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Trials on set-back of segregated cycle lanes at side-road crossings

Annex 5 Trials M13 with car drivers using a driving simulator

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1 Introduction

1.1 This document

This Annex presents the findings from the fourth in a series of trials carried out by TRL to investigate segregation set-back at cycle lane crossings of side-roads (trial M13). This trial uses a driver simulator to investigate the effect of two segregation set-back distances and whether the presence of cyclists affected driver behaviour and cyclist safety. Two set-back distances were tested: kerb segregation ending at either short distance before the junction (5 m) or ending a longer distance before the junction (20 m). These two distances were selected following results from the first two test track trials (Results presented in Annex 2 and 3)[1] as being of greatest interest, representing a distance long enough for cyclists to re-introduce themselves into the traffic flow and one short enough to affect the geometry of the junction and hence affect speed and vehicle position when turning.

The trial used three different densities of other cyclists in order to investigate drivers' perceptions about the likelihood of encountering cyclists. Where other cyclists were present, some were travelling in the same direction as the driven vehicle and some were on other side of the road travelling in the opposite direction. The three densities of other cyclists were no other cyclists present, a few cyclists present and many cyclists present.

1.2 Aims and Objectives of the trial

This trial concentrated on the main type of manoeuvre that can result in conflict: a left-turning car and a cyclist continuing straight ahead over the side road. In moving traffic a conflict can occur if a driver misjudges the cyclist's position or speed and/or alternatively inappropriately overtakes and turns in front of the cyclist[2].

The aim of the study was to assess the safety and use of an on-carriageway kerb segregated cycle lane using TRL's driving simulator. The trial was conducted in a simulated urban environment and used higher density traffic, involving more potential risk for the simulated cyclists, than was practical to study in other trials on the test track[4].

The study investigated driver behaviour and decisions when making a left hand turn across a kerb segregated cycle lane with two different set-backs: the distance between the end of the segregation kerb and the entrance to the side road, either 5 metres or 20 metres.

The main behaviour of interest is the actions of the driver[3] when turning left into the side road across the kerb segregated cycle lane and potential conflicts with a cyclist proceeding ahead. The trial had two main assessment objectives:

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[1] Available at www.trl.co.uk

[2] A driver who misjudges a cyclist's speed may also inappropriately overtake the cyclist due to the misjudgement. Therefore, these may be examples of the same behaviour - an inappropriate overtake may be an example of misjudging speed.

[3] In this report, the participant who is operating and driving the car simulator will be referred to as the "driver".

- To what extent does the different kerb set-back effect:
    - The position of drivers relative to cyclists when undertaking the turning manoeuvres
    - How far in advance of the junction does the driver initiate their manoeuvre, whether to turn or give way, and what decision do they make
    - The speed of drivers on approach to the junction
    - The distance between the cycle and the car when they are parallel
- To what extent does cyclist volume effect the safety of cyclists:
    - conflicts between cyclists going straight ahead and left-turning vehicles when there is a high, low or no other cyclists

2 Study Design

There were three variables of interest (set-back distance, density of cyclists, conflict) and each variable had a number of different conditions:

- *2 x set-back distance* – a short set-back (5 m) or a long set-back (20 m)
- *3 x cyclist density*– no cyclists, few cyclists or many cyclists
- *2 × conflict condition* - conflict or no conflict

Each participant was confronted with all twelve scenarios. All the different combinations of independent variables are shown in Table 1. The focus of this study was situations where there was conflict between the driver and the simulated cyclists. However, to reduce a participant's expectations about each simulator scenario, we included drives where the participant completed the required left turn manoeuvre across the cycle lane without conflict. Participants therefore completed six 'conflict' conditions and six 'no conflict' conditions. The design of the scenarios is discussed in more detail in Section 3.3.

Table 1: The scenarios in the trial

Set-back distance	Cyclist Density		
	No cyclists*	**Few cyclists**	**Many cyclists**
Short (5 m)	conflict / no conflict	conflict / no conflict	conflict / no conflict
Long (20 m)	conflict / no conflict	conflict / no conflict	conflict / no conflict

* 'No cyclists' condition includes one cyclist in conflict with the vehicle (in the conflict conditions only) and no other cyclists present along the route.

2.1 Segregated Cycle Lane and Set-Back Distance

The primary measure was a kerb segregated cycle lane at carriageway level, with segregation ending prior to a side-road turning so that cyclists continue past the side-road using a coloured advisory cycle lane. The trial gave consideration to the effect on driver behaviour and safety of different segregation set-back distances in advance of the junction.

For comparison purposes, the layout and design of the segregated cycle lane was similar to that used in the trials that took place on the Small Roads System at TRL4. However, one difference was that the road was much wider in the simulator, with two vehicle lanes in each direction in the simulator and one lane in each direction in the track trials. The layout road comprised a kerb-segregated cycle lane up to a side road junction. The cycle lane was coloured green throughout and continued from the end of the segregation and across the side road as an advisory cycle lane, additionally using triangular markings to highlight the cycle lane for turning vehicles. These are not an approved road marking in the UK but are similar to those used in the Netherlands and elsewhere as a 'give way' marking.

Two different set-back distances of the kerb segregation were tested: segregation ending at either short distance before the junction (5 m; Figure 1) or long distance before the junction (20 m; Figure 2). These two distances were selected following results from the first two test track trials as being of greatest interest, representing a distance long enough for cyclists to re-introduce themselves into the traffic flow and one short enough to affect the geometry of the junction and hence affect speed and vehicle position when turning. Participants completed 12 test drives. For six of the drives, the set-back distance was 5m and for the other six drives, the set-back distance was 20 m.

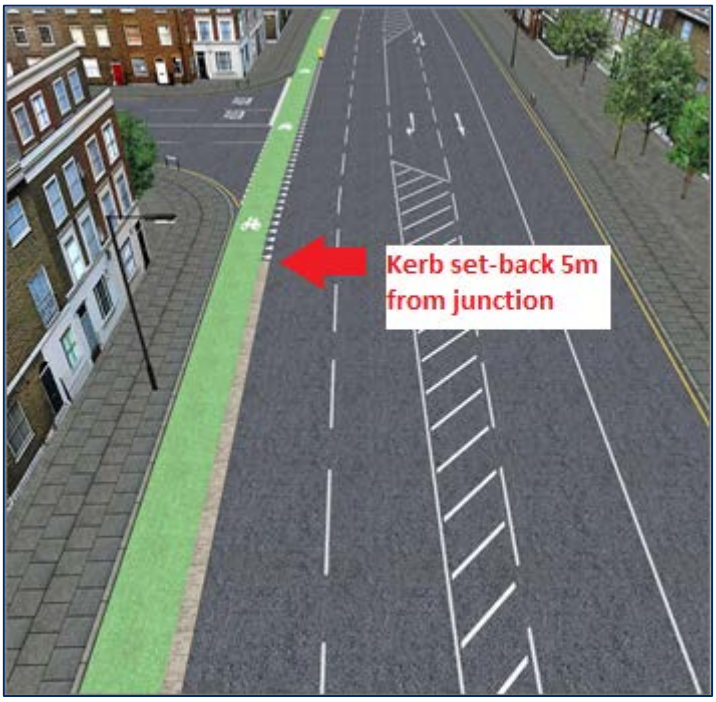


Figure 1: Aerial view of virtual segregated cycle lane with the kerb set back 5 m from the entrance to the side road (short distance)

[4] Kerb Segregated On-Carriageway Cycle lanes: Goods vehicles left turn (W1.SCWa.M1), and Kerb Segregated On-Carriageway Cycle lanes: Drivers and Cyclists (WS1.SCWa.M2).

Figure 2: Aerial view of virtual segregated cycle lane with the kerb set back 20 m from the entrance to the side road (long distance)

2.2 Cyclist Density

In order to change drivers' perceptions about the likelihood of encountering cyclists, the drivers navigated the environment containing three different densities of cyclists. Where other cyclists were present, some were travelling in the same direction as the driven vehicle and some were on other side of the road travelling in the opposite direction. The three densities of other cyclists were:

- no other cyclists [5]
- few cyclists (4 cyclists on the same road side, 3 on the other side)
- many cyclists (12 cyclists on the same road side, 7 on the other side)

The distance between the other cyclists and the conflicting one was kept long enough to avoid any influence of the other cyclists on drivers when turning.

The 12 test drives were made up of 4 of the drives in which there were no other cyclists, 4 drives where there were few cyclists and 4 drives where there were many cyclists. Figure 3 and Figure 4 show an example of the density of cyclists in the few cyclists and many cyclists scenarios, respectively.

[5] There was one cyclist in the 'no cyclist' scenario, this cyclist was intended to be at the conflict point with the driver at the side road.

Figure 3: Screenshot showing a scenario with few cyclists. The cyclists in this screenshot are indicated with red arrows for illustrative purposes only

Figure 4: Screenshot showing a scenario with many cyclists. The cyclists in this screenshot are indicated with red arrows for illustrative purposes only

2.3 Conflict with Cyclist at the Junction

In half the test drives, a simulated cyclist was programmed to be on a conflicting trajectory with the driver by being present on the junction as the driver arrived to turn left into the side road (see Figure 5 and 6). This created a conflict situation where the driver would need to be aware of the presence of the cyclist and choose either to accelerate ahead of the cyclist or wait for the cyclist to pass before making the left turn.

In order to create the conflict situation, a simulated cyclist in the segregated cycle lane ahead of the driver had its speed linked to the speed of the driven vehicle as it approached the left-turn junction such that the cyclist travelled at a speed half the speed of the driven vehicle. Consequently, the cyclist and the driven vehicle always arrived together at a set position 15 metres before the junction with the cyclist slightly ahead of the driven vehicle. After this point, the conflict cyclist's speed was set to a constant value (12 mph) and the driver could choose whether to overtake to make the left turn or allow the cyclist to pass before initiating the manoeuvre.

In the drives where this conflict cyclist was not present, there were no other cyclists present on the junction when the driver was making the left-turn manoeuvre. This allowed the driver to freely choose when to turn left, without any potential influence from cyclists.

Figure 5: Driver's point of view of the conflicting cyclist approaching the side road cycle lane (conflict situation). The conflicting cyclist is indicated with the blue circle for illustrative purposes

Figure 6: Driver's point of view of the same conflicting cyclist crossing the side (conflict situation). The driver will turn left into this side road

2.3.1 *Design of the cyclist and driver conflict*

In half the test drives, a simulated cyclist was programmed to be on a conflicting trajectory with the driver by arriving at the junction at the same time the driver arrived. To ensure the conflict happened, the following series of steps was programmed to occur.

1. *Initial positioning of the conflicting cyclist.* At the beginning of the test drive, roads the simulated cyclist was placed at the beginning of the segregated cycle lane and was stationary. At this time, the cyclist was out of sight of the driver because the driver was around a bend in the road and still a short distance away from the segregated cycle lane. Therefore, although the cyclist was stationary at the start of the drive, it was not visible to the driver.

Figure 7: Illustration of the point in which the conflicting cyclist (highlighted in yellow) is activated to start moving, when the driver is 90 m behind the cyclist.

2. *Activation of the conflicting cyclist.* The conflicting cyclist was programmed to be activated to start moving when the driver was at a distance of 90 metres behind the cyclist. At this distance, the cyclist is first visible to the driver and this distance is illustrated in Figure 7.

3. *Matching of cyclist and driver speeds*. Every driver will choose a slightly different driving speed. To ensure a conflict would always occur[6], the cyclist and drivers' speeds were matched. That is, when the cyclist started moving (when the driver was 90 m behind them), the conflicting cyclist's speed was set to be exactly half of the drivers speed. This matching of speeds ensured that the cyclist arrived at the junction at the same time as the driver.

4. *Cyclist speed release point*. When the cyclist was 9 metres from the junction, the matching of cyclist and driver speeds was stopped and the cyclist's speed was set to an average cyclist speed of 12 mph (see Figure 8). This point is the 'cyclist speed release point' and by removing the matching of driver and cyclist speed, it allowed the driver to avoid a collision if they changed their path or speed from this point.

Figure 8: The point when the conflicting cyclist's speed was release from matching half of the drivers speed. This is the 'cyclist speed release point' and this point was when the cyclist was 9 metres from the junction.

2.4 Other Traffic

Participants completed a series of 12 short drives in a generic urban environment alongside a mix of other traffic (cars, London buses, vans, trucks, black cabs and cyclists). The cyclists within the traffic included different types of bicycles (e.g. commuter, racing, hired) plus variance in rider behaviour in terms of speed and lane positioning. There was no traffic directly in front of the participant's vehicle so as not to

[6] A conflict would occur if the driver did not adjust their path or speed after the cyclist speed release point.

impede or influence the speed or path chosen by the driver. Examples of the other traffic in the scenarios are shown in Figure 9.

Figure 9: Drivers point of view to show other traffic in the scenarios. This screenshot shows other cyclists, cars and a London bus

2.5 Road Design and Layout

Participants were required to complete driving scenarios in which they travelled straight ahead along a four lane bi-directional road (two lanes in each direction) before turning left into a minor side road. The main road included an on-carriageway kerb segregated cycle lane, as shown in Figure 10. At the junction with the side road, participants turned left across the cycle lane, as shown in Figure 11.

The total driving route was approximately 0.5 km in length. Participants drove approximately 0.4 km before reaching the start of the segregated cycle lane. The segregated cycle lane started approximately 0.1 km before the entry to the side road.

Figure 10: Aerial view of the simulated segregated cycle lane

Figure 11: View of the segregated cycle lane at the turning into the side road. Participants travelled alongside the segregated cycle lane and turned left into the side road shown, across the cycle lane

The widths of the road lanes used in this trial are shown in Figure 12. The segregated cycle lane was 2.5 m in width. The driver travelled alongside the segregated cycle lane and had the choice of using the left (3.4 m width) or the right lane (3.3 m width). The driver turned into a side road that also had two lanes – 4.0 m and 3.8 m in width.

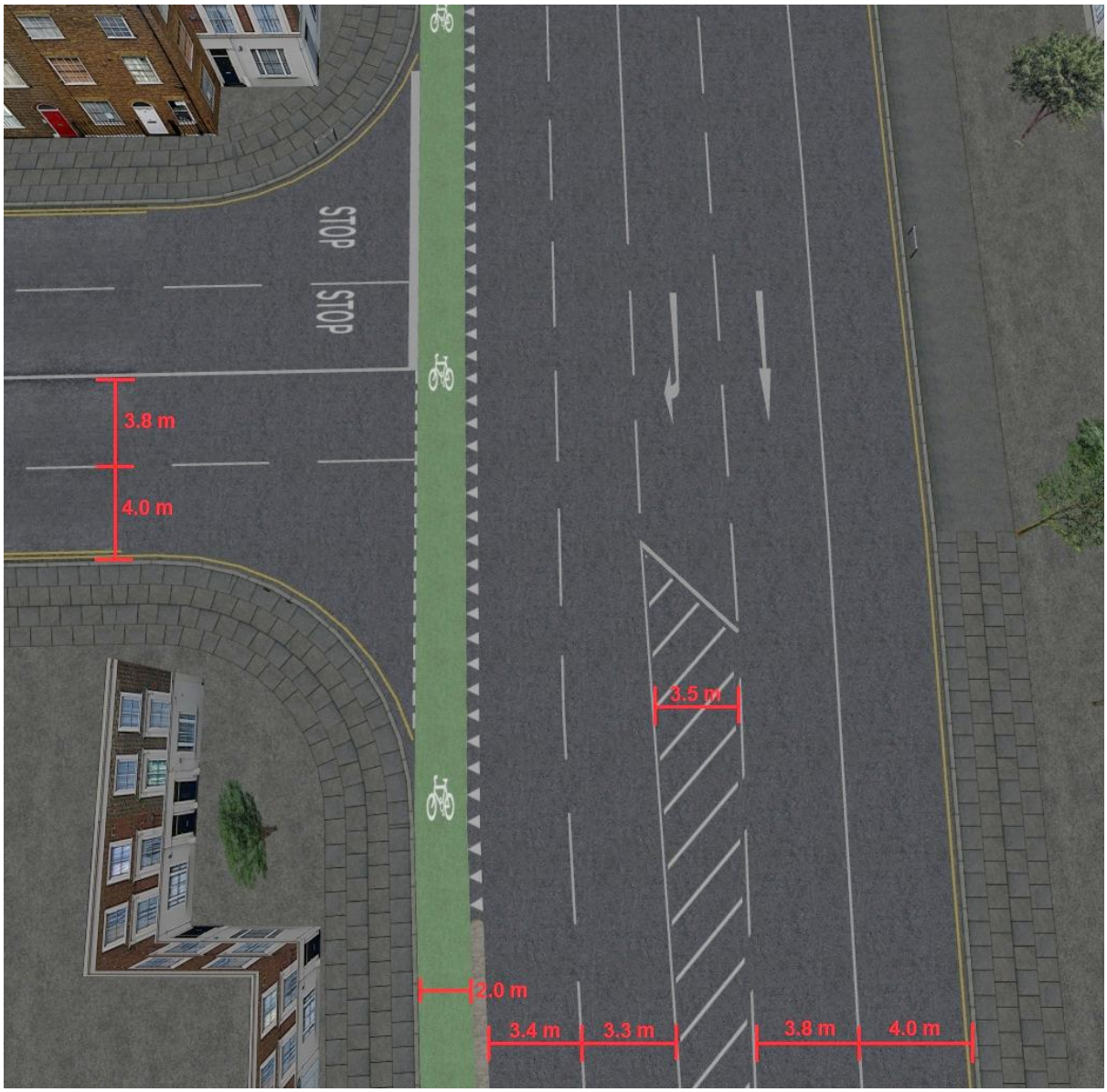


Figure 12: The junction with the lane widths indicated. The driver travelled alongside the segregated cycle lane and turned left into the side road.

3 The trial methodology

3.1 Driving Simulator

The trial was undertaken using TRL's driving simulator, DigiCar. Participants were presented with a naturalistic driving task in a generic urban (London-like) environment with appropriate buildings, pedestrians, cyclists and vehicles (e.g. London buses, black cabs). A segregated cycle lane was created within this environment for the purposes of this trial.

The DigiCar vehicle is a standard car and the controls are operated as in a real vehicle. The vehicle is mounted on four electric actuators connected to the axles behind each wheel to provide motion with three degrees of freedom; heave, pitch, and roll. The simulator provides 210º forward field of view using three flat screens. A rear screen gives a 60º rearward field of view with a display that is adjusted to appear correct for each of the driving mirrors. Simulator data relating to participants operation of the vehicle and the position of the vehicle relative to the conflicting cyclist and the segregated cycle lane were recorded and used to compare driving behaviour across experimental conditions.

3.2 Trial Procedure

The purpose of this trial was to consider the effect of a short and long cycle lane setback distance and the effect of the number of cyclists on six research questions, each of which was related to the overall objectives of understanding how the setback distance affected safety at the side road.

Participants were given a set of standard instructions before driving the simulator. They were told to 'drive as you normally do' and that their 'driving is not being judged'. They were also asked 'not treat the simulator as a computer game'; this was to ensure that the drivers focused on the task and reacted in a 'normal' manner.

3.2.1 *Familiarisation drive*

In order to become familiar with the sensation of driving in the simulated environment and placement of the controls of the simulator vehicle (which may be different to participants' usual car), all participants completed a short familiarisation drive prior to completing any drives from which we recorded data for later analysis.

The familiarisation drive was conducted in the same simulated urban environment as the test drives. It consisted of navigating a short route with light on-coming traffic. Participants were given experience of braking to a stop and accelerating again so that they became familiar with the performance characteristics of the simulated vehicle. Since the trial involved turning left into a side road, participants practiced left turns within the familiarisation drive. The familiarisation drive took about five minutes to complete.

3.2.2 *Test drives*

After completing the familiarisation drive, participants completed the twelve short test drives. For the test drives, participants navigated along a short length of road and were instructed to turn left into a side road. All test drives involved the participant driving the

same route; however, the scenarios in each route were different (see Section 2 for a description of the scenarios).

Each participant undertook 12 short simulator drives containing the two possible set-back distances (5 m, 20 m) and three possible densities of cyclists (none, few and many). All combinations of set-back distance and cyclist densities were completed twice – once with a cyclist at conflict and again without a cyclist at conflict. The order of the set-back distances, cyclist density and conflict situations was varied for each participant in order to minimise the impact of learning effects on the trial.

Once they turned into the side road, participants were met with a queue of traffic and were instructed to stop (see Figure 13). The purpose of the queue was to ensure the participants slowed down and came to a stop the end of each driving scenario.

The test drives incorporated the following features:

- Participants drove along a predetermined route within an urban environment for approximately two minutes
- Participants encountered an on-carriageway kerb segregated cycle lane, with the kerb ending either 20 m or 5 m from the entrance to a side road
- Participants encountered other traffic, including a varying density of cyclists
- Participants encountered a cyclist in a position of conflict in half of the drives

Figure 13: The driver's view of the queue of vehicles immediately after turning left into the side road

3.2.3 *Questionnaires*

The objective data collected through the simulator was supplemented by participants' subjective opinions collected using questionnaires. A questionnaire was administered after each drive in which there was a conflicting cyclist and a final questionnaire was administered at the end of the trial.

Participants completed a short questionnaire after each conflict drive (see Appendix A). These post-drive questionnaires were utilised to gain immediate feedback on the decisions participants' made when turning across the cycle lane when there was a cyclist present at the junction.

All participants were asked to complete a questionnaire after completing the trial to ascertain their overall thoughts, preferences and understanding of the segregated cycle lane (see Appendix B). This questionnaire asked participants about their experiences of the two set-back distances and any issues or opinions they had with the segregated cycle lane.

3.3 Participant Profile

Thirty participants took part in the study. Participants were drawn from TRL's participant database, containing of over 2,000 drivers. The profile of participants can be found in Appendix A.

The age group of the participants varied from 18-24 years to 65-74 years. There was one participant aged 45-54 years and no participants aged 75 years or over. There was an equal split of male and female participants.

The majority (21 of 30) of participants stated that they never ride a bicycle during a typical week. Of the remainder, seven participants stated they usually ride on one day a week, one participant stated that they ride between two and three days a week and one participant stated that they ride five or more days per week.

All participants stated they drive a car during a typical week. The majority (23 out of 30) were frequent drivers and drive on five or more days per week. Participants tended to use a car most often for travelling to or from work or education.

The usual distances travelled by car (one journey in one direction) by participants covered a range of distances. Nine out of 30 participants typically drive up to 5 miles per journey, 10 out of 30 drive between 5 and 10 miles per journey and 9 out of 30 drive 11 to 20 miles per journey.

4 Results

4.1 Data Recorded

The following data were recorded by the driving simulator at a rate of 20 Hz (20 samples per second):

- driving data (e.g. speed, acceleration and deceleration)
- vehicle data (e.g. steering wheel angle, braking and accelerator pedal), and
- data about the road environment (e.g. position of simulated road users)

4.2 Locations of Data Analysis

The data were analysed to investigate different drivers' behaviour at three locations:

- Speed and drivers' position on the road were analysed at different distances on approach to the junction. For the purpose of the analysis, the road was divided into different section as illustrated Figure 14:
  - section 1: represents a baseline section in equal length to section 3 (= 76.15m) but without a cycle lane
  - section 2: from the start of the cycle lane to 20 metres before the junction
  - section 3: from 5 to 20 metres before the junction
  - section 4: from 0 to 5 metres before the junction
- Drivers' position when the turning manoeuvre was initiated.
- Cyclist speed release point: For half of the drives, there was a virtual cyclist in the segregated cycle lane that was programmed to be on a conflicting trajectory with the driver (see Section 2.3). That is, the virtual cyclist was programmed to collide with the driver by travelling across the entrance to the side road, following the green cycle lane, at the same moment the driver turns left across the cycle lane into the side road. If the driver does not take action (e.g., change speed or path) in response to the cyclist across their path, a collision will occur. To create this conflict situation between the cyclist and the driver, the cyclist's speed was programmed to match half of the driver's speed until a certain point immediately prior to the junction (see Section 2.3.1 for more details on the conflict). The matching of speeds was done to ensure a collision would occur by allowing for the variety of drivers' choosing different driving speeds when approaching the side road. At a designated point immediately prior to the junction, the cyclist's speed was "released" meaning that the cyclist's speed was no longer being matched with the driver's speed. This releasing of the cyclist allowed the cyclist to continue straight ahead at an average cycle speed and pass across the side road. This then enabled the driver to continue into the side road after the cyclist had passed. The 'cyclist speed release point' was within section 3 (see Figure 14) and at this point, the distance between the driver and the cyclist was at its minimum.[7]

[7] To further illustrate this, Figure 6 shows a screenshot of the cyclist at the speed release point, when it's released from matching the driver's speed and is continuing across the entrance to the side road. In this screenshot, the driver has avoided a collision by waiting for the cyclist to pass in front of their vehicle.

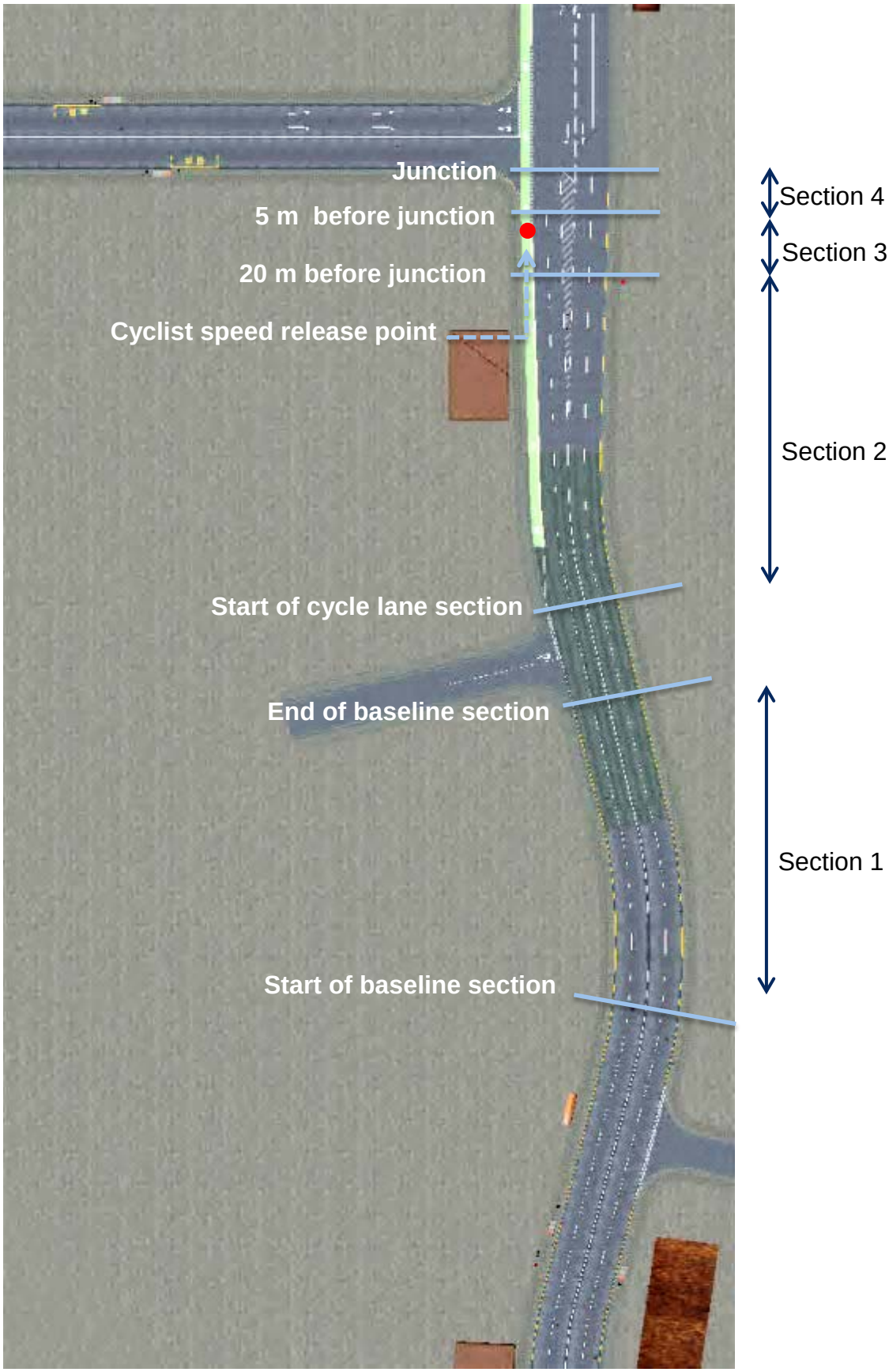


Figure 14: Illustration of the four road sections before the junction where participants turned left

4.3 Lane Position When Approaching To Turn

In this section, drivers' behaviour on approach to the junction in terms of speed and lane position was analysed according to the different sections.

4.3.1 *Lane position when approaching to turn*

Drivers' lateral lane position when driving next to the segregated cycle lane (section 2) was compared to a baseline (section 1), when not driving next to the segregated cycle lane. The parameter considered for the analysis is the vehicles' deviation in metres from the middle of the lane. This was a measure of the drivers' lateral position in the traffic lane. When drivers are positioned to the left of the middle of the lane, the parameter has a positive value and conversely, when drivers are positioned to the right of the middle of the lane, the value is negative.

An overview of the results is displayed in Figure 15. The data analysis showed a significant effect of the section. On average, participants drove significantly more to the right of the lane in section 2 (Mean = -0.46 m; SD = .03) as compared to section 1 (Mean = 0.20 m; SD = .07). That is, drivers' positioned themselves away from the segregated cycle lane, leaving a greater distance between their vehicle and the cyclists in the segregated cycle lane.

A significant effect of the cyclist density condition was also observed. Pairwise comparisons showed a significant difference between the 'few cyclists' condition and the two others ('no other cyclists' and 'many cyclists'). In the condition 'few cyclists', participants were generally driving more on the left side of the road than in the two other conditions. The mean lane position in each of the cyclist density condition is reported Table 2.

Table 2: Drivers' lane position in each cyclist density condition (m)

Cyclist density	M	SD
No other cyclists	-0.05	0.03
Few cyclists	-0.25	0.06
Many cyclists	-0.01	0.07

Finally, there is a significant effect of the presence of a potential conflict with a cyclist (though it should be noted that the conflicting cyclist was only present in the cycle lane in section 3). On average, drivers tend to drive more to the right of the lane when there was a potential conflict with a cyclist (M = -0.11m; SD = .05) as compared to no conflict (M = -0.16m, SD = .05). That is, in situations where there were potential conflicts with cyclists, drivers tended to drive in a lateral position further from the cyclist, giving the cyclist more space.

Set-back distance was not included as a factor in these data analyses as it was not relevant to drivers in section 1 and of limited relevance to drivers in section 2.

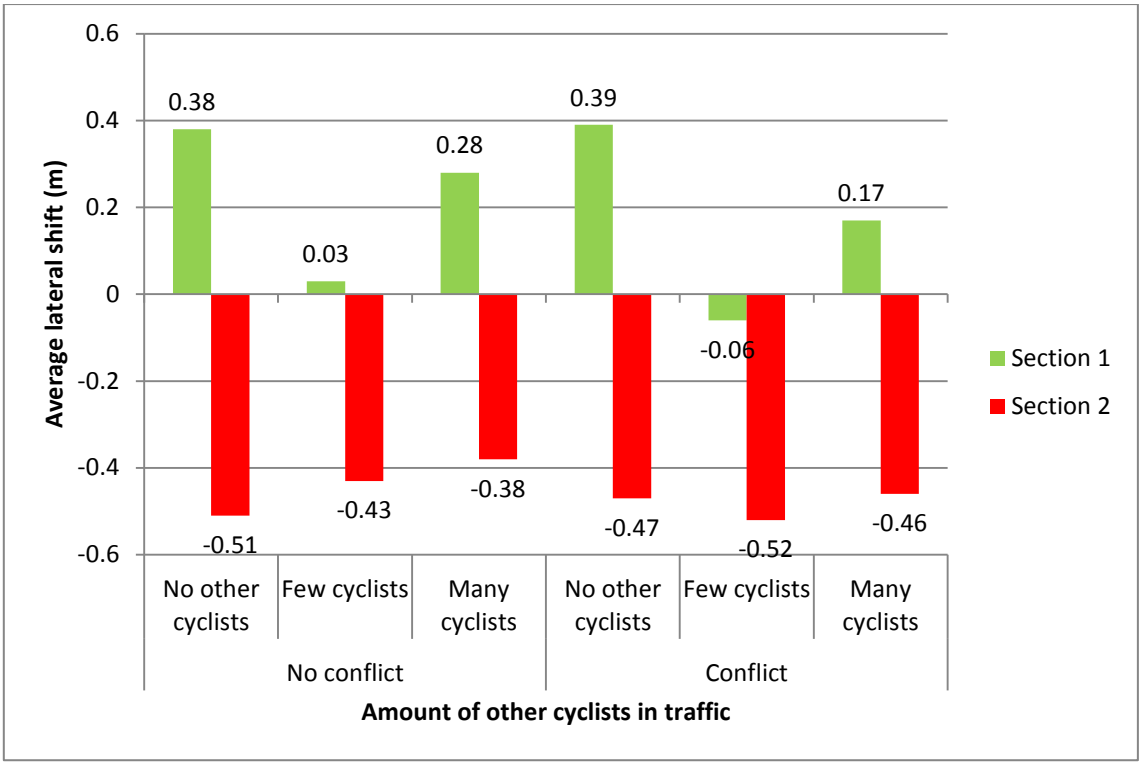


Figure 15: Average lane lateral shift (m)

4.3.2 *Driver speed when approaching to turn*

This section investigates drivers' speed as they are approaching the junction and looks at whether the presence of a conflicting cyclist, the different set-back distances (5m vs. 20m) or the density of cyclists has any impacts on driver speed. The results are shown in Figure 16 and Figure 17. Figure 16 shows the average driver speed when the drivers are between 20 m and 5 m from the junction (section 3 in Figure 14), and Figure 17 shows the average driver speed when the drivers are closer to the junction, between 5 m and 0 m from the junction (section 4 in Figure 14).

Effect of the presence of a conflicting cyclist on driver speed

There are three main findings when investigating the effect of a conflicting cyclist on average speed and these are shown in Figures 14 and 15. The first finding was that overall, there was a significant impact of the presence of a conflicting cyclist on driver speed. That is, when there was a conflicting cyclist present, drivers chose a slower speed and this can be seen in both Figures 14 and 15 by the lower average speed across all conditions.

The second main finding was that, when there was no conflicting cyclist, drivers choose a lower speed on average when closer to the junction compared with further away, and this is shown by lower average speeds in section 4 (Figure 15) compared to section 3 (Figure 14). This finding shows that drivers were slowing down in preparation to turn left.

The third main finding was that when a conflicting cyclist was present, average speeds were higher when the driver is closer to the junction (opposite to what was found when there was no conflicting cyclist). This finding is because in section 3, the drivers slowed down to wait for the conflicting cyclist to pass in front on them. In section 4, the cyclist

passed in front of the driver and the driver increased their speed to make the turn into the side road behind the cyclist.

Effect of cyclist density and set-back distance on driver speed

The results showed that the presence of cyclists did not affect driver speed. There was no evidence that density of cyclists had any influence on drivers' speed in sections 3 or 4. This can be seen by in Figures 16 and 17 by the fact that there was no difference average driver speed in the no- few- and many cyclist conditions either for when there was a conflicting cyclist or when the was not.

The results showed that the kerb set-back distance did not affect average speed when drivers were approaching the junction (section 4). There was no evidence that the set-back distances had any effect on drivers' average speed before the junction (section 3). This is a surprising result, as results from the track trials (M1, M2 and M4) indicated that drivers slowed down more to turn with a 5 m kerb segregation set-back distance as this shorter set-back reduced the vehicle turning radius. This difference might be explained by differences in the road width and geometry of the junction in the simulator compared to road layout used in the track trials. The lane widths in the simulated roads used in this trial were wider and the road had two approach lanes and side road also had two lanes (see Figure 12) whereas the road layout used in M1, M2 and M4 were single lanes with narrow lane widths.

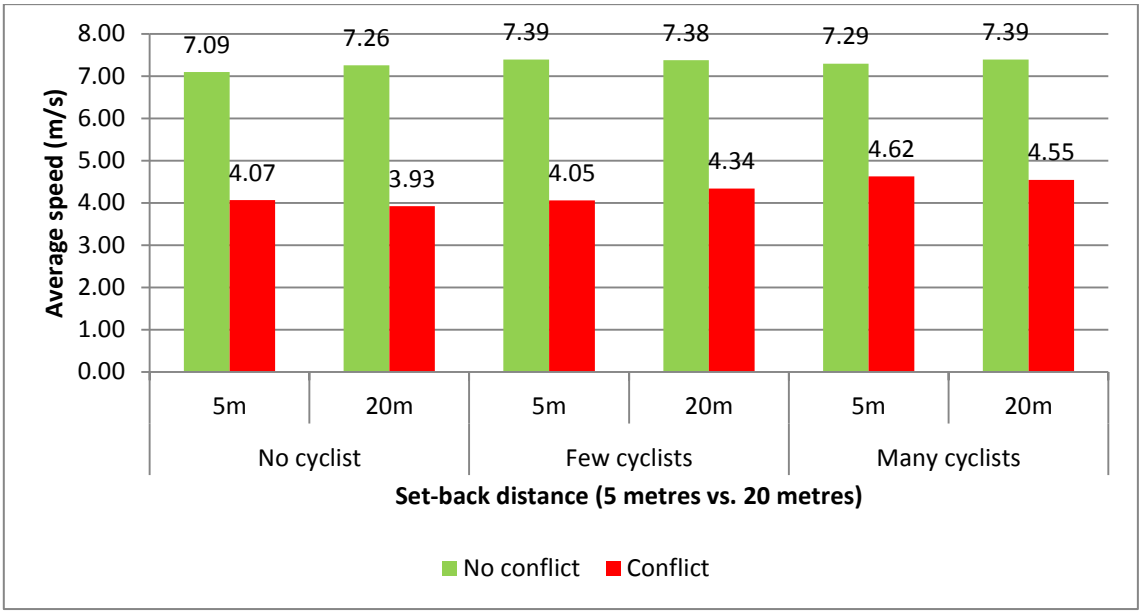


Figure 16: Average speed (m/s) from 20 to 5 metres before the junction (section 3)

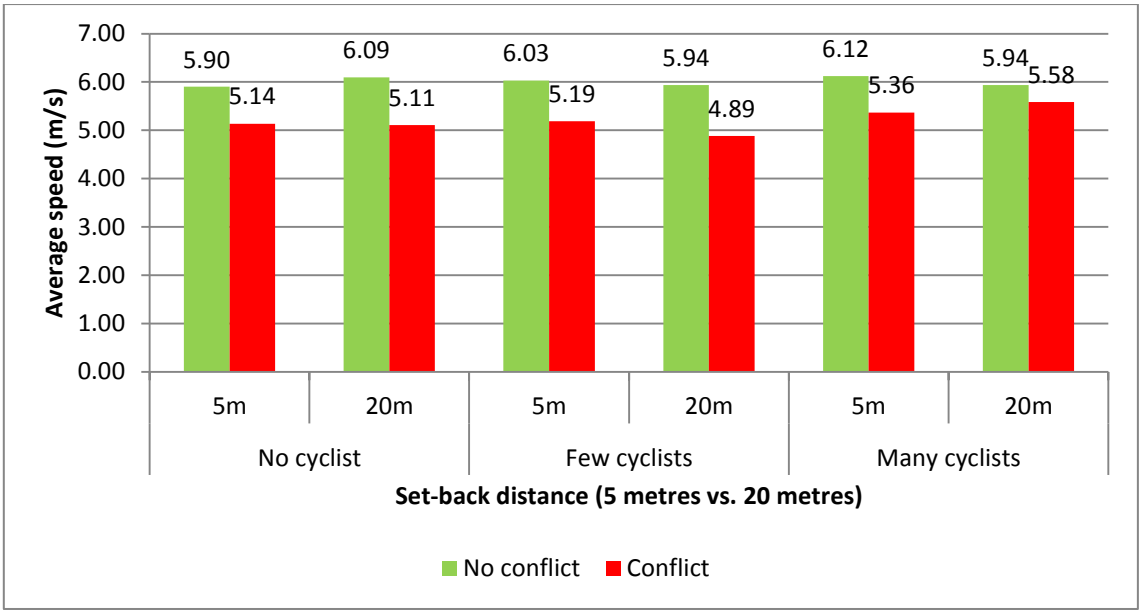


Figure 17: Average speed (m/s) from 5 to 0 metres before the junction (section 4)

4.4 Driving Behaviour Related to Initiation of the Turning Manoeuvre

This section considered the position of the driven vehicle when the turning manoeuvre was initiated based on steering wheel movement (steering wheel angle). Figure 18 shows steering wheel angle data for a scenario to illustrate how the initiation of the turning manoeuvre was measured. The maximum amplitude of steering wheel angle indicates when the car was turning most sharply in making the left-turn manoeuvre. The time at which the steering angle was at a minimum value before the maximum was taken as the reference point at which the turning manoeuvre was initiated. Analysis of driving behaviour was therefore related to this point.

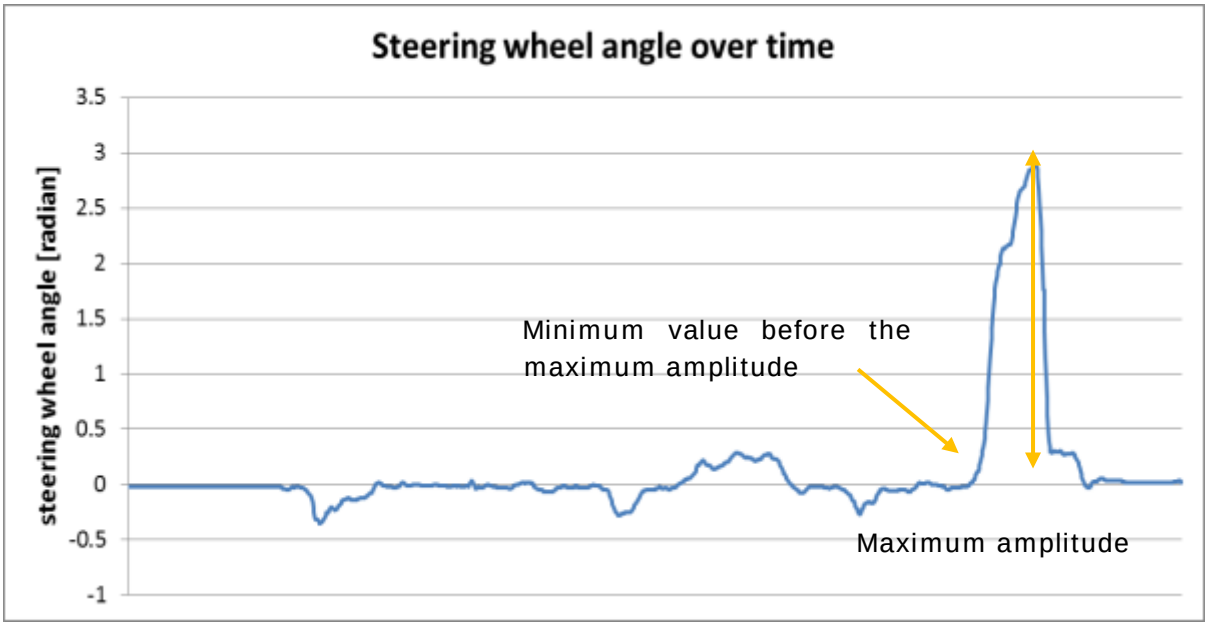


Figure 18: Data sample for one participant as an example for the calculation of the initiation of the turning manoeuvre

The results demonstrated that the presence of a cyclist in the drivers' path when turning had a significant influence on drivers' position when the turning manoeuvre was initiated. In a conflict situation, the turning manoeuvre was initiated at a closer point to the junction (*M* = 6.17 m, *SD* = 1.16) as compared to a non-conflict situation (*M* = 9.91 m, *SD* = 1.62). This suggests that when there was a conflict, drivers initiated the turn 3.74m closer on average.

However, there was no evidence for an influence of the density of cyclists on drivers' position when the turning manoeuvre was initiated. Furthermore, there was no evidence of any influence of the set-back distance either.

4.5 Driver Behaviour at the Cyclist's Speed Release Point

This section investigates driver speed and position at the point in which a conflicting cyclist and the driver are on a conflicting path. This section investigates whether driver speed or position varies depending on the density of other cyclists visible on approach to the junction (no other cyclist/ few cyclists/ many cyclists) or the between the two different set-back distances (20 m vs. 5 m).

Explanation of the cyclist speed release point

For half of the drives, there was a virtual cyclist in the segregated cycle lane that was programme to collide with the driver if the driver did not take action (e.g., change their speed or path). This collision was designed take place at the entrance to the side road, with the cyclist travelling straight ahead following the green cycle lane, and the driver turning left across the cycle lane into the side road.

This conflict scenario was created to investigate drivers' response to a cyclist using the segregated cycle lane and in a situation when the driver was forced to change their behaviour in order to avoid a collision. To create this conflict situation between the cyclist and the driver, the cyclist's speed was programmed to match driver's speed until a point immediately prior to the junction with the side road. This matching of cyclist and driver speeds was done to ensure a conflict would occur by allowing for the variety of drivers' choosing different driving speeds when approaching the side road. At a point immediately before the junction, the cyclist's speed was "released" meaning that the cyclist's speed was no longer matched with the driver's speed.

This section investigates driver speed and lane position at the moment in which the cyclist speed is released. This "cyclist speed release point" was also the last possible moment when the driver and the cyclist were on the confliction trajectory. After this point, the driver could change their speed or position without the cyclist's speed also being changed, and therefore the driver could avoid a conflict. Looking at driver's speed and distance to the cyclist at this point is therefore an indication about the safety of drivers' behaviour.

Data analysed in this section was only the drives in which there was a conflicting cyclist. For each participant, there was a conflicting cyclist in 6 of the 12 drives and therefore, this section presents analysis of half of the drives.

4.5.1 *Driver speed at the cyclist speed release point*

Driver's speed at the speed release point was significantly influenced by the density of cyclists. Pair-wise comparisons show a significant effect between the density 'no cyclist' and the density 'many cyclists' and the effect is marginally significant between 'no cyclist' and 'few cyclists'. There is no significant difference between the two densities 'few cyclists' and 'many cyclists'. Detailed results are presented Table 3.

These findings show that drivers' speed increases with more cyclists in traffic (see Table 3). This result can be explained by the configuration of the cyclists in the segregated cycle lane on the approach to the junction. As shown in Figure 19, compared to when there were few cyclists, the gaps between the cyclists were narrower in the 'many cyclists' condition. In the many cyclists condition, drivers wanted to turn into the side road in the gap after the conflicting cyclist had passed but before the other cyclists in the segregated cycle lane approached too closely, and therefore drivers increased their speed slightly to turn in before the oncoming cyclists approached.

Table 3: Drivers' speed at the cyclist speed release point (mph)

Cyclist density	M	SD
No other cyclists	8.39	0.48
Few cyclists	9.59	0.48
Many cyclists	10.44	0.57

Figure 19 Aerial view before the junction in the condition 'few cyclists' (top figure) and in the condition 'many cyclists' (bottom figure)

Figure 20 shows the average driver speed at the cyclist release point, by set-back distance and cyclist density. **A key finding was there was no evidence for any influence of the set-back distance on drivers' speed at the release point.** This finding was unexpected as some effect on turning speed and position was expected on the basis of results obtained from the track trials.

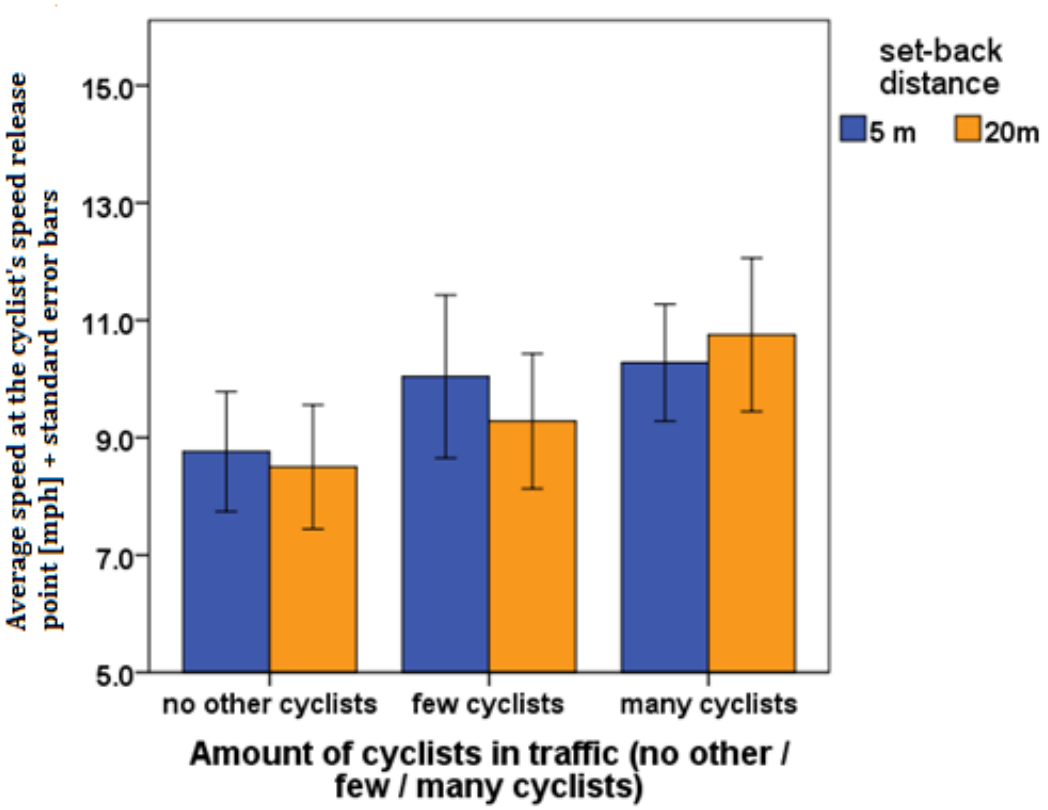


Figure 20: Mean driver speed at the cyclist speed release (mph) for each density of cyclists and set-back distances[8]

4.5.2 *Driver position at the cyclist speed release point*

Separation to the cyclist at the cyclist speed release point was significantly influenced by the density of cyclists. Drivers' position relative to the cyclist (as measured by the straight line distance) at the point in which the cyclist speed was released was significantly larger when there were many other cyclists present in the cycle lane as compared with the conditions when there were fewer or no cyclists present. There was a significant difference in speed between the conditions "many cyclists" and "no other cyclists". Detailed results are presented Table 4.

Again, there is no evidence for any influence of the set-back distance on drivers' distance to the cyclist at the cyclist speed release point. An overview of all the results is presented in Figure 21.

[8] The narrow vertical bars on the charts are standard error bars. These error bars represent 95 percent confidence interval around the mean. If the upper error bar for one average speed overlaps the range of values within the error bar of another average speed, there is a much lower likelihood that these two speed values differ significantly.

Table 4: Drivers' distance to the conflicting cyclist at the cyclist speed release point (m)

Cyclist density	M	SD
No other cyclists	7.69	0.14
Few cyclists	7.61	0.18
Many cyclists	8.70	0.16

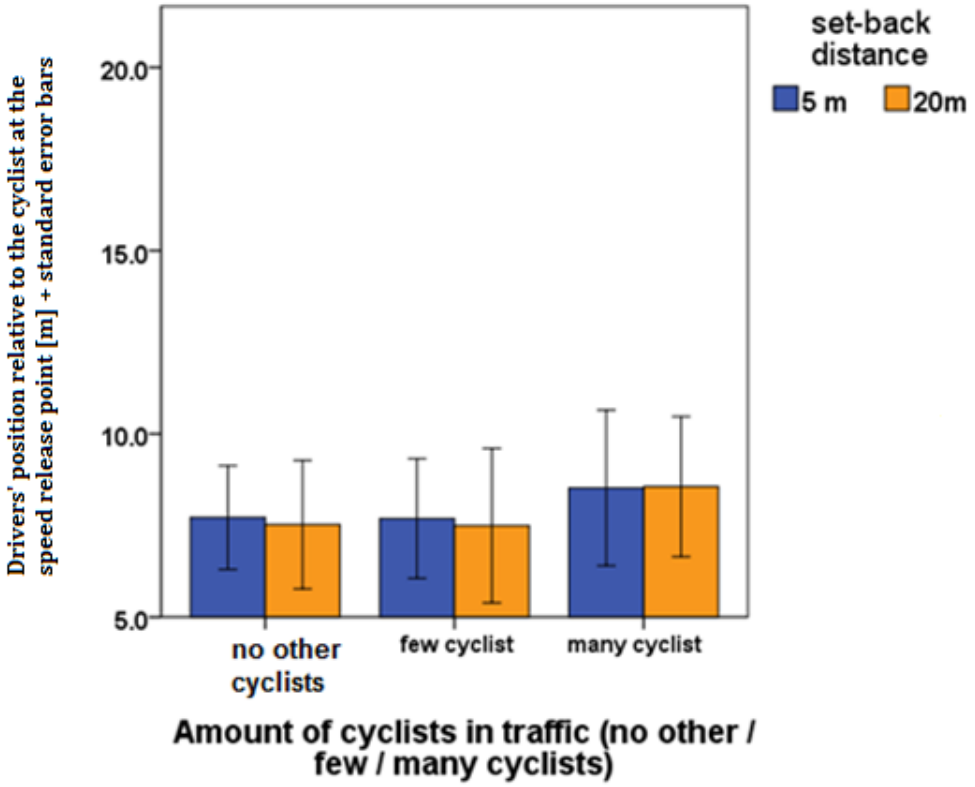


Figure 21: Mean driver lateral position relative to the cyclist at the conflict point (m) for each density of cyclists and set-back distances

4.6 Summary of the Speed Results

In this study, driver speed was investigated in two different ways. First, driver average speed was examined as the drivers approached the junction, at between 20 m and 5 m from the junction and between 5m and 0 m from the junction. Second, driver speed was examined when there was a conflicting cyclists, at the last possible point in which the driver and the cyclist were on a conflicting trajectory (at the cyclist speed release point). Table 5 brings together all the speed results.

Table 5: Summary of speed results

	Results	Explanation of results
Effect of conflict on speed	On the approach to the junction (20 m to 5 m from the junction; section 3), there was significant effect of the presence of a conflict on driver speed. Overall, the speed was lower when a conflict was present. On the approach to the junction (5 m to 0 m from the junction; section 4), there was a significant effect of the presence of a conflict on drivers' speed. Overall, the speed was lower when a conflict was present. Drivers' speed was higher in conditions with a conflict in section 4 as compared to section 3.	When there was a conflicting cyclist present, drivers chose a slower speed in response to the cyclist. The difference in speed in conditions with a conflict could be explained by the fact that in section 4, the cyclist passed in front of the driver and the driver increased their speed to make the turn into the side road behind the cyclist. Conversely, the conflicting cyclist was mostly in drivers' trajectory in section 3, potentially encoring drivers to slow down.
Effect of cyclist density on speed	At the cyclist speed release point, there was a significant effect of the density of cyclists in traffic. Overall, the speed was higher in condition 'many cyclists' and lower in 'no other cyclists'. On the approach to the junction (sections 3 and 4), there was no significant effect of the density of cyclists in traffic.	The higher speed in the 'many cyclists' group has been interpreted by an effect of cyclists' configuration before the junction. In the 'many cyclists' condition, drivers appeared to want to turn into the side road in the gap after the conflicting cyclist had passed but before the other cyclists in the segregated cycle lane approached, and therefore drivers increased their speed slightly to turn in before the oncoming cyclists approached. Contrary to cyclist's speed when measured at the conflict point, there is no significant effect of cyclists' density in traffic. This is justified firstly by the larger amount of data in the two sections 3 and 4 as compared the single measure point at the speed release point. Secondly, looking at the cyclists' speed at the speed release only considers half of the data because there was a conflict only in half of the test drives.

Effect of kerb set-back distance on speed	At the cyclist speed release point, there was no significant effect of the set-back distances. On the approach to the junction (sections 3 and 4), there was no significant effect of the set-back distances.	Results may be due to the wider lane widths of the simulated junction, where the driver had road space and their turn was not restricted.

4.7 Path at the Junction

An averaged path taken by the driven vehicle in completing was calculated through all drivers and in each of the twelve conditions. The average path has been computed taking driver's time when they passed a defined coordinate at the junction. The 5 seconds after and 5 seconds before this point where considered for the calculation of the averaged path.

The two different set-back distances (5 m vs. 20 m) were compared in each of the six pictures below. The calculated data for the mean path taken is presented accurately. However, the background picture of the junction serves only as an approximate guide to the path relative to the junction as there may be some inaccuracy in the matching between coordinate systems from the data and to the mapped image of the junction.

Participants tended to follow the same path at the junction as the paths for the 5 m and 20 m paths were overlaid. However, in some of the conditions a slight dissociation between the two paths can be observed: participants selected a slightly larger radius to execute the turning manoeuvre when there was a 5 m set-back distance at the junction, as would be predicted based on the results of the track trial. This result may be due to the greater road width available for drivers to use in the simulator in comparison with the track trial. Diagrams of the driver path can be found in Appendix B.

4.8 Questionnaire Results

The objective data collected through the simulator was supplemented by participants subjective opinions collected using questionnaires. A questionnaire was administered after each drive in which there was a conflicting cyclist to gain immediate feedback on the decisions participants' made when turning across the cycle lane when there was a conflicting cyclist in the junction (see Appendix A for a copy of the questionnaire).

A final questionnaire was administered at the end of the trial and sought overall thoughts, preferences and understanding of the segregated cycle lane (see Appendix B for a copy of the questionnaire).

4.8.1 *Decisions when to turn with presence of conflicting cyclist*

Participants completed a short questionnaire after each drive in which there was a conflict with a cyclist (see Appendix A for a copy of the questionnaire). These post-drive questionnaires were utilised to gain immediate feedback on their perception of the turning manoeuvre and the decisions participants' made when turning across the cycle lane when there was a cyclist present at the junction.

Overall, the average rating across both set-backs was 1.81. This means that participants rated turning into the junction as 'easy' or 'fairly easy' (Figure 22).

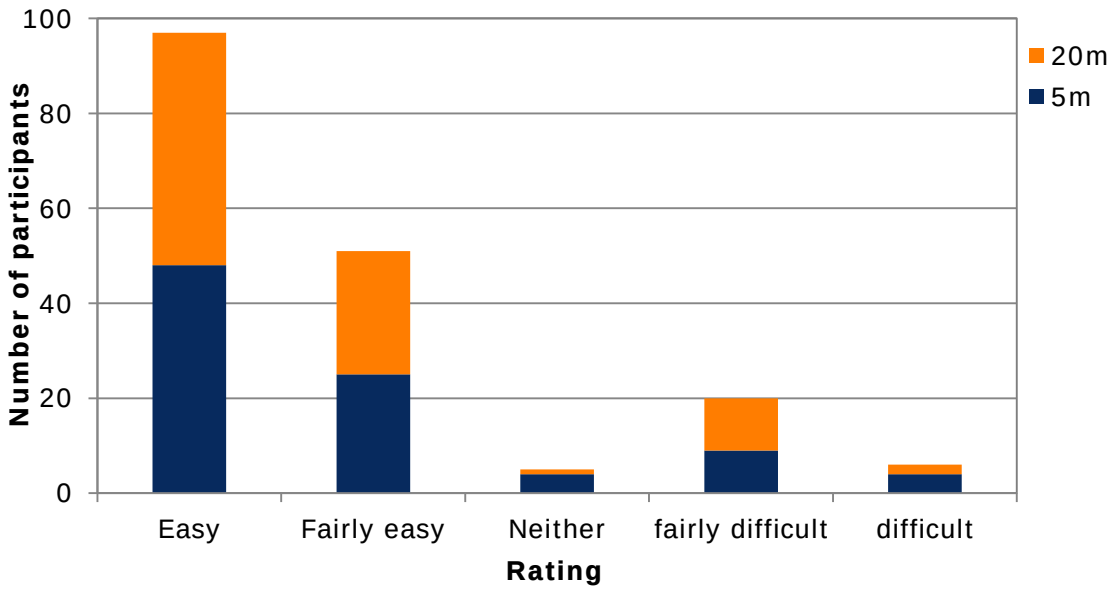


Figure 22: Participants rating of how easy or difficult it was to turn into the side road (scale of 1 to 5, where 1=easy and 5=difficult)

Participants were asked whether they changed their decision about when to turn into the junction, for each drive where there was a cyclist at conflict. For 80% of these drives, participants stated they did not change their mind and this did not differ between the 5 m and 20 m set-backs. Of the 20% of drives when a the driver did change their mind about when to turn, the difficult in their decision was whether the cyclist had right of way and whether to go in front of the cyclist or wait for it to pass. The theme of uncertainty about who had right of way also arose in the final questionnaire and is discussed more in Section 5.7.3.

4.8.2 *Relative ease of making the left turn with different setbacks*

Drivers' assessments of the two different setback distances were used to identify the relative ease of making the turn with different setbacks. After completing all simulator drives, participants were asked about the relative ease of making the left turn with a short setback, a long setback or there was no difference.

Overall, responses showed that there was no clear preference for any one of the two setback distances (see Appendix B for participant responses) and where there was a preference for specific setback distances, it was not particularly marked.

The segregated cycle lane setback made no difference to seeing the cyclist for the majority of drivers (23 of the 30 participants). The segregated cycle lane setback made no difference to the participants' judgment of getting into the correct position (19 of 30).

The majority of drivers felt that the set-back distances made no difference in using the junction. However, those who did have a preference stated that the short setback was better overall for making the turn (10 of 30), better overall ease of using the junction (10 of 30) and safer of making the turn (10 of 30). Refer to Appendix B for the results.

4.8.3 *General opinions of segregated cycle lanes*

Fifty-three per cent of participants did not notice that the kerb segregation stopped at two different distances from the entrance to the side road. There were no age or sex differences between those who did and did not notice the two set-back conditions.

Participants (28 of 30) agreed that segregated cycle lanes were a good idea for cyclists. The main reasons were for cyclists' safety and having a separate lane for cyclist:

> *More space between cyclists and cars is a more comfortable way to cycle [f, 55-64]*
>
> *Improved safety, may encourage more people to cycle if they don't have to integrate with traffic [f, 25-34]*
>
> *The unpredictability and vulnerability makes them more likely to be involved in motor accidents. Giving them a separate lane would minimise this [f, 65-75]*
>
> *It makes it clearer for cyclists that it is a cycle lane. I also think that as they have the kerb there separating them from the main carriageway that it helps to keep the cyclists safer [f, 25-34]*

Participants (27 of 30) also agreed that segregated cycle lanes were a good idea for drivers. There were also clear themes to why participants agreed that segregated cycle lanes were a good idea for drivers. Participants mentioned cyclist safety, ease of overtaking cyclists and a clearer view of cyclists as reasons the segregated cycle lanes were a good idea for drivers. Comments included:

> *I felt much more comfortable, not having to judge what a safe passing distance was, and not having to wait behind a cyclist [f, 35-44]*
>
> *Better for drivers because they don't have to steer round cyclists, entering additional lane [m, 35-44]*
>
> *Drivers will still be able to see cyclists and have confidence that they will not stray onto the main road [m, 55-64]*
>
> *The motorist has a clear view of them [cyclists] in a lane and are more visible its safer all round [f, 45-54]*

When asked whether cyclists should join the main traffic queue earlier (preference for a long set-back) before the junction or remain separated for as long as possible (preference for a short set-back), the majority of participants (20 of 30) stated that they should remain separated. Three participants stated cyclists should join the traffic earlier and seven were unsure.

The most common reason stated for remaining separated for as long as possible was for safety:

> *Safer for cyclist and easier for car drivers to concentrate on other driving tasks if separated [f, 25-34]*
>
> *Safer. Reinforces the difference in road use between vehicles and cyclists [m, 65-75]*
>
> *Because I feel cyclists are always safer when segregated from traffic [f, 25-34]*

Those who preferred that cyclists joined the traffic earlier before the junction, also mentioned safety reasons. However their reasons described re-joining the main traffic stream and awareness of what other traffic was doing at the junction:

> *So they [cyclists] can be aware sooner where other road users are in relation to them and what those other users are intending to do (i.e. turn left across the cycle lane) [m, 55-65]*

> *They need to look around and see what is going on around them and the traffic coming up [f, 35-44]*

Fourteen of the thirty participants did not have any issues or concerns with either the short or the long set-back distances. Five had a concern with the *short set-back* distance and these concerns related to the ability for the car to turn into the junction:

> *It made anticipation at the junction harder in relation to the main road. It was only clear at the last minute that is was permissible to cross the cycle lane [m, 55-64]*

> *At the end of the curb at the short distance, it felt as though you should start turning into the junction but it was a little bit too soon to do so [f, 25-34]*

Seven participants had a concern with the *long set-back distance*. Their concerns included:

> *This creates more chance of a collision between cyclist and driver as it makes it more difficult to judge when the cyclist may cross the junction or re-join the traffic [f, 35-44]*

> *Could be a tendency to cut across cyclist rather than wait [m, 65-75]*

> *That the cyclist may swerve onto the main roadway [f, 25-34]*

> *The longer distance would give cyclist an opportunity to move out of lane [m, 55-65]*

When asked whether there were any changes they would like to be seen made to the segregated cycle lane, 15 of the 30 participants stated there was not, 5 of 30 participants stated that there were and 10 participants did not know. Suggested changes included better demarcation of the end of segregation and signage indication cyclists have priority:

> *Make kerb markings more noticeable [m, 65-75]*

> *Not in relation to the kerbs but I would like to have seen a sign indicating junction ahead on nearside and also maybe a warning triangle 'cyclists' [*f, 25-34*]*

> *Fluorescent coloured ends to the concrete barrier would make them easier to see [m, 18-24]*

Finally, participants were asked for any additional comments regarding segregated cycle lanes. There were a range of comments, including mentions of the infrastructure and coloured surfacing, comments about encouraging cycling and uncertainty about who had right of way.

Infrastructure and coloured surfacing comments included:

I do think that the colour of the cycle lane across the junction makes it difficult to see where the junction is. Perhaps hatching colour across the junction (or something other than solid colours) would make it more apparent [f, 25-34]

The green colour of the cycle lane made it very visible [f, 55-64]

Right of way uncertainty comments included:

My main concern being the green lane making it slightly confusing for the driver when he has to cross it at junctions. Does the cyclist assume he has right of way all the time? [m, 55-64]

Clearer right of way signs as I didn't know who had the right of way (me or cyclist) [f, 25-34]

Comments on cycling included:

Segregated cycle lanes are excellent for cyclists, but if not designed correctly with both cyclist and driver in mind could lead to a higher risk of accidents [f, 35-44]

I think they are great but only if used properly by cyclist and car drivers. Most car drivers would need re-educating [f, 35-44]

5 Summary of findings

- The presence of the segregated cycle lane had a small effect on drivers' lateral lane position. Compared to when there was no segregated cycle lane, drivers' positioned themselves away from the segregated cycle lane, leaving a greater distance between their vehicle and the cyclists in the segregated cycle lane.
- No evidence was found that the set-back distances had any effect on drivers' average speed before the junction.
- The results of the study showed that on the approach to the junction and just before the junction, drivers' behaviour was influenced by the presence of a conflicting situation. On average, when there was a conflict, drivers significantly reduced their speed and they initiated the turning manoeuvre at a later point on the road.
- At the conflict point, there was a significant effect of the density of cyclists in the traffic on drivers' speed and drivers' position relative to the cyclist. The results indicate that drivers' speed increases with more cyclists in the traffic.
- There was no effect of the set-back distances of the kerb segregation on drivers' position at the point when they initiated the turning manoeuvre.
- A subtle difference in path was observed between the two set-back distances in some of the conditions: when there is a 5 metre set-back distance at the junction, participants selected a larger radius for their turning manoeuvre.
- Fifty-three per cent of participants did not notice that the kerb segregation stopped at two different distances from the entrance to the side road. There were no age or sex differences between those who did and did not notice the two set-back conditions.

In summary, this study has identified that, in the simulated scenarios presented, there was little difference between drivers' behaviour with 5m or 20m setback. Any differences in behaviour tended only to emerge in relation to cyclist density and the presence/absence of conflict at the junction. Similarly, participants' subjective views did not particularly discriminate between 5 m and 20 m set-back distances with similar numbers preferring either option (and most finding no difference). Slightly more than half the participants did not notice the difference in set-back distance. Consequently, the choice as to whether a 5 m or 20 m set-back should be adopted must rest on factors other than those tested here.

Irrespective of set-back distance, responses of many participants showed that there is a degree of uncertainty over who has priority at the side road. There were also comments suggesting uncertainty about the meaning and status of the road markings. These, alongside the high proportion of participants that did not notice the different segregation set-back distances, suggests that it may be helpful to do more to indicate the end of the segregation, such as a bollard or the use of different lane colours.

Appendix A Participant Profile

Thirty participants took part in the study. Participants were drawn from TRL's participant database, containing of over 2,000 drivers. The participants were asked about their cycling and driving exposure and their age group. The results are provided in this section.

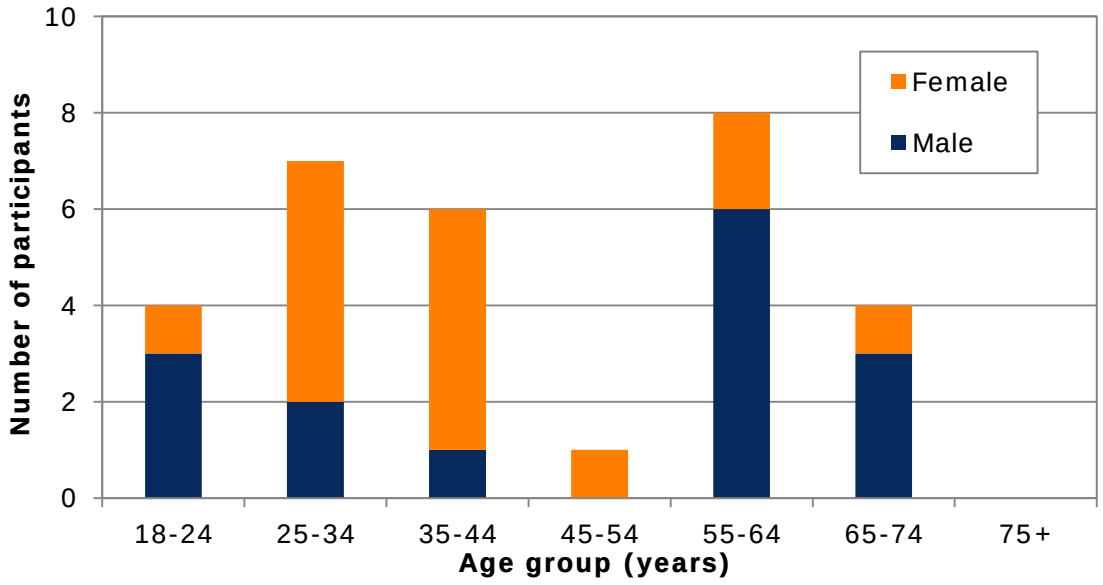


Figure A1: Age group and sex of participants

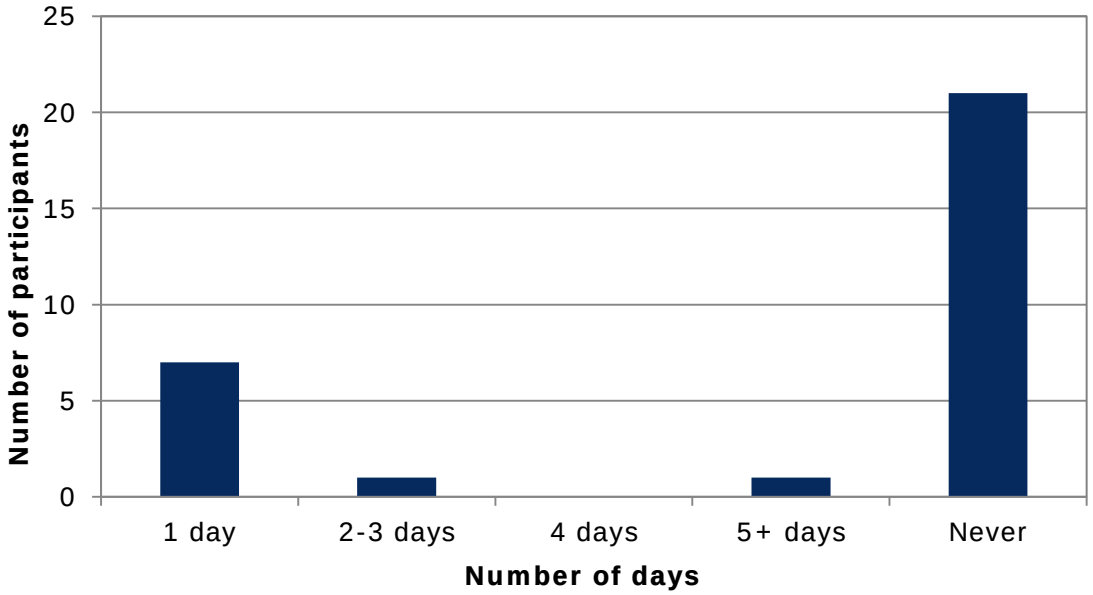


Figure A2: How many days in a week do you usually ride a bicycle?

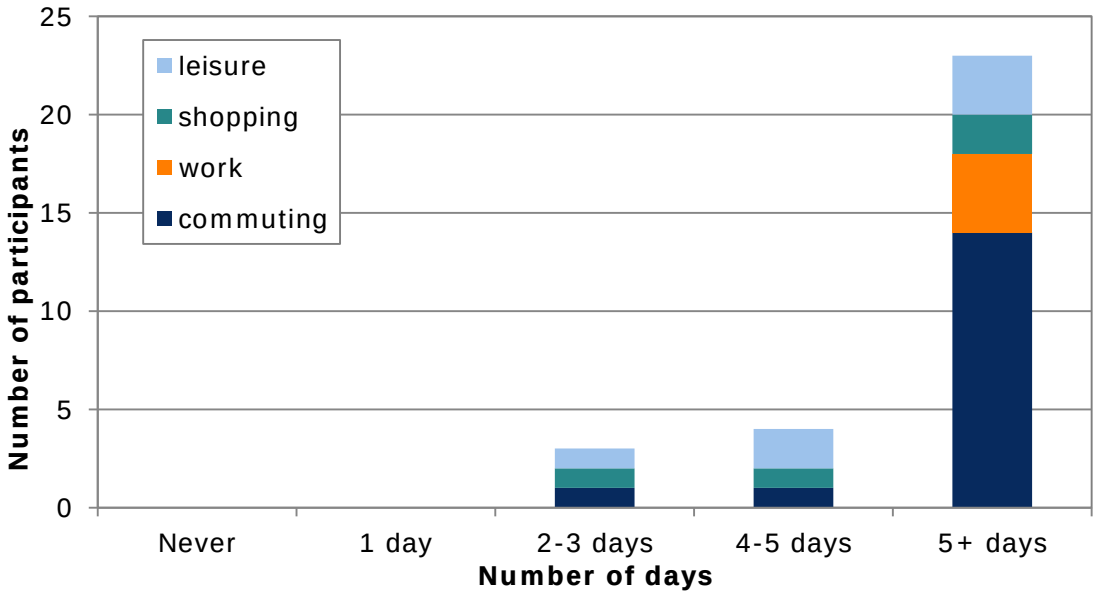


Figure A3: Number days per week usually use a car and main purpose of car journey

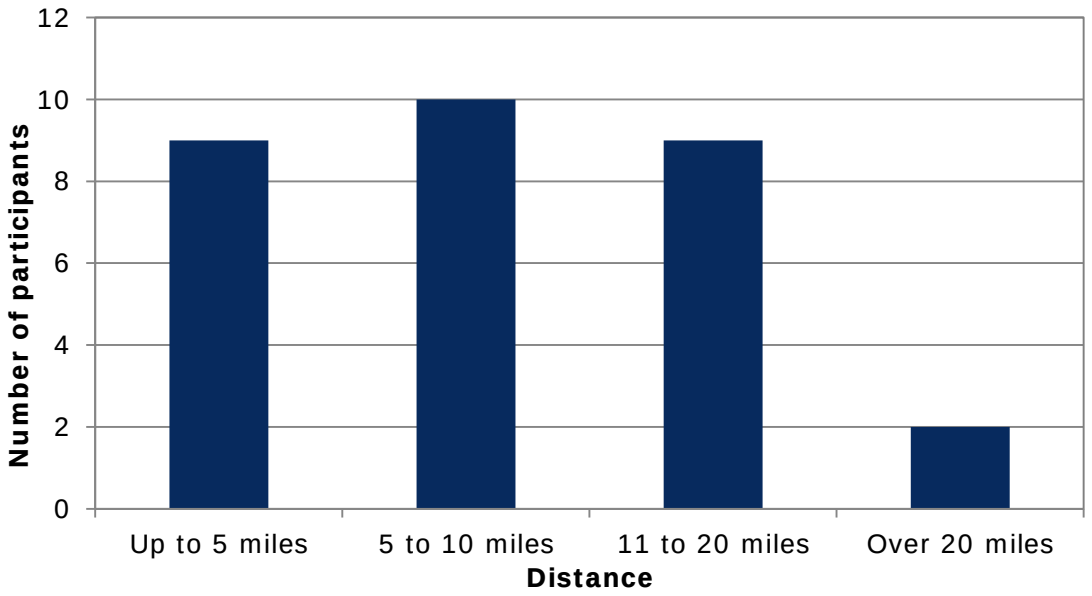
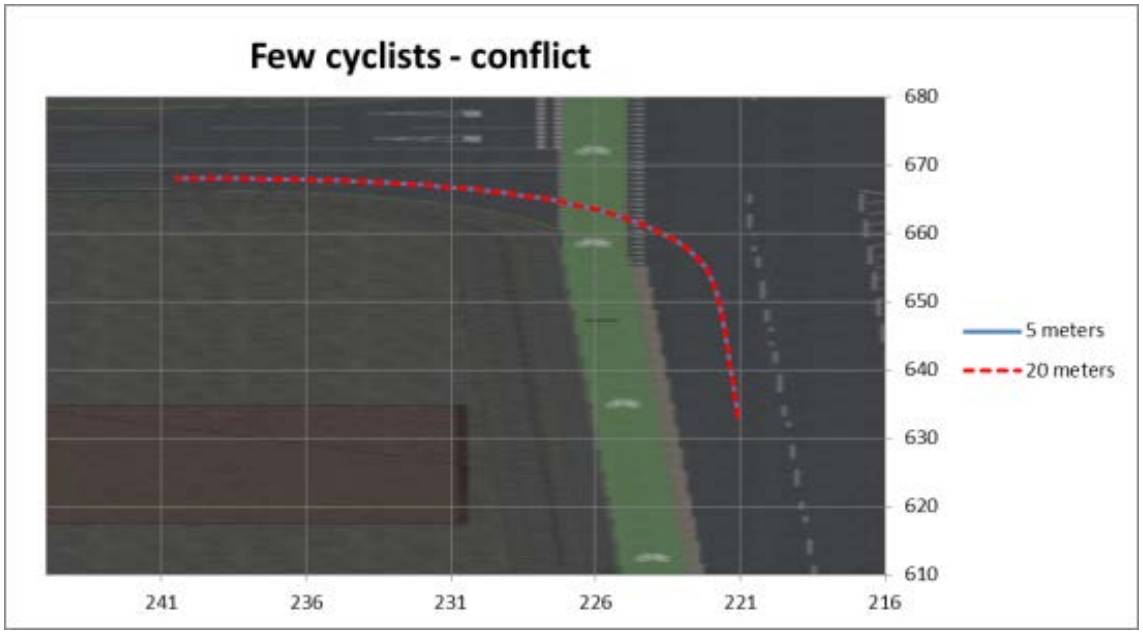
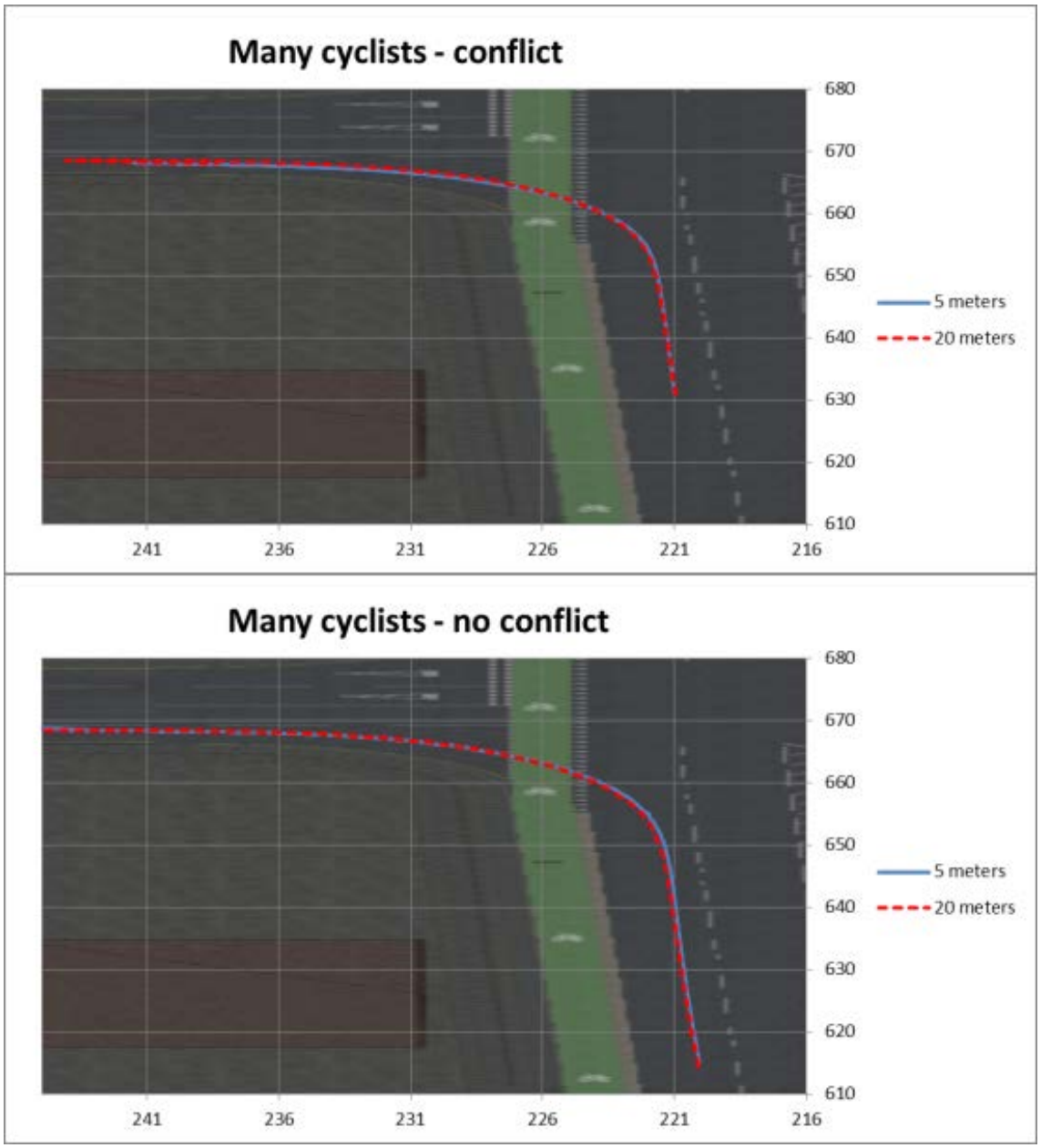


Figure A4: Distance travelled by car per week

Appendix B Average Path Taken by the Driven Vehicle


Few cyclists - no conflict
680
670
660
650
640
630
620
610
241
236
231
226
221
216
5 meters
20 meters

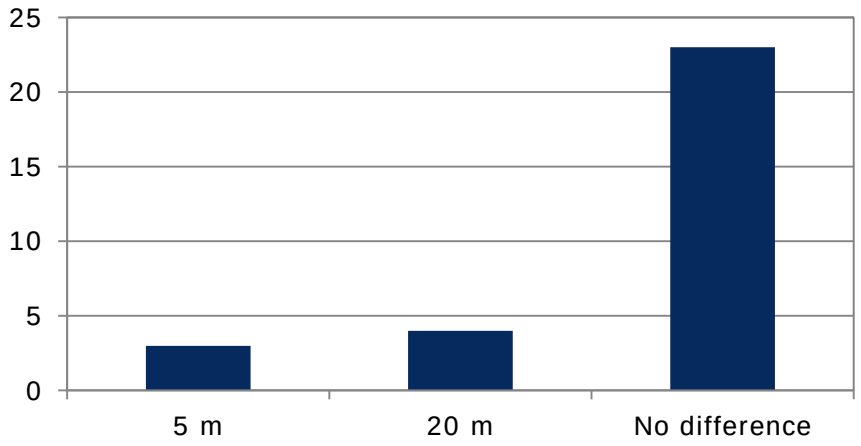

Few cyclists - conflict
680
670
660
650
640
630
620
610
241
236
231
226
221
216
5 meters
20 meters


Many cyclists - conflict
680
670
660
650
640
630
620
610
241
236
231
226
221
216
5 meters
20 meters
Many cyclists - no conflict
680
670
660
650
640
630
620
610
241
236
231
226
221
216
5 meters
20 meters

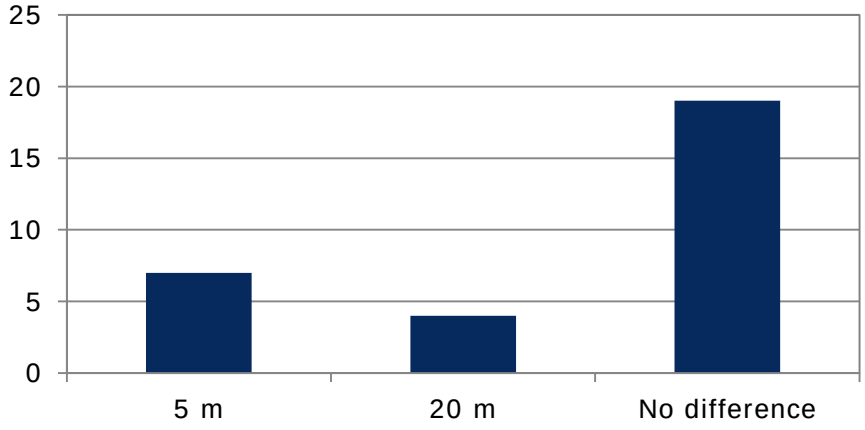
Appendix C Final Questionnaire Results

These charts show the number participants and their preferences for the 5 m or 20 m set-back.

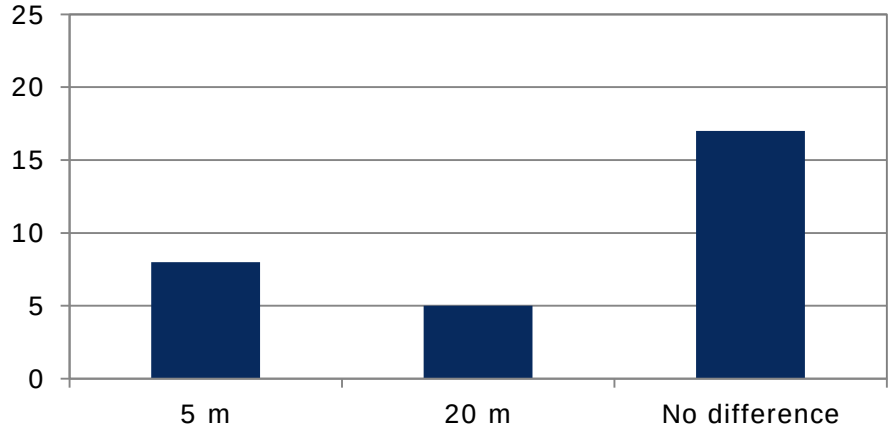
Easier to see the cyclist



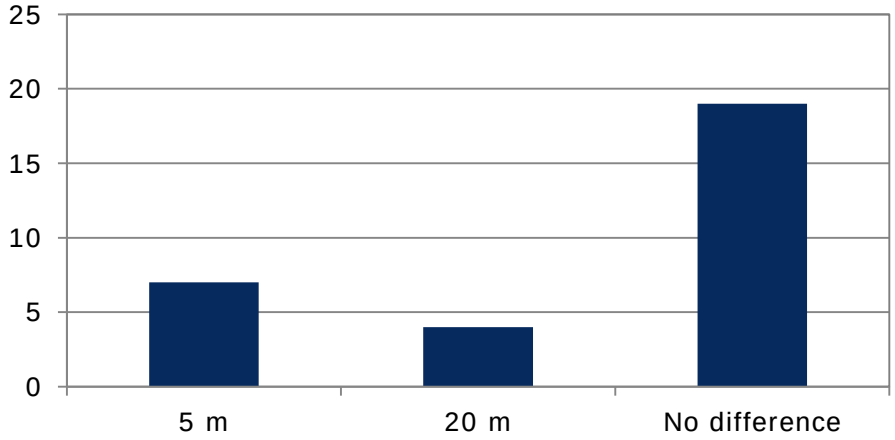
Easier to correctly judge the speed of the cyclist



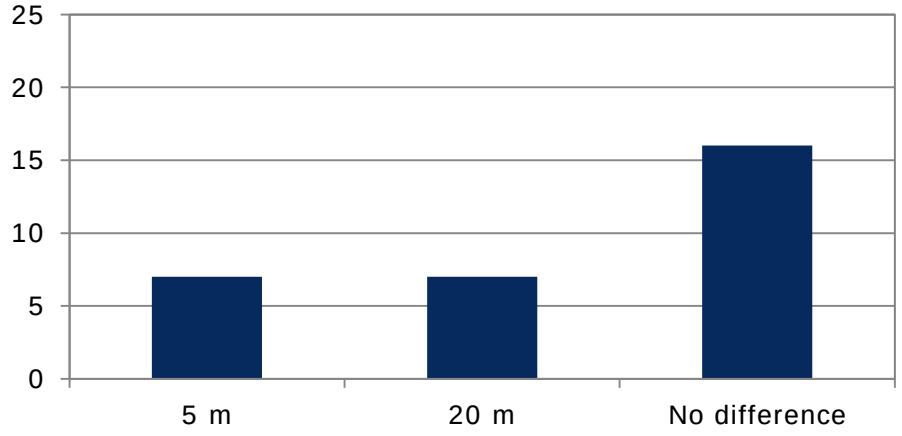
Easier to make the correct initial decision



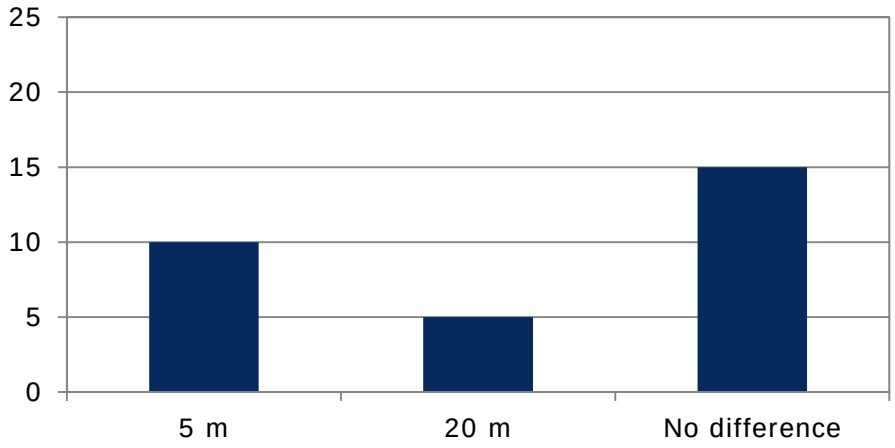
Easier to correctly judge the position of the cyclist



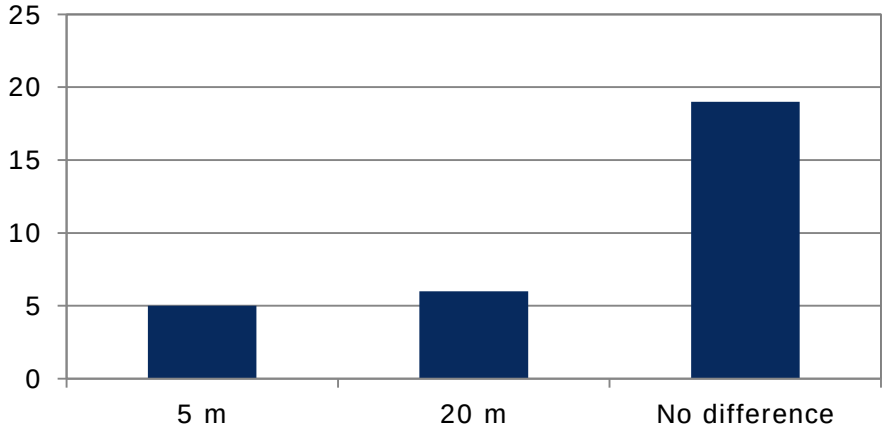
Easier to initially decide to turn before or after the cyclist



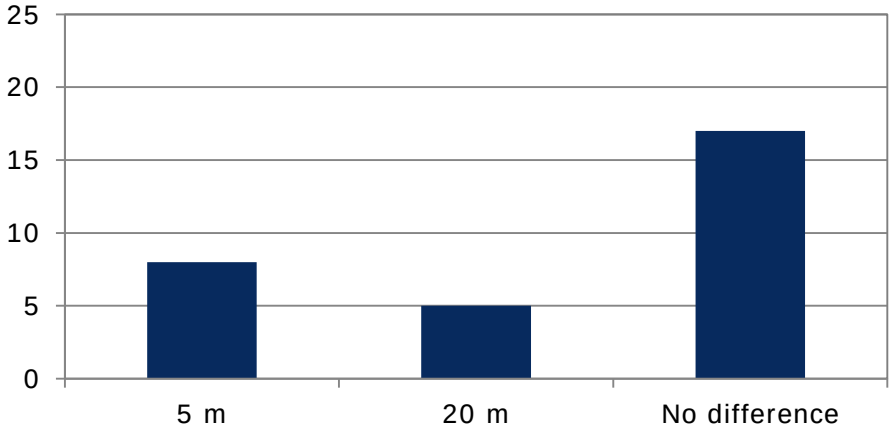
Safer to make the turn



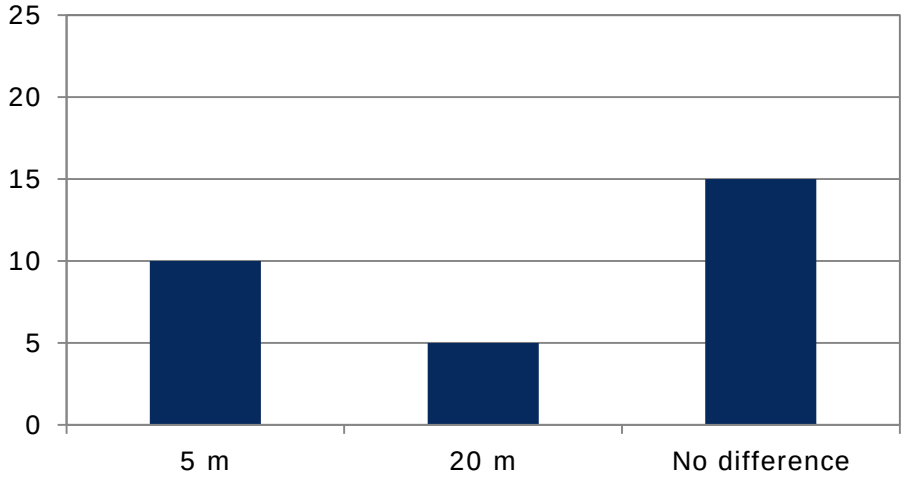
Easier to get into the correct position to make the turn



Easier to make the turn into the junction



Overall easier to use the junction



Appendix D Post Drive Questionnaire

POST DRIVE QUESTIONNAIRE

Please tick one answer only

1. Did you find it easy or difficult to decide when to turn left into the side road?
Please tick one answer only

Easy ☐ Fairly easy ☐ Neither ☐ Fairly difficult ☐ Difficult ☐

2. Did you change your initial decision about when to turn left into the side road?
Please tick one answer only

Yes ☐ No ☐

3. If yes, what was the reason you changed your decision?

Appendix E Final Questionnaire

FINAL QUESTIONNAIRE

Please tick one answer only

1. Please state your age

18-24 ☐ 25-34 ☐ 35-44 ☐ 45-54 ☐ 55-64 ☐ 65-75 ☐ 75+ ☐

2. How many days in a week do you usually travel by bicycle?

1 day ☐ 2 or 3 days ☐ 4 or 5 days ☐ 5 + days ☐ Never ☐

3. What is your MAIN reason (most often) for travelling by bicycle?

Commuting to/from work or education ☐ For work/as part of work ☐ Shopping ☐ Leisure/ recreation ☐ I don't cycle ☐

4. How far do you travel by bicycle during your most regularly made cycle trips (in one direction)?

Up to 1 mile ☐ 1 to 3 miles ☐ 4 to 5 miles ☐ Over 5 miles ☐ I don't cycle ☐

5. If you cycle, do you generally travel on the road or on cycle paths?

On road/ cycle lane on road ☐ Separate cycle path/ shared path ☐ Off-road ☐

6. How many days in a week do you usually use a car?

1 day ☐ 2 or 3 days ☐ 4 or 5 days ☐ 5 + days ☐ Never ☐

7. If you use a car, what is your MAIN reason (most often) for travelling by car?

Commuting to/from work or education ☐ For work/as part of work ☐ Shopping ☐ Leisure/ recreation ☐

8. If you use a car, how far do you usually travel during a car trip (in one direction)?

Up to 5 miles ☐ 5 to 10 miles ☐ 11 to 20 miles ☐ Over 20 miles ☐

YOUR EXPERIENCES TODAY - For the next series of questions, think about the cycle lane you have travelled alongside today.

The cycle lane was separated from traffic by a kerb. In some drives the kerb stopped a **short distance** from the junction and in other drives the kerb stopped a **long distance** from the junction (please refer to the picture card).

Please answer the following questions. Tick one answer only.

9. Did you notice that the kerb stopped at two different distances from the junction?

Yes ☐ No ☐

10. At which distance did you find it easier to see the cyclist in the cycle lane?

Short distance ☐ Long distance ☐ Both the same ☐

11. At which distance did you find it easier to judge the speed of the cyclist?

Short distance ☐ Long distance ☐ Both the same ☐

12. At which distance did you find it easier to judge the position of the cyclist?

Short distance ☐ Long distance ☐ Both the same ☐

13. At which distance did you find it easier to decide to turn before or after the cyclist?

Short distance ☐ Long distance ☐ Both the same ☐

14. At which distance did you find it easier to make the correct decision about when to turn?

Short distance ☐ Long distance ☐ Both the same ☐

15. At which distance did you find it easier to get into the correct position to make the turn?

Short distance ☐ Long distance ☐ Both the same ☐

16. At which distance did you find it easier to make the turn into the junction?

Short distance ☐ Long distance ☐ Both the same ☐

17. At which distance did you find it easier to use the junction overall?

Short distance ☐ Long distance ☐ Both the same ☐

18. At which distance did you find it safer to make the turn?

Short distance ☐ Long distance ☐ Both the same ☐

GENERAL OPINIONS

19. Do you think cyclists should join the main traffic earlier before the junction, or remain separate for as long as possible?

Joint traffic earlier ☐ Remain separated ☐ Don't know ☐

Can you tell us why?

20. Did you have any concerns or issues when using the road with the kerb stopping at a short distance near to the junction?

Yes ☐ No ☐ Don't know ☐

If you had any concerns or issues, what where they?

21. Did you have any concerns or issues when using the road with the kerb stopping at a long distance far from the junction?

Yes ☐ No ☐ Don't know ☐

If you had any concerns or issues, what where they?

22. Having used the road with the kerb ending at two different distances, are there any changes you would like to see?

Yes ☐ No ☐ Don't know ☐

What changes would you like to see?

23. Do you think that it would be a good idea or a bad idea to have segregated cycle lanes in your community?

Good idea ☐ Bad idea ☐ Don't know ☐

24. Do you think segregated cycle lanes are a good idea FOR CYCLISTS?

Yes ☐ No ☐ Don't know ☐

Can you tell us why?

25. Do you think segregated cycle lanes are a good idea FOR DRIVERS?

Yes ☐ No ☐ Don't know ☐

Can you tell us why?

26. Do you have any further comments about the segregated cycle lanes?

Appendix F Picture Card for Final Questionnaire