-feature site pictures were significantly different from the pedestrian perspective ($F$ (5,199) = 2.452, $p < .05$), but not significant from the driver perspective ($F$ (4,48) = 1.554, $p > 0.05$). The removal of one feature from the full 8-feature picture did not significantly alter priority from either perspective (Figure 5.6). This suggests that the 8-feature site is so saturated with features that a change may not be noticed by anyone.

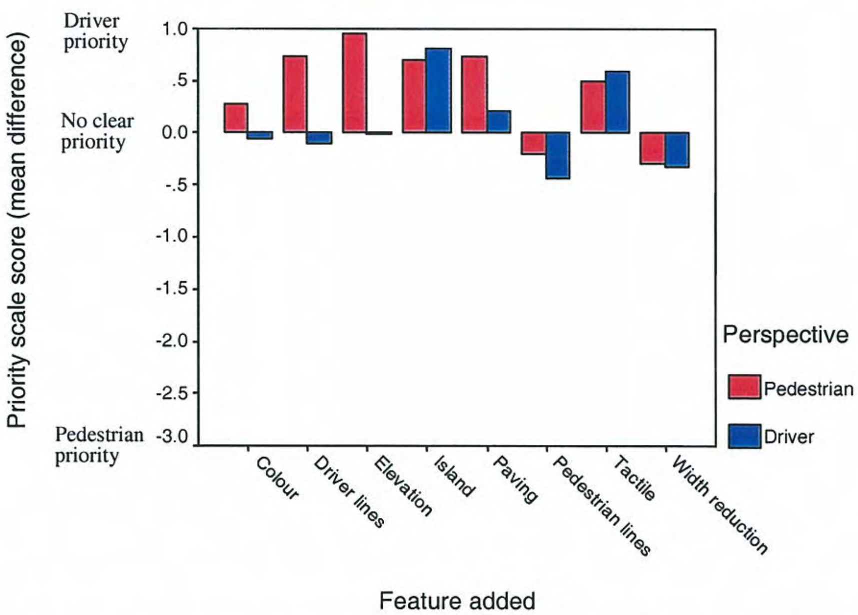



**Figure 5.6 Mean change in priority when adding each of eight features to the 8-Feature Baseline Site for pedestrian and driver groups.**

### 5.2.3 5-feature Site

In the 5-feature site, significant differences in priority were obtained between pedestrian perspective pictures of the site ($F$ (4,167) = 5.978, $p < .001$). Fading the Colour and adding Pedestrian lines both increase pedestrian priority from a pedestrian perspective (Figure 5.7). Driver perspective pictures of the site were also significantly different ($F$ (4,125) = 2.423, $p < .05$), with the removal of Pedestrian lines increasing pedestrian priority from a driver's perspective (Figure 5.7). Pedestrian lines were the only feature that increased pedestrian priority from both perspectives.

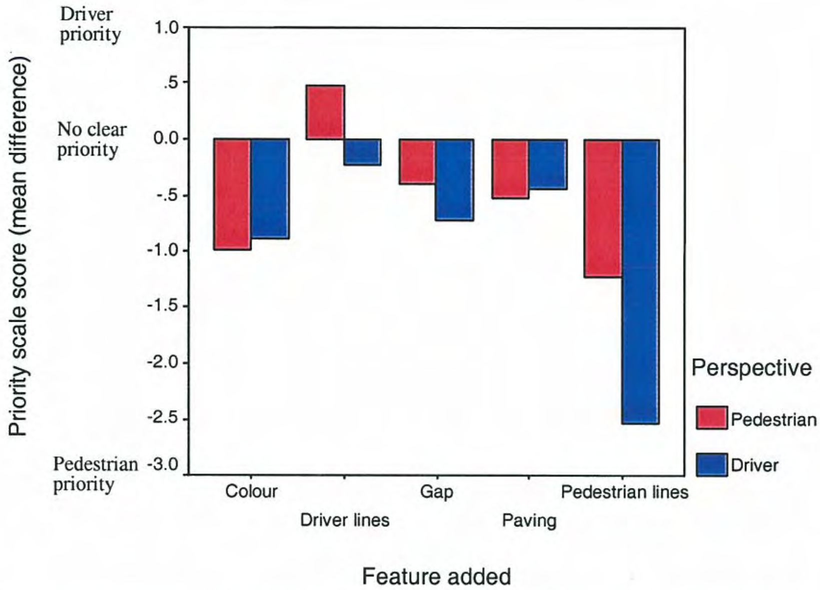



**Figure 5.7 Mean change in priority when adding each of five features to the 5-Feature Baseline Site for pedestrian and driver groups.**

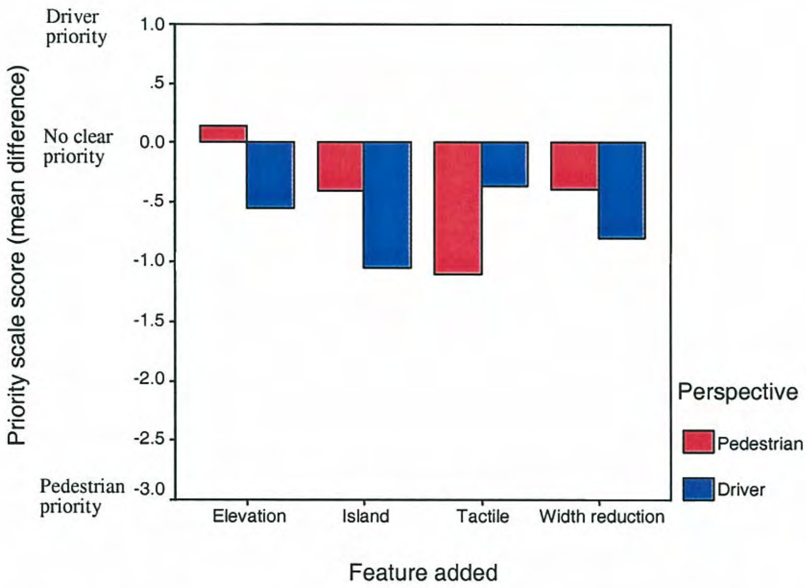



**Figure 5.8 Mean change in priority when adding each of four features to the 4-Feature Baseline Site for pedestrian and driver groups.**

### 5.2.4 4-feature Site

For the 4-feature site, significant differences in priority were found between pedestrian perspective pictures of the site ($F$ (3,103) = 12.205, $p < .001$). The removal of the Tactile surface increased pedestrian priority from a pedestrian perspective (Figure 5.8). The driver perspective pictures were not significantly different for the 4-feature site ($F$ (3,83) = 0.791, $p > .05$) (Figure 5.8).

## 5.3 Differences between Sites

A typical pedestrian crossing (known as a Zebra crossing) was included in the analysis of the difference between sites.

Repeated measures MANOVAs found significant differences in ratings of priority between the different sites (Figure 5.9). From the pedestrian perspective ($F$ (4,69) = 9.036, $p < .001$), the typical pedestrian crossing rated lower than all other sites and the Zero-feature site rated higher than all other sites in terms of driver priority. From the driver perspective ($F$ (3,37) = 4.172, $p < .05$), the pedestrian crossing rated higher in pedestrian priority than all other sites, and the Zero-feature site rated higher than the 8-feature and 5-feature sites in terms of driver priority.

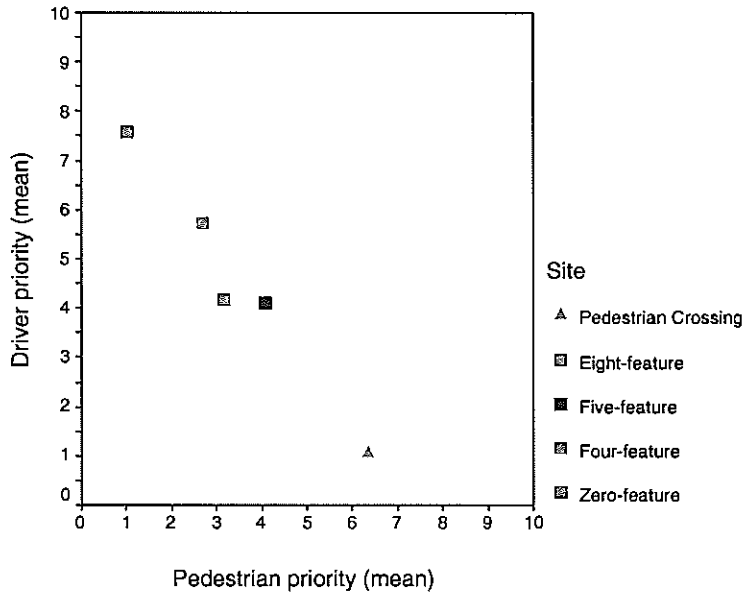



**Figure 5.9 Scatter plot of mean priority ratings for right of way made by drivers and pedestrians, at the four baseline sites. and at the pedestrian crossing.**

As shown below in Figure 5.10, clarity about who has right of way does not differ significantly between sites ($p < .05$).

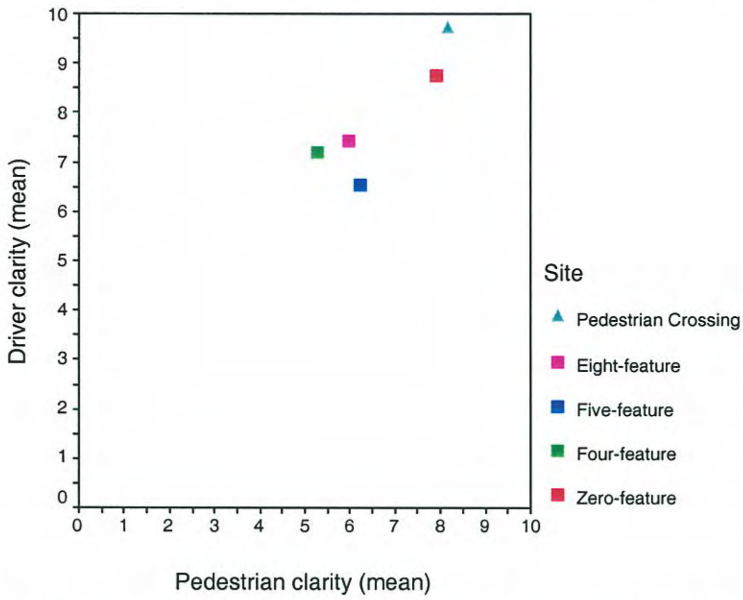



**Figure 5.10 Scatter plot of mean clarity ratings for right of way made by drivers and pedestrians, at the four baseline sites, and at the pedestrian crossing.**

Figure 5.11 shows that the different sites varied in comfort from a pedestrian perspective ($F$ (7,112) = 2.113, $p < .05$) but not from a driver perspective ($F$ (3,37) = 0.779, $p > .05$). Post-hoc tests revealed that from the pedestrian perspective, the pedestrian crossing is more comfortable to enter compared with the Zero-feature site and the 4-feature site ($p < .05$).

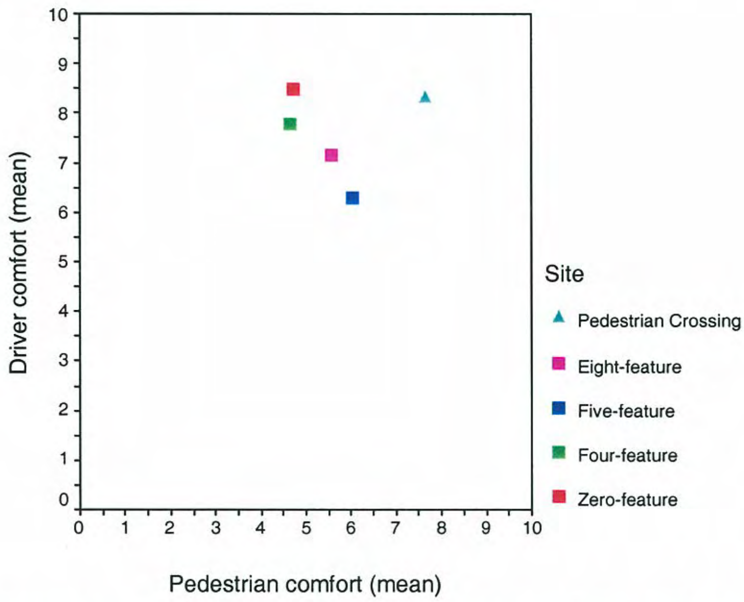



**Figure 5.11 Scatter plot of mean comfort ratings for right of way made by drivers and pedestrians, at the four baseline sites and at the pedestrian crossing.**

## 5.4 Differences in Samples

Independent samples t-tests found no differences between the two samples of convenience when comparing average scores on the priority scale, as well as the overall average scores on comfort and clarity ($p > .05$). There are no differences in gender between the samples, but there is an age difference, with the first sample being younger than the second sample ($t$ (73) = –2.035, $p < .05$).

## 5.5 Differences in Age Groups

No age differences for measures of priority, clarity or comfort were observed from a driver perspective ($p > .05$). From the pedestrian perspective, age showed no relationship with clarity ($r$ (44) = 0.596, $p < .001$), but age positively correlated with priority ($r$ (44) = 0.596, $p < .001$), and negatively correlated with comfort ($r$ (44) = -0.435, $p < .01$). This means that as pedestrian age increases, pedestrians are more likely to give way to drivers and the pedestrian is more likely to feel uncomfortable when entering a pedestrian–vehicle space.

## 5.6 Consistency of Responses

One picture was repeated later in the procedure to check internal consistency of the participants' responses. Repeated measures t-tests found no differences within subjects for priority, clarity or comfort ($p > .05$).

## 5.7 Footage Type

The footage used, whether photograph or video clip, did not show significant differences in priority, clarity or comfort for the pedestrian crossing from either perspective (Figure 5-12). Likewise, no difference was noted in the dependent measures between footage types for an actual pedestrian–vehicle space, which featured Elevation, Tactile surfaces, Pedestrian lines, Driver lines, Width change, and a Traffic island. There was a difference in priority between video and photographs for the Zero-feature road from the pedestrian perspective. The pedestrian group rated the picture higher for driver priority compared with the video for the Zero-feature site (t (18) = 3.028, p < .01). The pedestrian group also rated the picture higher for clarity of right of way than the video for the Zero-feature site (t (18) = 2.669, p < .05). There were no differences in priority, clarity or comfort for the Zero-feature site from a driver perspective.

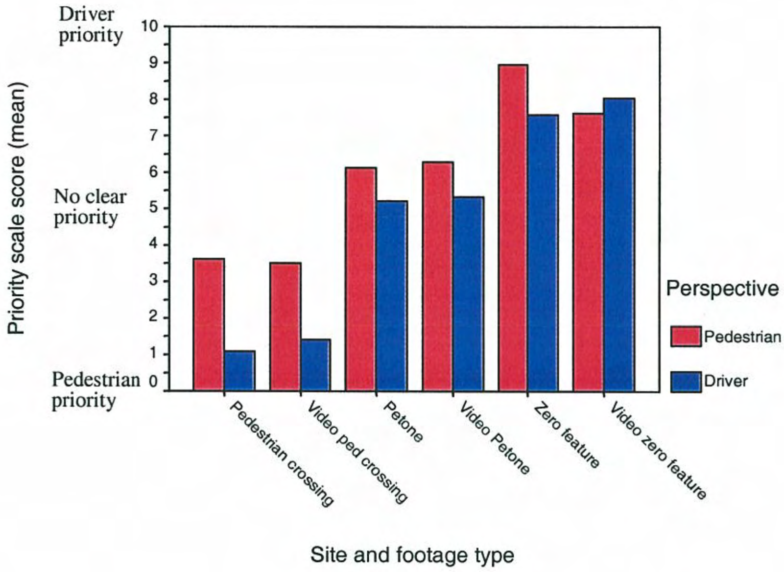



**Figure 5.12 Priority scale score means for the different types of footage for the pedestrian and driver perspective groups.**

# 6. Discussion

## 6.1 Perception of Priority between User Perspectives

Overall, there is a difference between pedestrians' and drivers' perceptions of priority when entering the same space. The difference indicates increased caution when entering a pedestrian–vehicle space, as each group is giving greater priority to the other.

There are two explanations for the difference. It may be that drivers are highly cautious when entering a space that could be entered by a pedestrian, and cede priority to pedestrians.

Alternatively, pedestrians may feel vulnerable when entering a space that could be occupied by a vehicle, and cede priority to drivers. There is evidence for the pedestrian vulnerability explanation, as pedestrians rate clarity and comfort lower when entering a pedestrian–vehicle space, compared with drivers.

Whatever the reason, the difference in ratings of priority is consistent between drivers and pedestrians, and could be interpreted in two ways. First, the difference could be seen as increasing safety for that pedestrian, as one perspective group is more likely to give way to the other. Second, the difference could be seen as a traffic management issue, as the users of the space are being overly cautious, and may consequently slow the flow of traffic through the site.

## 6.2 Perception of Comfort and Clarity

Drivers overall feel more comfortable entering pedestrian–vehicle spaces compared with pedestrians. Drivers also believe they are getting clearer cues that they have right of way compared with pedestrians. Contrary to this, when features of pedestrian–vehicle spaces are changed, drivers are less sensitive to the resultant change in priority than pedestrians. The lack of driver sensitivity was particularly evident when a feature was added to the Zero-feature site. There the addition of a feature had a considerable influence from a pedestrian perspective by increasing pedestrian priority, but it did not register as a change in priority from a driver perspective.

## 6.3 Effects of Changing Key Features

The use of a single feature in isolation to change the priority of a Zero-feature road should be avoided. Drivers did not significantly alter their perceived priority when any of the single features were added to the Zero-feature site. Drivers are not sensitive to minor changes in the driving environment, and may require several features to be present before they clearly register any enhancement in pedestrian priority.

When a feature is removed from a 4-feature or 5-feature space, a change in priority compared to the change for the Zero-feature site is more likely from both perspective groups. Therefore, drivers are more likely to recognise priority changes when multiple features are present in the pedestrian–vehicle space.

When a feature is removed from an 8-feature space, neither perspective is likely to perceive a change in priority. There appears to be a ceiling effect to priority. Redundancy caused by the presence of too many features may reach the stage where the space becomes visually "cluttered", and in the worst cases cause fragmentation of user pathways (James 1995). There is, however, no evidence of reduced clarity for the 8-feature site.

## 6.4 Changes in Key Features

More specific findings, relating to the changes caused by the individual key features, provide evidence that changes in the features themselves, such as the fading of Colour and the use of Tactile features in a pedestrian–vehicle space, give stronger signals of pedestrian priority to pedestrians. This could therefore lead to conflict between the driver and pedestrian groups. The use of Pedestrian lines in a pedestrian–vehicle space however cues pedestrian priority from both driver and pedestrian perspectives. None of the nine features cued driver priority, and none of the nine features individually altered clarity over right of way or comfort from either perspective.

*Use of Tactile Features*

The use of Tactile features in a pedestrian–vehicle space enhances pedestrians' perceived priority, but does not impact on perceived priority from a driver perspective. The conflicting priority messages sent by Tactile features occurred in both the Zero-feature site and the 4-feature site. This finding indicates that the addition of a Tactile feature will increase the probability of a pedestrian entering the pedestrian–vehicle space without reducing the probability a driver will enter the pedestrian–vehicle space. The ambiguity caused by the Tactile feature may consequently lead to increased conflict between pedestrians and drivers.

The Tactile feature used in this experiment was a conspicuous yellow colour, and as such strongly indicates a crossing point from a pedestrian perspective. However, from a driver perspective, the angle at which the Tactile feature is viewed when approaching a pedestrian–vehicle space, combined with the fact that the object may be partially blocked by other features (such as bollards) from a driver perspective, may cause the feature to be less noticeable.

The use of tactile paving is primarily to advise blind or partially sighted people that they are approaching a roadside kerb. Therefore, abolishing the use of tactile features is not really an option, as it may cause safety issues where visually impaired pedestrians are concerned.

One alternative would be to make the tactile feature more conspicuous from a driver perspective. However, given that the colour of the Tactile feature altered in this study was bright yellow, this is unlikely to be an easy alternative to accommodate.

An alternative would be to reduce the visual salience of the Tactile features, which would reduce ambiguity without interfering with the function of the tactile surface. As Tactile features of a similar colour to the footpath are already in use this should not be an issue.

Therefore the use of inconspicuous Tactile surfaces should be examined as they may provide the same function without giving conflicting priority messages.

***Use of Colour Features***

The fading of colour in pedestrian lines and paving in a pedestrian–vehicle space, cues priority towards pedestrians from a pedestrian perspective, but does not alter priority from a driver perspective. Therefore, when colour fades, the probability that a pedestrian will enter a pedestrian–vehicle space increases, without decreasing the probability that a driver will enter the pedestrian–vehicle space. This finding only occurred in the 5-feature site, as colour was not examined in the Zero-feature site.

This finding is counterintuitive, as the fading of Colour was expected to increase driver priority from a driver perspective and reduce pedestrian priority from a pedestrian perspective. This is because the Pedestrian lines and Paving features were expected to enhance pedestrian priority, and when these features are faded, pedestrian priority was expected to reduce. Counter to this, pedestrian priority was found to increase. There is no apparent explanation for the seemingly contrary finding.

Nonetheless, the results do provide evidence for conflict when colour fades. Over time, features such as Pedestrian lines and Paving fade because of tyre marks. To remove this conflict, the maintenance of features of pedestrian–vehicle spaces could be regulated so that they stay bright and clear. Further investigation of the effect of fading colour in pedestrian–vehicle spaces is needed in order to warrant more stringent regulation over the maintenance of pedestrian–vehicle spaces.

***Use of Pedestrian Lines***

Pedestrian lines were the only feature to cue pedestrian priority exclusively. Pedestrian lines, the pair of lines that cross the entire width of the drivers' pathway horizontally (much like the give-way line, but across the entire width of the road), essentially form a pathway for pedestrians and a barrier to drivers. In the Zero-feature site they increased pedestrian priority from a pedestrian perspective, and in the 5-feature site they increased pedestrian priority from both driver and pedestrian perspectives. Pedestrian lines were the only feature examined that was able to alter priority from a driver perspective.

Drivers already attend to take heed of lines similar to Pedestrian lines at intersections, in the form of give-way and stop-line markings, which they associate with yielding behaviour.

Previous research also indicates that the use of Pedestrian lines increases driver-yielding behaviour towards pedestrians, and reduces pedestrian–vehicle conflicts (Van Houten 1988). Therefore, to increase the pedestrian priority of an existing space, or design for a pedestrian-dominated space, Pedestrian lines should be implemented.

*Use of Elevation*

The findings of this research do not support previous research suggesting that the use of elevated platforms at crossing points will increase yielding behaviour in drivers (Dixon & Jacko 1998). Elevation did not significantly influence perceptions of priority from either perspective. Factors outside the scope of visual cues, such as physical or tactile information, may be required before Elevated platforms will influence priority.

## 6.5 Study Procedure

***Limitations***

A necessary limitation to this study was that the context surrounding the site was controlled. This meant that a number of factors already identified as relating to yielding behaviour, such as the surroundings leading up to the pedestrian–vehicle space, and the volume of total users, were not examined (Hine 1996; Braun & Roddin 1978).

A further limitation was that cyclists were not included in the scope of this research. As another road user, a cyclist perspective could have been examined but the difficulty of the negotiation of the features examined from a cyclist perspective may have confounded the results. Also the primary focus was on reducing conflict between pedestrians and motor vehicles, as these accident types have more serious repercussions.

***Consistency in this Study***

Controls were used to examine internal consistency, fatigue effects, and footage type. Repeating a picture in the presentation showed participants gave good internal consistency and also found no evidence of fatigue effects. This indicated that the length of the presentation had not led to any error. Video footage only differed for the Zero-feature road from a pedestrian perspective, and only varied in terms of the clarity of the cues. The addition of the binocular depth cues received from video footage only served to reduce the clarity over right of way. This suggested that pictorial presentation, where only monocular cues were present, was more effective from a pedestrian perspective. The footage type had no effect on any of the dependent measures from a driver perspective. Overall, the method of presenting the footage, by video or picture, had little effect on the participants, but some evidence indicated that photographic presentation was preferable to video from a pedestrian perspective.

The survey instrument showed significant variation of responses between photographs. The combined priority scale was sensitive enough to pick up changes in perceived priority, not only between the extremes of the pedestrian crossing and the

Zero-feature road, but it also picked up the subtler changes in priority caused by individual features.

None of the feature additions or removals significantly altered feelings of clarity over right of way, or feelings of comfort when entering a pedestrian–vehicle space, from the perspective of either driver or pedestrian. Individual feature changes may have been too subtle to be detected on these scales. However, as changes in comfort were detected between sites, this is unlikely.

# 7. Conclusions

- When attempting to enhance the pedestrian priority of a space, the use of single features in isolation sends conflicting messages to both pedestrians and drivers. Minor changes to a space enhance pedestrians' sense of priority without impacting on drivers' perceptions of priority. Therefore, the use of single features should be avoided, as drivers are not sensitive to the single feature change, and conflict may arise.

- Altering a driver's perceptions of priority is difficult, and may require a large change in the driving environment. Multiple features should be used to clearly signal an increase in the pedestrian priority of a space to both driver and pedestrian user groups.

- The use of visually conspicuous tactile features in a pedestrian–vehicle space gives conflicting visual cues to driver and pedestrian groups. Tactile features increase pedestrians' sense of priority but do not impact on drivers' sense of priority. The removal of tactile features may lead to other safety issues.

  One solution is to use visually inconspicuous tactile surfaces that may not send conflicting priority messages, but will provide non-sighted pedestrians the tactile cues required to indicate the presence of a road.

- The fading of colour in paving and line markings caused by wear may lead to conflict. This finding should be treated with care, and further investigation needs to occur to warrant more stringent regulation over the maintenance of pedestrian–vehicle spaces.

- The use of pedestrian lines in a pedestrian–vehicle space clearly signals pedestrian priority to both drivers and pedestrians. Pedestrian lines should be used when attempting to enhance the pedestrian priority of a pedestrian–vehicle space.

- Evidence is that pedestrians are cautious when entering pedestrian–vehicle spaces. Pedestrians feel less comfortable, and believe they receive lower clarity over right of way, when entering a pedestrian–vehicle space.

# 8. Recommendations

- Avoid using single features in isolation when attempting to increase the pedestrian priority of a pedestrian–vehicle space. Drivers may not perceive such minor changes.

- To clearly enhance the pedestrian priority of a shared pedestrian–vehicle space, a combination of features should be used. Multiple features have the ability to clearly signal a change in priority to both drivers and pedestrians.

- Pedestrian lines should be used in the design of pedestrian–vehicle spaces when attempting to enhance pedestrian priority. Pedestrian lines were the only feature that clearly signalled pedestrian priority to both drivers and pedestrians.

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# Appendix 1: Evaluation of Focus Group Questionnaire

## Evaluation of Questions

For all statistical analysis an alpha level was set at .05. Questions 1, 2 and 4 were reversed for the analysis. High scores on questions 1-8 indicate low user priority.

Participants were shown how to use the 11-point continuous scale. They were then told to put themselves in the mindset of a pedestrian and were presented with a pedestrian perspective picture and 11 scale items to respond to for that picture (see Appendix 1). Two further pedestrian pictures were presented and participants answered 11 questions for each of these pictures as well. The pictures were chosen on the basis that they would likely vary in terms of which perspective group had priority. At the end of this process participants were asked to comment on the questions. Did the questions make sense? Were they easily understood? Which questions were redundant?

Participants were then told to put themselves in the mindset of a driver and asked to go through the same process pictures taken from a driver's perspective. The 11 scale items were reworded to accommodate a driver perspective.

At the end of this process several minor wording changes were suggested, including the removal of negatively worded questions such as *"A change in your walking behaviour is not necessary"* by removing the 'not'. Also, the change was made from pronouns ("You") to personal pronouns ("I").

Question 7 for the driver scale, *"A learner driver should slow down and pay more attention to pedestrians"*, was altered to *"A driver distracted by children in the back seat would not realise they were entering a pedestrian space"* to better match the pedestrian version of Question 7, *"A young child would not realise they were crossing a road"*.

The scale itself was altered to change the semantic anchors of 'Very weakly' and 'Very Strongly' to 'Strongly Agree' and 'Strongly Disagree'. The 'Not sure/Neutral' option was altered from the scale to leave just 'Neutral'. It was determined that the clarity of priority instilled by the features should be examined by a separate question: "It is unclear who has right of way".

One-way Analysis of Variance (ANOVAs) found that questions 4, 6, 7, 8, 9, 10, and 11 varied significantly across the three pedestrian photographs. The photographs were chosen to vary in terms of the priority cues they gave to each group. It was assumed that high variation in question responses was indicative of a good question as respondents picked up the variation in priority caused by the picture. These questions show good variation between the different sites, and should remain in the survey instrument. Questions 1, 2, 3, and 5 did not vary significantly across the three pedestrian photographs, and should be examined for removal.

ANOVAs found no significant variation between the three driver perspective pictures for any of the questions. This may suggest that the responses to questions do not vary for drivers. However, the overall standard deviation for the combined scale of questions 1-8 was higher for drivers than for pedestrians so this does not appear to be the case (see Table A1).

**Table A1: Mean priority for pedestrian and vehicle perspective photographs.**

| Question | Pedestrian | | Driver | | Overall | |
|---|---|---|---|---|---|---|
| No. | Mean | StdDev | Mean | StdDev | Mean | StdDev |
| Q1 | 5.86 | 2.93 | 5.63 | 2.11 | 5.75 | 2.55 |
| Q2 | 6.70 | 2.97 | 4.36 | 2.89 | 5.53 | 3.08 |
| Q3 | 8.09 | 1.95 | 3.26 | 2.38 | 5.67 | 3.27 |
| Q4 | 6.20 | 2.15 | 6.45 | 1.93 | 6.33 | 2.67 |
| Q5 | 8.03 | 2.09 | 3.49 | 2.62 | 5.76 | 3.47 |
| Q6 | 6.31 | 2.56 | 6.58 | 2.36 | 6.44 | 2.86 |
| Q7 | 3.95 | 2.46 | 4.31 | 3.11 | 4.13 | 3.19 |
| Q8 | 5.36 | 2.19 | 3.33 | 2.44 | 4.36 | 2.65 |
| Q9 | 4.94 | 2.41 | 6.95 | 2.06 | 5.95 | 2.79 |
| Q10 | 5.19 | 2.06 | 7.00 | 1.94 | 6.09 | 2.39 |
| Q11 | 5.44 | 1.73 | 6.68 | 1.81 | 6.06 | 2.19 |
| Scale 1-8 | 50.35 | 11.03 | 37.40 | 13.20 | 40.18 | 14.69 |

It was commented that the driver perspective photos were more difficult to view. This may have been a contributing factor to the lack of variation for the driver perspective photographs. This was most likely due to the distance and angle the photographs were taken from. The location of the driver photos was chosen primarily to fit the entire pedestrian-vehicle space into one shot. This meant that many of the photos were taken from the centre of the road, and at a distance at least 10m back from the pedestrian-vehicle space. Pedestrian photos could be taken from a closer distance, as the pedestrian pathway was narrower and the features were easier to fit into the shot. The different features may have been less salient from the driver perspective as a consequence.

Questions 9 and 11 were not statistically different ($\underline{t}$ (47) = –0.596, $p > .05$) and could be seen as semantically equivalent. Participants suggested that it was redundant to have both questions, and suggested the removal of question 9.

Participants unanimously agreed that question 1, *"You have priority and need not look for traffic/pedestrians"*, should be removed, as it really asked two questions, neither of which contributed much to the scale. This was corroborated in the results, as an ANOVA showed that question 1 did not vary significantly across the different photos ($\underline{F}$ (2,21) = 1.080, $p > .05$). Question 2, *"A change in your walking/driving behaviour is not necessary"*, did not vary significantly across the sets of photographs ($\underline{F}$ (2,21) = 0.655, $p > .05$). The participants also targeted question 2 as it was too vague, and does not specify what kind of change.

Questions 3 ($\underline{F}$ (2,21) = 0.608, $p > .05$) and 5 ($\underline{F}$ (2,21) = 2.199, $p > .05$) both related to paying attention to traffic/pedestrians, and showed no significant variation across the photographs. These questions did vary significantly across perspectives ($\underline{t}$ (46) = 7.624, $p < .001$ and $\underline{t}$ (46) = 6.003, $p < .001$, respectively). Because of their similarity they were simply made into one question: *"I should pay more attention to traffic/pedestrians"*.

Questions 1, 2, and 9 were removed from the scale; questions 3 and 5 were collapsed into one question. Questions 1-5 remain to form a priority scale, question 6 examines the clarity of who has right of way, question 7 examines comfort, and question 8 examines whom the space has been designed for.

## Initial focus group questionnaire

### Pedestrian perspective items

| For the photograph presented please place an X on each of the following lines to indicate how strongly or weakly the photograph suggests that: | Very Weakly 0 | 1 | 2 | 3 | 4 | Not sure/ Neutral 5 | 6 | 7 | 8 | 9 | Very Strongly 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. You have priority and need not look for traffic | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 2. A change in your walking behaviour is not necessary | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 3. You should look for traffic entering this space | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 4. You have priority and need not give way to traffic | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 5. You should slow down and pay more attention to traffic | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 6. You are entering a vehicle-dominated space | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 7. A young child would notice they were crossing a road | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 8. A driver will not stop for you if you move to cross | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

9. Who has priority in this picture (please place an X on the line)?

| Pedestrian 5 | 4 | 3 | 2 | 1 | No clear priority | 1 | 2 | 3 | 4 | Vehicle |
|---|---|---|---|---|---|---|---|---|---|---|

10. How comfortable do you feel stepping out into this space?

| 0 Very Uncomfortable | 1 | 2 | 3 | 4 | 5 Not sure/ Neutral | 6 | 7 | 8 | 9 | 10 Very Comfortable |
|---|---|---|---|---|---|---|---|---|---|---|

11. Whose space is this?

| 0 Pedestrian | 1 | 2 | 3 | 4 | 5 No clear priority | 6 | 7 | 8 | 9 | 10 Vehicle |
|---|---|---|---|---|---|---|---|---|---|---|

## Driver perspective items

| For the photograph presented please place an X on each of the following lines to indicate how strongly or weakly the photograph suggests that: | Very Weakly (0) — 1 — 2 — 3 — 4 — Not sure/ Neutral (5) — 6 — 7 — 8 — 9 — Very Strongly (10) |
|---|---|
| 1. You have priority and need not look for pedestrians | 0 1 2 3 4 5 6 7 8 9 10 |
| 2. A change in your driving behaviour is not necessary | 0 1 2 3 4 5 6 7 8 9 10 |
| 3. You should look for pedestrians entering this space | 0 1 2 3 4 5 6 7 8 9 10 |
| 4. You have priority and need not give way to pedestrians | 0 1 2 3 4 5 6 7 8 9 10 |
| 5. You should slow down and pay more attention to pedestrians | 0 1 2 3 4 5 6 7 8 9 10 |
| 6. You are entering a pedestrian-dominated space | 0 1 2 3 4 5 6 7 8 9 10 |
| 7. A learner driver should slow down and pay more attention to pedestrians | 0 1 2 3 4 5 6 7 8 9 10 |
| 8. A pedestrian may walk out in front of you | 0 1 2 3 4 5 6 7 8 9 10 |

9. Who has priority in this picture (please place an X on the line)?

5 4 3 2 1 | 1 2 3 4

Pedestrian — No clear priority — Vehicle

10. How comfortable do you feel stepping out into this space?

0 1 2 3 4 5 6 7 8 9 10

Very Uncomfortable — Not sure/ Neutral — Very Comfortable

11. Whose space is this?

0 1 2 3 4 5 6 7 8 9 10

Pedestrian — No clear priority — Vehicle

# Appendix 2: Final Questionnaire

## Pedestrian perspective items

| Please indicate your level of agreement that this photograph suggests that: | Strongly Disagree — Neutral — Strongly Agree |
|---|---|
| 1. I need to give way to traffic | 0 1 2 3 4 5 6 7 8 9 10 |
| 2. I should pay more attention to traffic | 0 1 2 3 4 5 6 7 8 9 10 |
| 3. I am entering a vehicle-dominated space | 0 1 2 3 4 5 6 7 8 9 10 |
| 4. A young child would not realise they were entering a vehicle space | 0 1 2 3 4 5 6 7 8 9 10 |
| 5. A driver will stop for me if I move to cross | 0 1 2 3 4 5 6 7 8 9 10 |
| 6. I am not sure who has right of way | 0 1 2 3 4 5 6 7 8 9 10 |

7. How comfortable do you feel stepping out into this space?

0 1 2 3 4 5 6 7 8 9 10

Very Uncomfortable (0) — Not sure/ Neutral (5) — Very Comfortable (10)

8. Whose space is this?

0 1 2 3 4 5 6 7 8 9 10

Pedestrian (0) — No clear priority (5) — Vehicle (10)

### Driver perspective items

| Please indicate your level of agreement that this photograph suggests that: | Strongly Disagree | | | | | Neutral | | | | | Strongly Agree |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. I need to give way to pedestrians | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 2. I should pay more attention to pedestrians | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 3. I am entering a pedestrian-dominated space | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 4. A driver distracted by children in the back seat would not realise they were entering a pedestrian space | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 5. A pedestrian will stop for me if I move to cross | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 6. I am not sure who has right of way | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

7. How comfortable do you feel driving into this space?

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Very Uncomfortable | | | | | Not sure/ Neutral | | | | | Very Comfortable |

8. Whose space is this?

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Pedestrian | | | | | No clear priority | | | | | Vehicle |

# Appendix 3: Evaluation of Features by the Focus Group

## Evaluation of Features

The third phase of the focus group involved presenting participants with the proposed 11 features of pedestrian-vehicle spaces that had been identified by the researchers as having the ability to influence priority. These were width change, driver lines, pedestrian lines, change in elevation, paving, change in surface texture, change in surface colour, traffic throttle (e.g. bollard or tree), signage, tactile feature, and the view-through.

Each feature was presented with a picture where that feature was prominent, and participants were asked using a Likert scale whether the feature: is an important feature for this research to examine (see Table A1); signals a strong change in the environment (see Table A2); signals that they should give way (see Table A3). This was done for both driver and pedestrian perspectives (the tactile feature was only used for the pedestrian perspective, the view through was only used for the driver perspective). The features were discussed to ensure none were missing from this list.

All 11 features were ranked in order of importance. Overall the features scored lower in importance from the vehicle perspective (see Table A1), which aligns with the idea that the photographs may not be as clear from a driver perspective.

The lowest scoring feature was the driver perspective feature of view-through the site (see Tables A1, A2 and A3). View-through could be called a factor of the surrounding environment of the site rather than one of its features. View-through should be removed from the key feature list.

Driver lines (such as the centre and roadside line markings which define the driving lanes on the road) were seen as significantly more important to pedestrians than drivers ($\underline{t}$ (14) = 4.498, $p < .01$). Driver lines also signalled a stronger change in the environment for pedestrians compared with drivers ($\underline{t}$ (14) = 3.837, $p < .01$). Change in elevation is more likely to signal pedestrians to stop than drivers ($\underline{t}$ (14) = 2.701, $p < .05$), and paving was more important from a pedestrian perspective ($\underline{t}$(14) = 2.393, $p < .05$). These findings suggest that driver lines, elevation and paving may vary between the user groups in terms of their importance to cueing a change in the environment and right of way.

Another issue is feature salience across user type. A feature such as a "stop for pedestrians" sign may influence drivers without any impact on pedestrians, as they are not viewing the sign. This type of feature is outside the scope of this study as this research is focused on those features that may send conflicting signals to drivers and pedestrians. The features must be visible to both user groups simultaneously for it to cause conflict. Therefore, triangular road markings, and signage were removed from this study due to a lack of interaction between the different user groups.

**Table A1. Features ranked in order of importance as a cue to priority from pedestrian and driver perspectives.**

| *Pedestrian* | *Score* | *Driver* | *Score* | *Overall* | *Score* |
|---|---|---|---|---|---|
| Paving | 4.75 | Elevation | 4.19 | Paving | 4.38 |
| Elevation | 4.25 | Paving | 4.00 | Elevation | 4.22 |
| Colour | 4.25 | Texture | 4.00 | Texture | 4.07 |
| Texture | 4.13 | Width | 3.88 | Sign | 3.63 |
| Driver lines | 3.94 | Pedestrian lines | 3.38 | Tactile | 3.63 |
| Sign | 3.88 | Sign | 3.38 | Colour | 3.57 |
| Throttle | 3.88 | Colour | 2.88 | Width | 3.51 |
| Pedestrian lines | 3.75 | Throttle | 2.88 | Throttle | 3.38 |
| Tactile | 3.63 | View | 2.67 | Pedestrian lines | 3.32 |
| Width | 3.13 | Driver lines | 2.13 | Driver lines | 3.13 |
| Average Score | 3.96 | Average Score | 3.34 | View | 2.67 |

**Table A2. Features ranked by the strength of change in the environment they signalled from pedestrian and driver perspectives.**

| *Pedestrian* | *Score* | *Driver* | *Score* | *Overall* | *Score* |
|---|---|---|---|---|---|
| Elevation | 4.63 | Elevation | 4.25 | Elevation | 4.44 |
| Width | 4.00 | Width | 4.13 | Width | 4.06 |
| Colour | 4.00 | Texture | 3.88 | Texture | 3.88 |
| Paving | 3.88 | Sign | 3.75 | Sign | 3.75 |
| Texture | 3.88 | Colour | 3.38 | Colour | 3.69 |
| Throttle | 3.88 | Paving | 3.25 | Paving | 3.56 |
| Sign | 3.75 | Throttle | 3.13 | Throttle | 3.50 |
| Driver lines | 3.63 | Pedestrian lines | 2.63 | Tactile | 3.13 |
| Tactile | 3.13 | View | 1.83 | Driver lines | 2.69 |
| Pedestrian lines | 2.38 | Driver lines | 1.75 | Pedestrian lines | 2.51 |
| Average Score | 3.88 | Average Score | 3.31 | View | 1.83 |

**Table A3. Features ranked by how well they signalled someone should stop, from pedestrian and driver perspectives.**

| *Pedestrian* | *Score* | *Driver* | *Score* | *Overall* | *Score* |
|---|---|---|---|---|---|
| Elevation | 4.50 | Sign | 4.00 | Elevation | 4.06 |
| Colour | 3.75 | Width | 3.75 | Sign | 3.75 |
| Width | 3.63 | Elevation | 3.63 | Width | 3.69 |
| Pedestrian lines | 3.63 | Texture | 3.63 | Colour | 3.44 |
| Driver lines | 3.50 | Paving | 3.38 | Texture | 3.38 |
| Sign | 3.50 | Colour | 3.13 | Pedestrian lines | 3.38 |
| Throttle | 3.25 | Pedestrian lines | 3.13 | Driver lines | 3.07 |
| Texture | 3.13 | Throttle | 2.75 | Paving | 3.00 |
| Tactile | 3.00 | Driver lines | 2.63 | Throttle | 3.00 |
| Paving | 2.63 | View | 1.83 | Tactile | 3.00 |
| Average Score | 3.452 | Average Score | 3.186 | View | 1.83 |

# Appendix 4: Example pictures of the 9 feature type alterations from baseline sites

**Baseline 8-feature site**

**Driver lines removed**

**Baseline 8-feature site**

**Colour faded**

**Baseline 8-feature site**

**Island removed**

**Baseline 8-feature site**

**Pedestrian lines removed**

**Baseline 8-feature site**

**Paving removed**

**Baseline 8-feature site**

**Elevation removed**

**Baseline 8-feature site**

**Tactile surface removed**

**Baseline 8-feature site**

**Width reduction removed**

**Baseline zero-feature site**

**Gap added**

# Appendix 5: Table of means, standard deviations and significant differences in priority scale scores between pedestrian and driver perspective groups

| | Pedestrian | | Driver | | |
|---|---|---|---|---|---|
| Footage | Mean | Std error | Mean | Std error | Difference |
| **Zero-feature baseline** | 8.97 | 0.2 | 7.57 | 0.2 | 1.4 *** |
| Zero-feature with Driver lines | 8.18 | 0.3 | 7.97 | 0.4 | 0.21 |
| Zero-feature with Elevation | 7.20 | 0.4 | 6.06 | 0.4 | 1.14 |
| Zero-feature with Gap | 8.05 | 0.3 | 7.94 | 0.4 | 0.1 |
| Zero-feature with Island | 7.57 | 0.3 | 6.26 | 0.4 | 1.3 * |
| Zero-feature with Paving | 6.61 | 0.3 | 6.51 | 0.4 | 0.1 |
| Zero-feature with Pedestrian lines | 6.84 | 0.4 | 5.85 | 0.4 | 0.98 |
| Zero-feature with Tactile | 7.72 | 0.3 | 7.46 | 0.4 | 0.26 |
| Zero-feature with Width reduction | 7.09 | 0.4 | 5.84 | 0.4 | 1.25 * |
| **8-feature baseline** | 6.83 | 0.4 | 4.16 | 0.4 | 2.67 *** |
| 8-feature less Colour | 6.57 | 0.3 | 4.22 | 0.4 | 2.35 *** |
| 8-feature less Driver lines | 6.10 | 0.4 | 4.26 | 0.5 | 1.84 ** |
| 8-feature less Elevation | 5.87 | 0.4 | 4.17 | 0.7 | 1.7 |
| 8-feature less Island | 6.13 | 0.4 | 3.35 | 0.4 | 2.78 *** |
| 8-feature less Paving | 6.09 | 0.4 | 3.94 | 0.5 | 2.15 ** |
| 8-feature less Pedestrian Lines | 7.02 | 0.3 | 4.59 | 0.4 | 2.44 *** |
| 8-feature less Tactile | 6.33 | 0.4 | 3.58 | 0.4 | 2.76 *** |
| 8-feature less Width reduction | 7.12 | 0.3 | 4.48 | 0.4 | 2.64 *** |
| **4-feature Baseline** | 7.29 | 0.3 | 5.71 | 0.4 | 1.57 ** |
| 4-feature Elevation | 7.14 | 0.3 | 6.26 | 0.4 | 0.88 |
| 4-feature Island | 7.69 | 0.3 | 6.76 | 0.4 | 0.92 |
| 4-feature Width reduction | 7.68 | 0.3 | 6.52 | 0.4 | 1.16 * |
| 4-feature Tactile | 8.40 | 0.3 | 6.08 | 0.3 | 2.32 *** |
| **5-feature Baseline** | 5.91 | 0.4 | 4.10 | 0.4 | 1.81 ** |
| 5-feature Colour | 6.89 | 0.3 | 4.99 | 0.4 | 1.9 ** |
| 5-feature Driver Lines | 5.43 | 0.4 | 4.32 | 0.5 | 1.11 |
| 5-feature Gap | 6.31 | 0.4 | 4.82 | 0.4 | 1.49 * |
| 5-feature Paving | 6.43 | 0.4 | 4.54 | 0.4 | 1.89 ** |
| 5-feature Pedestrian Lines | 7.13 | 0.3 | 6.63 | 0.4 | 0.5 |
| **Other sites** | | | | | |
| Unaltered Porirua site | 7.59 | 0.5 | 5.66 | 0.6 | 1.93 * |
| Unaltered Havelock North site | 6.59 | 0.5 | 6.85 | 0.6 | -0.26 |
| Unaltered Petone site | 6.13 | 0.5 | 5.20 | 0.6 | 2.56 *** |
| Pedestrian Crossing | 3.63 | 0.3 | 1.07 | 0.3 | 0.93 |
| Video Zero-feature | 7.61 | 0.6 | 8.03 | 0.7 | -0.42 |
| Video Pedestrian Crossing | 3.51 | 0.4 | 1.41 | 0.5 | 2.1 ** |
| Video Petone site | 6.31 | 0.6 | 5.35 | 0.6 | 0.95 |

* $p < .05$    ** $p < .01$    *** $p < .001$