Transport Research Laboratory

Through junction running simulation study

by C Diels, N Reed, R Robbins, T Rees, I Summersgill, AM Parkes

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Executive summary

Introduction

Use of the hard shoulder as an active running lane has been demonstrated to be an effective measure to reduce congestion and improve journey time reliability on the M42 Active Traffic Management (ATM) pilot project (Sultan et al., 2008). A refinement that has the potential to improve traffic flows further by maximising the capacity of the motorway network would be to allow traffic to use the hard shoulder (HS) through junctions. This is termed Through Junction Running (TJR). Figure 1 shows some screenshots of TJR and displays the junction approach (a) through to the solid white line marking (d) to indicate the end of Hard Shoulder Running when the hard shoulder is closed.

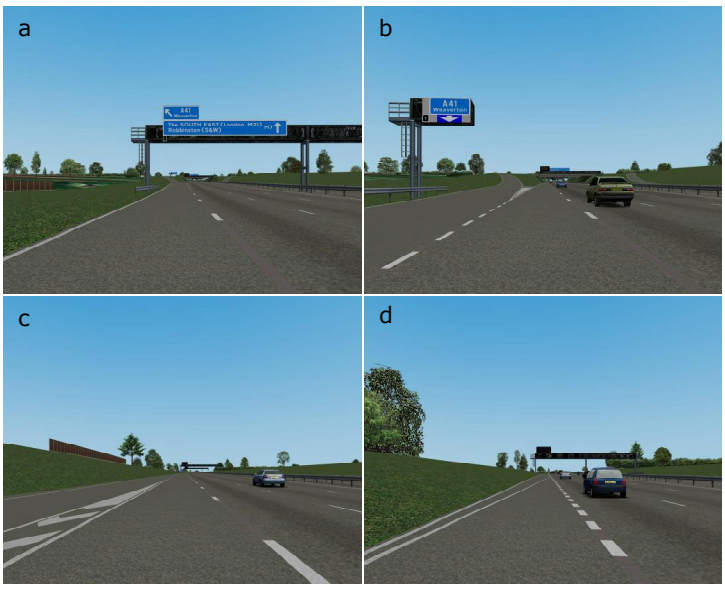


Figure 1 – Screenshots showing TJR from junction approach (a) to solid white line marking indicating the end of the hard shoulder as a normal running lane when hard shoulder is closed for traffic (d).

Of course, the introduction of TJR must not lead to a reduction in safety standards and, furthermore, the scheme must be reasonably intuitive such that naïve users on the scheme do not feel threatened or insecure on their journey. Understanding how drivers are likely to behave in a TJR scheme is critical in ensuring its safe and efficient operation. Furthermore, drivers' opinions, attitudes and acceptance of TJR must be understood in order to create a scheme that is usable and viewed positively by the motoring public. To this end a driving simulator study was conducted.

In addition to driving behaviour in a TJR scheme, a further aim of this study was to evaluate the effect of removal of the last sign on diverge, also known as the 'confirmatory gantry'. Three options were evaluated (see Figure 2). In line with the current guidance, Option 1 showed exit information on the slip road as well as ahead information on the final signal gantry. In Option 2, exit information was provided on the slip road gantry, but no ahead information on the final signal gantry. Finally, in Option 3, neither exit information nor ahead information was provided.

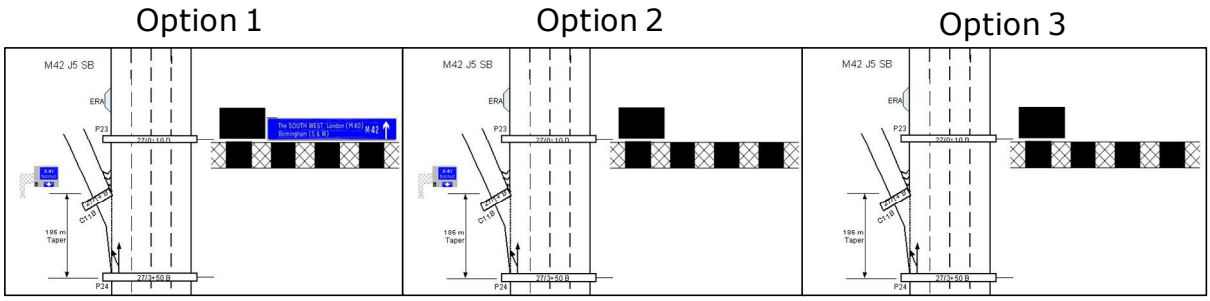


Figure 2- Diagram showing the 3 confirmatory gantry configuration options.

Methods

Investigating drivers' reactions to, and opinions of, TJR in a real-world setting would be potentially dangerous. Driving simulation provides a safe and efficient alternative method to answer these questions. TRL's advanced driving simulator not only permits the construction of a virtual TJR scheme which can be tested in safety, it also replicates the driving environment in high fidelity, in complex traffic conditions (see Figure 3 for a view of TRL's advanced car simulator).

The simulator allows for the capture of broad range of real-time behavioural data; in other words a detailed picture of each driver's performance, moment by moment, can be recorded and analysed in detail. These data are supplemented with a range of custom designed questionnaires which obtain measures of participants' subjective experience of each drive. From these two sources of data we can paint a clear picture of how drivers behave and feel during any drive.

Figure 3 - The TRL advanced car simulator.

In the simulator study, a total of 96 drivers participated, each driving a 40 minute route. These participants were evenly split into three groups, one for each confirmatory gantry configuration. Furthermore, within each of these groups, participants were evenly split into two age groups (Younger=17-44 yrs; Older = 45+ yrs) with an equal number of male and female participants in each group. This created 6 (age 2 x confirmatory gantry 3) experimental subgroups.

Each driver was required to drive a familiarisation route to acquaint themselves with the vehicle controls before completing a 40 minute drive along a 4 lane motorway with hard shoulder running available (but only open to traffic on some sections). The effect of TJR and confirmatory gantry configurations was evaluated on the basis of driving behaviour and subjective impressions as assessed by a series of questionnaires. In addition, eye movement recordings allowed for the evaluation of drivers' glances towards the different signs, and the confirmatory gantry signs in particular. Eye movement measures were the total number of glances and glance duration.

Results - Through Junction Running (TJR)

The first observation was that upon encountering the first TJR junction, more than half (54%) of participants drove in Lane Below Signal 1 (LBS1) – the hard shoulder. About 10% of the participants entered LBS1 from LBS2 within the junction. These results indicate that a large proportion of users will stay in lane when driving through the junction rather than move into LBS2 out of unfamiliarity with TJR. It further indicates that a considerable proportion of participants were confident crossing the white line to make use of the additional capacity.

The first TJR junction enabled the evaluation of the position at which participants moved from LBS1 to LBS2 when LBS1 was closed after the junction. As can be seen in Figure 4, the vast majority moved to LBS2 just before the start of the on-slip thereby avoiding any potential conflict with traffic joining the motorway. None of the participants continued in LBS1 following its closure.

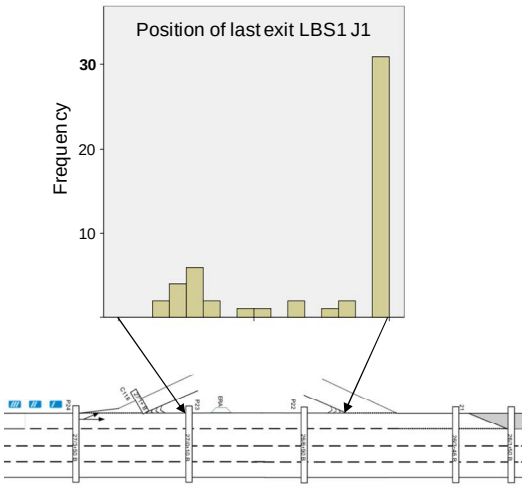


Figure 4 – Frequency distribution of the position of last exit LBS1 within Junction1 for participants driving in LBS1 (n=52).

In the sections connecting the first three TJR junctions, LBS1 was closed for traffic. The results showed that the level of contravention (illegitimate use of LBS1) was very low (<5%). In the first two sections only three and five participants drove in LBS1, respectively. None of the participants used LBS1 in the following section. This indicates that the road markings and signs clearly indicated whether LBS1 was open to traffic between junctions.

Exiting and rejoining the motorway with TJR creates a different scenario compared to normal hard shoulder running. With TJR, upon rejoining the motorway, traffic is likely to be present in LBS1 which means there is less space and opportunity to accelerate in order to join the through traffic on the motorway. To evaluate this, participants were

asked to leave and subsequently rejoin the motorway with LBS1 closed before and after the junction, but open within the junction.

Figure 5 shows the mean speed and mean lateral positions across participants in each of the six experimental subgroups. Note that each of the participant groups are identified by the acronyms in the figure legend. The first letter refers to age category (Younger vs. Older). The remainder of the acronyms refer to one of the three confirmatory gantry options, i.e. C1-C3 (see section 1.1.2). For example, YC1 refers to the group consisting of Younger participants encountering Confirmatory gantry option 1.

The figure shows two adjacent panels; the left panel shows the mean speed of participants in each group section whilst the right panel shows the mean lateral position of the simulator vehicle (with the X-axis gridlines demarcating the lane boundaries). The participants' movement along the route is represented by movement of the trace up the graph in the Y-axis.

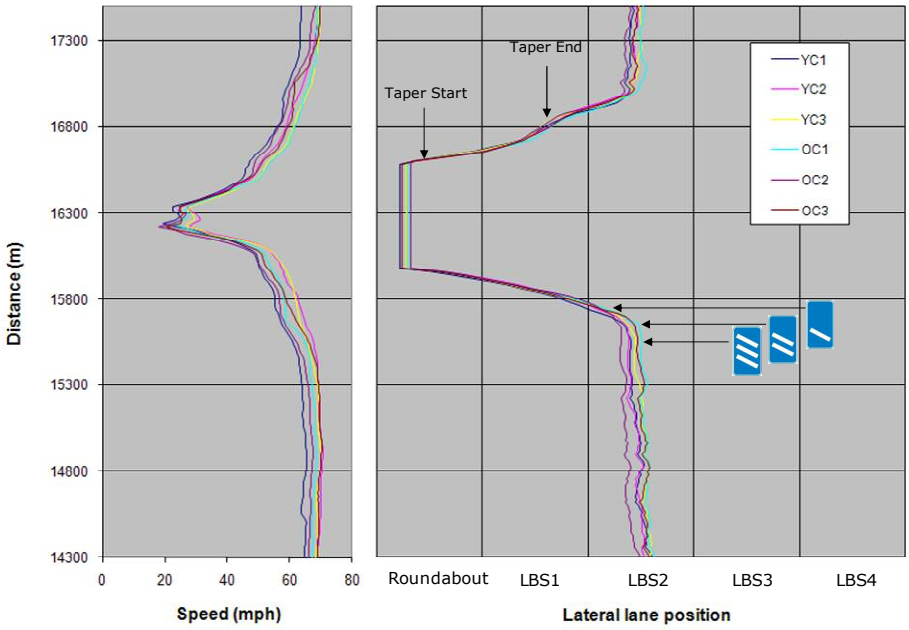


Figure 5 - Mean speed and mean lateral position of participants in Junction 2.

Overall, it can be seen that participants smoothly rejoined the motorway although the average speed at entering LBS1 was considerable lower (60mph) than the traffic within the junction which was travelling at the National Speed Limit (NSL). This was particularly true for Older participants (56mph) compared to Younger drivers (65mph). With the LBS1 open for traffic within the junction this may lead to braking and lane changing behaviour on behalf of through traffic in LBS1, which, in turn, may negatively affect safety and traffic flow. When asked to provide a safety rating when leaving and rejoining the motorway with LBS1 open or closed for traffic, participants rated rejoining the motorway when LBS1 was open as less safe.

TJR allows drivers to use LBS1 within junctions, even when LBS1 is closed both before and after a junction. One of the questions that arises is if and to what extent drivers will use the additional lane within the junction. The simulation study indicated that under these conditions, 23% of the participants moved from LBS2 to LBS1 to make use of the additional capacity. With LBS1 closed after the junction, those driving in LBS1 returned to LBS2 before the start of the on-slip avoiding potential conflict with joining traffic as was also observed in the first junction. It can be concluded that the extra capacity within

the junction was effectively used with drivers being able to rejoin the normal running lanes in time.

With LBS1 open to traffic in the preceding as well as the following link in junction 5, 73% of participants used LBS1 at some point. 44% of the participants drove in LBS1 throughout the entire junction. These results suggest that the majority of participants driving in LBS1 on the approach to the junction remain in LBS1, and continue to do so on passing the on-slip and thereafter. The majority of participants understood the concept of TJR properly.

Junction 6 was the only non-TJR junction, representing a junction as currently employed in the M42 ATM scheme. Despite the fact that participants had experienced TJR for each of the preceding five junctions, none of the participants illegitimately drove in LBS1. This suggests that combining TJR and non-TJR junctions is unlikely to lead to illegitimate use of LBS1 and that the signs and lane markings were clearly understood by all participants.

Overall, participants' comments indicated that TJR was thought to be beneficial in reducing congestion. However, a large number of participants expressed their concerns as to its effect on road safety and in particular the limited emergency services access and absence of a safe stopping place in case of vehicle breakdown.

Interestingly, several participants commented that the TJR junctions were less demanding in terms of attention and driving (i.e. lane changing) than the non-TJR junction.

Participants further mentioned feeling uneasy whilst being undertaken. Considering that undertaking is generally not permitted this may not be surprising. It can be expected that if participants were familiar with TJR they may express less concern at being undertaken. In line with this, several participants mentioned that following initial confusion about what lanes to use and when, once they had experienced the first few TJR junctions they quickly became used to the concept of TJR.

Finally, considering the low level of contravention and largely correct driving behaviour throughout the route, the TJR scheme as implemented in the current study appears to be largely self-explanatory.

Results - Confirmatory gantry

The different confirmatory gantry configurations were not found to affect driving behaviour as indicated by driving speed, lateral position or lane occupation.

There were also no apparent trends with regard to glance behaviour. The overall number of participants and number of glances towards the confirmatory gantry were very low and suggest the information displayed on the confirmatory gantry is not solicited very frequently. However, the navigational task of exiting the motorway at predefined exits could be considered a relatively undemanding task and hence not requiring the additional information displayed on the gantry.

Participants were also asked to rate the level of confidence they had left the motorway at the correct exit or had not missed any exits. The lower confidence level, as well as larger variability in confidence ratings in the participant group in which the confirmatory gantry was completely removed (option 3) suggests that the absence of the confirmatory gantry might have an effect, albeit small, on participants' confidence in following the correct direction. Further research might benefit from varying navigational task demands to evaluate the utilisation of the information displayed on the confirmatory gantry more fully.

Main Conclusions

- People are confident driving through the junctions

- Extra capacity both between and within junctions is used
- People move out of LBS1 after closure
- Signs indicating status of LBS1 between sections are clear
- Older people tend to rejoin the motorway at slower speeds
- Signs on rejoining the motorway are potentially unclear
- Presence of TO Service vehicle affects driving speed and lateral position
- The concept of TJR is understood
- Rejoining the motorway with LBS1 open was perceived as less safe
- Participants considered TJR as beneficial in reducing congestion
- Participants raised concerns regarding negative effects on road safety
- TJR junction experienced as less demanding than non-TJR junction
- Participants were uneasy being undertaken
- TJR scheme was largely self-explanatory
- Different confirmatory gantry configurations did not affect driving behaviour
- Confirmatory gantry signs were solicited infrequently
- Absence of confirmatory gantry might negatively affect participants' confidence in following the correct direction

1 Introduction

Several topics were studied as part a simulator trial. These are described in the following sections.

1.1 Through Junction Running

Use of the hard shoulder as an active running lane has been demonstrated to be an effective measure to reduce congestion and improve journey time reliability on the M42 Active Traffic Management (ATM) pilot project (Sultan et al., 2008). A refinement that has the potential to improve traffic flows further would be to allow traffic to use the hard shoulder (HS) through junctions – termed Through Junction Running (TJR). This simulator study was designed to test participants' behaviour in response to the planned implementation of TJR in terms of their ability to respond to the new signage and road marking schemes in a safe and appropriate manner.

1.2 Confirmatory gantry

A further aim of this study was to evaluate the effect of removal of the last sign at the diverge, also known as the 'confirmatory gantry'. Three options were evaluated (see Figure 6).

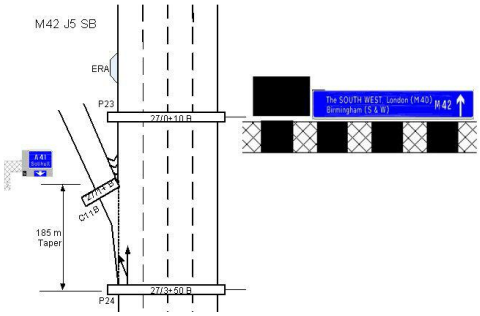
Option 1: in line with the current guidance, this option showed exit information on the slip road as well as ahead information on the final signal gantry.

Option 2: exit information was provided on the slip road gantry, but no ahead information on the final signal gantry.

Option 3: neither exit information nor ahead information was provided.

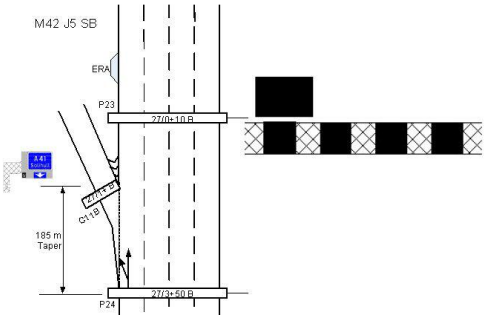
Option 1:

Slip Road Gantry exit information AND Final Signal Gantry ahead information



Option 2:

Slip Road Gantry exit information only



Option 3:

No information

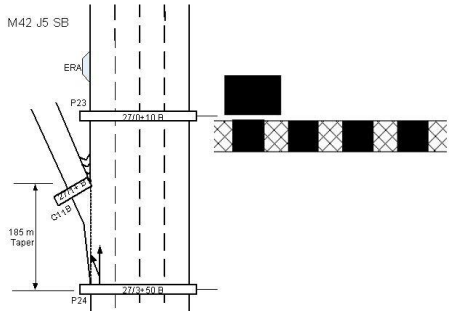


Figure 6 - Diagram showing the 3 confirmatory gantry configuration options.

For each of the above topics, an assessment of the impacts on safety and behaviour was made, along with a commentary on likely effects on the network.

1.3 Roof-bar lighting

An additional aim of this study was to investigate the safety case for different roof-bar lighting configurations on Traffic Officer Service vehicles. The vehicles currently display flashing amber lights when required (for example, whilst stationary on the hard shoulder). This study investigated driver behaviour in response to different configurations[1]. The different configuration variables are summarised below. In the study there were ten (lighting configuration (5) x vehicle position (2)) unique combinations of roof bar lighting and vehicle position.

1. Comparison of behavioural response to different roof-bar lighting configurations
    - Flashing red
    - Flashing amber
    - Flashing red & amber
    - Flashing blue
    - Unlit (control – normal vehicle lights, but no roof-bar light)
2. Comparison of behavioural response to varied positions of traffic officer vehicle

[1] In this study, note that simulated daylight conditions are considered only. Driver behaviour in simulated night-time driving conditions will be investigated as part of an Emergency Refuge Area study and the principal Roof Bar Lighting study. For further details, please refer to the relevant study plans.

- Parked parallel to lane in hard shoulder
- Parked fend-in in hard shoulder (at an angle)

A proportion of participants also completed the simulator drive with no Traffic Officer Service vehicle present. This acted as a baseline to which behaviour in the presence of the Traffic Officer Service vehicle could be compared.

Note that the roof-bar lighting study formed part of a bigger study into behavioural responses to Traffic Officer Service vehicle roof-bar lighting configurations. Consequently, the results obtained in the present study will not be reported here but can be found in the TO Service vehicle configuration report.

2 Methods

2.1 Participants and experimental design

Ninety-six participants were recruited from the TRL participant database to take part in this study. All participants had previously been familiarised with the TRL driving simulator and all possessed a current valid driving licence. There were no particular inclusion/exclusion criteria based on previous experience of hard shoulder use.

Age

Driving behaviour across the age range varies considerably (e.g. Schlag, 1993). Younger drivers are more likely to drive at faster speeds and more likely to engage in lane-changing behaviour. Older drivers are less likely to change lanes and therefore may fail to take advantage of the additional capacity that TJR provides. Consequently, their behaviour in response to TJR was of interest.

There were two levels of age across participants, Younger (17-44 years; n=50) and Older (45+ years; n=46) drivers. There was an equal number of males and females in each age group.

Confirmatory gantry configuration

Each participant drove the route under one of the three confirmatory gantry configurations (see section 1.2 for further details). This means that each of the three combinations was encountered by 32 participants.

Roof-bar lighting configurations

Eighty participants drove past stationary Traffic Officer Service vehicles parked on the hard shoulder under one of the ten conditions. This means that each of the ten combinations (see section 1.3 for further details) was encountered by eight participants. The remaining sixteen participants completed the simulator drive with no Traffic Officer Service vehicle present.

The design required each participant to drive in the simulator for a period of around 40 minutes, following an initial familiarisation drive to acquaint them with the controls of the vehicle and allow them to settle down to normal behaviour in the simulated environment. Each participant session lasted for about an hour, including introduction, familiarisation and debriefing.

2.2 Participant instructions

Participants were given standard instructions before driving the simulator. They were told to 'drive as they would normally do' and that their 'driving was not being judged'. They were also told that they 'should not treat the simulator like a computer game'. Participants were not given any information regarding hard shoulder running and the concept of TJR. Hence, all participants were naïve as to the purpose of the study.

2.3 Measures

2.3.1 Behavioural measures

Measures of interest with regard to driving included lane position, lane changing behaviour, and driving speed.

Eye movement recordings allowed for the evaluation of drivers' glances towards the different signs, and the confirmatory gantry signs in particular. Eye movement measures

were the total number of glances and glance duration. Figure 7 shows the eye movement recording system (SmartEye) displaying a participant's view from three infrared cameras mounted on the dashboard. By automatically connecting glance directions to the known coordinates of objects within the simulated environments, it is possible to reliably measure the number and duration of glances to objects of interest such as the confirmatory gantry.

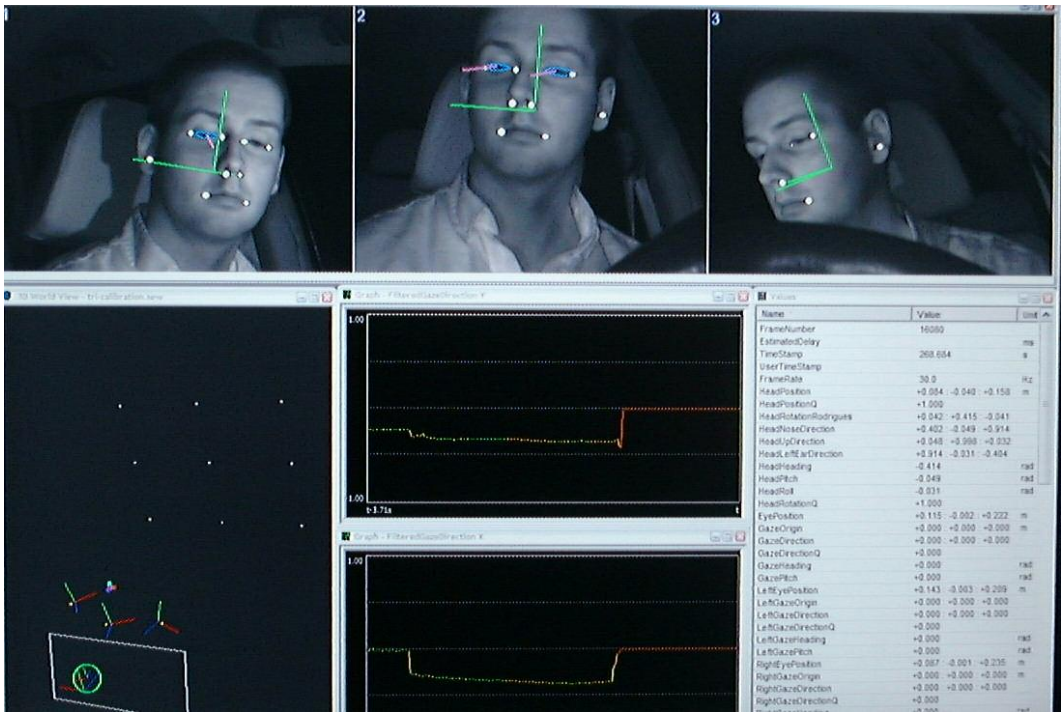


Figure 7 – SmartEye eye movement recording system.

2.3.2 Questionnaire

The trial was concluded by participants completing a questionnaire that investigated participants' subjective responses to driving through the TJR scheme as well as their attitudes towards managed motorways. It also ascertained their previous experience of using the M42 ATM section as this may have had a bearing on their expectations and behaviour through the simulated scenario in which TJR is allowed. In addition, the questionnaire addressed specific questions with regard to i) confirmatory gantry options (see section 1.2), ii) Traffic Officer Service vehicles' roof-bar lighting and position configurations (see section 1.3), and iii) understanding of the "prism gantry".

Prism gantry

The "prism gantry" refers to a new design of the ½ Mile ahead information gantry as shown in Figure 8. Depending on the status of the Lane Below Signal 1 (LBS1 – The hard Shoulder) (i.e. open vs. closed) the ahead information and downward arrow can be greyed out by means of a rotating prism as show in Figure 8.

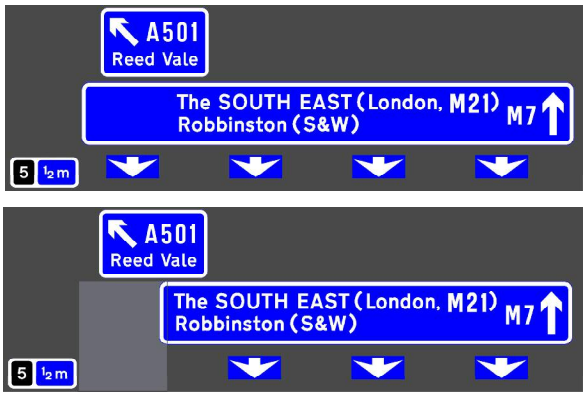


Figure 8 – New design of the ½ Mile ahead information "prism gantry". Top and bottom figure indicate LBS1 to be open and closed for traffic, respectively.

2.4 Route design

2.4.1 General features

The road throughout consisted of 54km of a 4-lane motorway with hard shoulder running available (but only open to traffic on some sections). The road layout, signs, and lane markings in the route were based on the Highways Agency documents '*Managed Motorway Implementation Guidance – Dynamic use of the hard shoulder*' and '*Managed Motorway Implementation Guidance – Through junction hard shoulder running*'. Where relevant, specific design features of the M42 Junction 5 southbound were included.

The motorway surroundings were generic with fields and trees. There were some bridges going across the motorway and junctions included. Where heavy traffic conditions were specified, each autonomous vehicle within the simulation was programmed to follow the vehicle ahead as closely as possible. Whilst this created a high density of traffic, gaps remained between vehicles into which it was possible to drive the simulator vehicle. However, this level of gap acceptance could be considered unsafe.

2.4.2 Route summary

Table 1 summarises the sections that drivers experienced through the trial. The three columns to the right of Table 1 show the status of the LBS1 in the links preceding and following each junction and within the junction itself. The status of the hard shoulder within junctions 2 and 7 is shown in brackets because the participant did not drive through these junctions but left the motorway and rejoined at the same junction. A schematic overview of the simulator scenario is provided in Figure 9. In addition to the speed restrictions above each lane, messages were displayed wherever the hard shoulder was open to traffic. On most of the sections, the message displayed was "CONGESTION USE HARD SHOULDER". On Section E (on the approach to the non-TJR junction), this message was only displayed on the first few signs. The majority of the messages on the approach to Junction 6 were "USE HARD SHOULDER FOR JUNCTION 6 ONLY".

Appendix 1 shows a schematic overview of the junction layouts employed in this study and defines the start and end of each junction. In addition, it shows the position of the 'prism gantry' and 'confirmatory gantry' within each junction.

Table 1 - Summary of the sections within the TJR simulator trial. LBS1 status is shown in the three end columns as open (O) or closed (C) to normal traffic before the junction (Pre-jct), within the junction (In-jct), or after the junction (Post-jct).

		LBS1 status		
Section	**Brief description**	**Pre-jct**	**In-jct**	**Post-jct**
Lead-in	Familiarisation; light traffic; LBS1 open			
Junction 1	TJR @ 60mph	O	O	C
Section A	Light traffic, 3 normal lanes open; LBS1 closed			
Junction 2	TJR @ 70mph Ppt exits and rejoins m/way with LBS1 closed	C	(O)	C
Section B	Light traffic, 3 normal lanes open; LBS1 closed			
Junction 3	TJR @ 70mph	C	O	C
Section C	Light traffic, 3 normal lanes open; LBS1 closed Traffic Officer vehicle parked on LBS1			
Junction 4	TJR @ 70mph	C	O	O
Section D	Heavy traffic; LBS1 open; 4VSL @ 60mph			
Junction 5	TJR @ 60mph	O	O	O
Section E	Heavy traffic; LBS1 open; 4VSL @ 60mph			
Junction 6	Non-TJR @ 60mph	O	C	O
Section F	Heavy traffic; LBS1 open; 4VSL @ 60mph			
Junction 7	TJR @ 60mph Ppt exits and rejoins m/way with LBS1 open	O	(O)	O
Lead-out	End of simulator scenario			

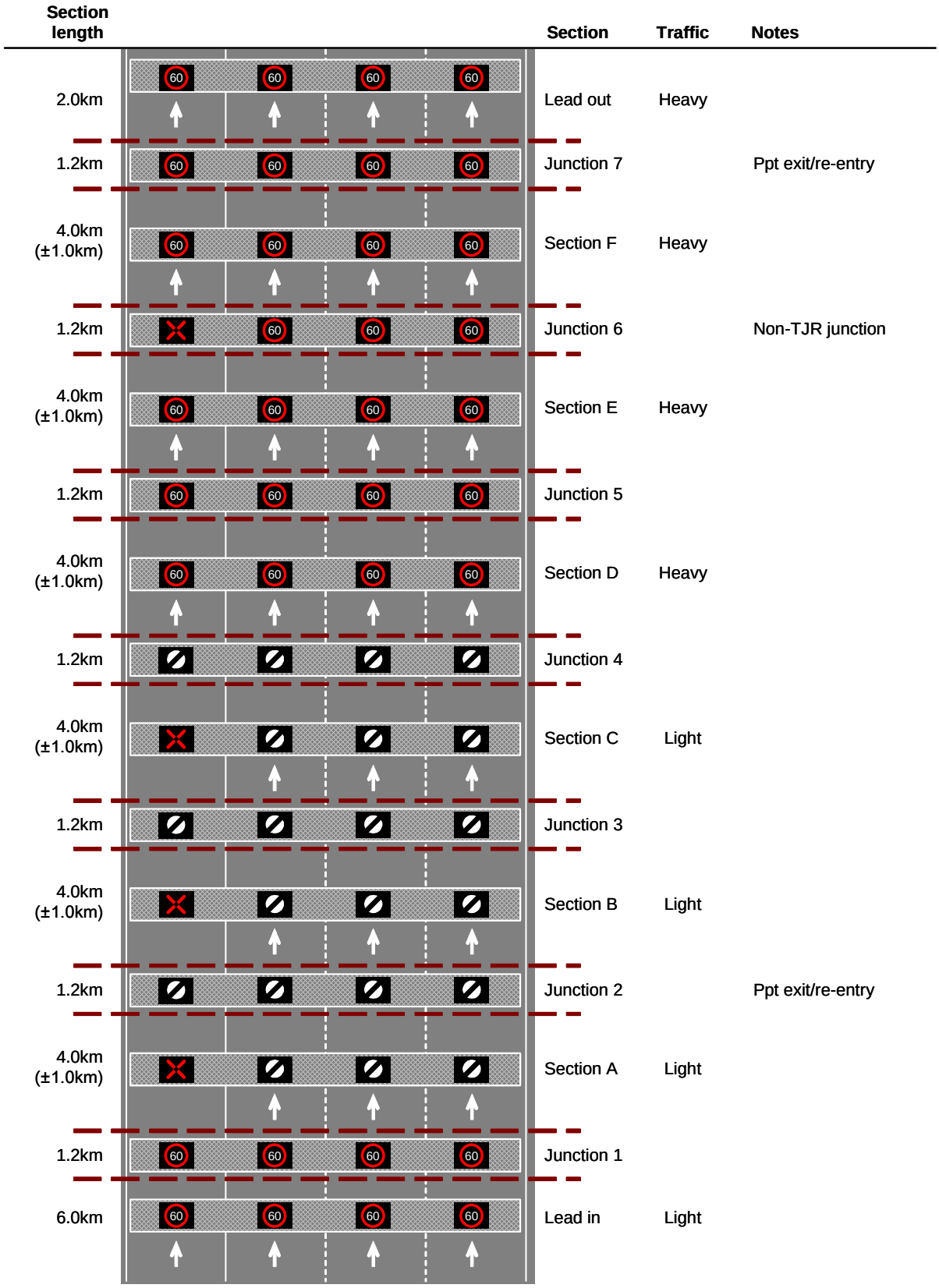


Figure 9 - Schematic overview of the simulator scenario

2.4.3 Route details

Section: Lead-in

Description: Familiarisation; 4 Lane VSL @ 60mph

Details: This was a 6.3km section with 4 Lane Variable Speed Limit (VSL) at 60mph. Light traffic was present comprising a mixture of cars, lorries, and buses travelling at 40-60mph. This section was included to enable drivers to become familiar with both the controls of the simulator vehicle and the feel of driving through the virtual environment. Experience shows that 5 minutes of driving allows the participant to relax into the task such that they start to behave as they would on real roads.

Analysis: Analysis in this section focussed on drivers' average speed as they negotiated the light traffic. It was expected that younger drivers would travel at significantly higher speeds than drivers in the older age group.

Section: Junction 1 – (OOC)

Description: TJR @ 60mph

Details: In this section the participant first encountered TJR. This section was included to investigate behaviour in relation to TJR when the preceding link has the LBS1 open but the following link has the LBS1 closed.

Analysis: The analysis focussed on whether participants chose to use the LBS1 through the junction and how and where they chose to leave the LBS1 if they were in that lane through the junction.

Section: A

Description: Light traffic, 3 normal lanes open; LBS1 closed

Details: This section had 3 Lane VSL at the national speed limit. Light traffic was present in advance of junction 2, where the participant was instructed to leave the motorway.

Analysis: Basic analysis of drivers' speed and lane choice.

Section: Junction 2 – (C(O)C)

Description: TJR @ 70mph

Details: Participants were instructed to leave the motorway at this junction and drive over the roundabout to rejoin the motorway. This junction was included to test how participants leave and rejoin the motorway when the LBS1 is not available as a running lane.

Analysis: The analysis of driver behaviour focussed on participants' behaviour when leaving and when rejoining the motorway with the hard shoulder closed on the links preceding and following the junction.

Section: B

Description: Light traffic, 3 normal lanes open; LBS1 closed

Details: This section had 3 Lane VSL at the national speed limit. Light traffic was present. This section provided a link with the LBS1 closed.

Analysis: Basic analysis of drivers' speed and lane choice.

Section: **Junction 3 – (COC)**

Description: TJR @ 70mph

Details: In this section the participant encountered TJR at the national speed limit. This section was included to investigate behaviour in relation use of TJR when the preceding and following links had the LBS1 closed.

Analysis: The analysis focussed on whether participants chose to use the LBS1 through the junction and how and where they chose to leave the LBS1 if they were in that lane through the junction.

Section: **C**

Description: Light traffic, 3 normal lanes open; LBS1 closed

Details: This section had 3 Lane VSL at the national speed limit with light traffic present. This section provided a link with the LBS1 closed.

In this section, the Traffic Officer vehicle was parked on the hard shoulder under one of the ten conditions (2 position x 5 vehicle configuration).

Analysis: Basic analysis of drivers' speed and lane choice. In addition, the behavioural (including eye movement data) and subjective responses with regard to the Traffic Officer Service vehicle were of interest. As mentioned previously, the results regarding the Traffic Officer Service vehicle are not presented here.

Section: **Junction 4 – (COO)**

Description: TJR @ 70mph

Details: In this section the participant encountered TJR at the national speed limit. This section was included to investigate behaviour in relation use of TJR when the preceding link had the LBS1 closed but the following link had the LBS1 open.

Analysis: The analysis focussed on whether participants chose to use the LBS1 through the junction and whether they chose to stay in the LBS1 through the junction.

Section: **D**

Description: Heavy traffic, 4 Lane VSL @ 60mph

Details: This section had 4 Lane VSL at 60mph with heavy traffic conditions. This section provided a link with the LBS1 open.

Analysis: Basic analysis of drivers' speed and lane choice.

Section: **Junction 5 – (OOO)**

Description: TJR @ 60mph

Details: In this section the participant encountered TJR at 60mph. This section was included to investigate behaviour in relation use of TJR when the preceding and following links had the LBS1 open.

Analysis: The analysis focussed on whether participants chose to use the LBS1 through the junction and whether they chose to stay in the LBS1 through the junction.

Section: **E**

Description: Heavy traffic, 4 Lane VSL @ 60mph

Details: This section had 4 Lane VSL at 60mph. Traffic conditions were heavy. This section provided a link with the LBS1 open in advance of a junction at which TJR was not available. Traffic conditions favoured the participant being in the LBS1 to make most rapid progress. The Variable Message Sign (VMS) sign above LBS1 displayed the text: 'Use hard shoulder for Junction 6 only'.

Analysis: Analysis in this section focussed on the position at which drivers chose to leave the LBS1 in advance of the junction.

Section: **Junction 6 – (OCO)**

Description: Non-TJR @ 60mph

Details: In this section the participant encountered a junction at which TJR was not available. VSL at 60mph applied across the available lanes. This section was included to investigate drivers' behaviour when they had experienced a number of junctions where the LBS1 was available as a running lane but it was unavailable through this junction.

Analysis: The analysis focussed on whether participants chose to use the LBS1 through the junction, contravening the signs indicating its closure.

Section: **F**

Description: Heavy traffic, 4 Lane VSL @ 60mph

Details: This section had 4 Lane VSL at 60mph with heavy traffic conditions. This section provided a link with the LBS1 open in advance of the junction at which TJR the participant was instructed to leave the motorway. Traffic conditions favoured the participant being in the LBS1 to make most rapid progress.

Analysis: Analysis in this section focussed on whether drivers chose to use the LBS1 on the approach to the junction.

Section: **Junction 7 – (O(O)O)**

Description: TJR @ 60mph

Details: Participants were instructed to leave the motorway at this junction and drive over the roundabout to rejoin the motorway. This junction was included to test how participants leave and rejoin the motorway when the LBS1 is available as a running lane.

Analysis: The analysis of driver behaviour focussed on participants' behaviour when leaving and when rejoining the motorway with the hard shoulder closed on the links preceding and following the junction.

Section: **Lead-out**

Description: 4 Lane VSL @ 60mph

Details: A short distance after having successfully rejoined the motorway, participants were informed that they had reached the end of the simulator trial and were asked to bring the vehicle to a halt.

Analysis: This section did not provide any meaningful data and was included to provide a convenient end of the trial.

3 TJR - Driving behaviour results

3.1 Section: Lead-in

The aim of lead-in section was to re-familiarise participants with the simulator. With regard to TJR, this section did not provide any meaningful data other than the finding that, as expected, Younger drivers drove at significantly ($p<0.05$) higher speeds (mean=67mph; SD=7.5mph) than Older drivers (mean=60mph; SD=9.4mph).

3.2 Section: Junction 1 – (OOC)

Junction 1 was the first junction at which participants encountered TJR. Results showed that more than half the participants (52 out of 96 or 54%) chose to use LBS1 within junction 1 (see Table 2). There was no significant difference in the use of LBS1 within junction 1 between the age categories (29 out of 50 Younger; 23 out of 46 Older participants). The vast majority of participants (74%) driving on LBS1 within Junction 1 was already in LBS1 on approach to Junction 1. 13 out of 52 participants entered LBS1 from LBS2 within Junction 1.

Table 2 – Number of participants driving in LBS1 within junction 1

Use of LBS1 within Junction1? (n=96)			
Yes 54% (n=52)		No 46% (n=44)	
Younger (29)	Older (23)	Younger (21)	Older (23)

Figure 10 shows the frequency distribution of positions within Junction 1 at which participants exited LBS1 to join LBS2 in response to the closed hard shoulder (LBS1) in Section A. It can be seen that the vast majority of participants chose to leave LBS1 at the start of the 205m taper.

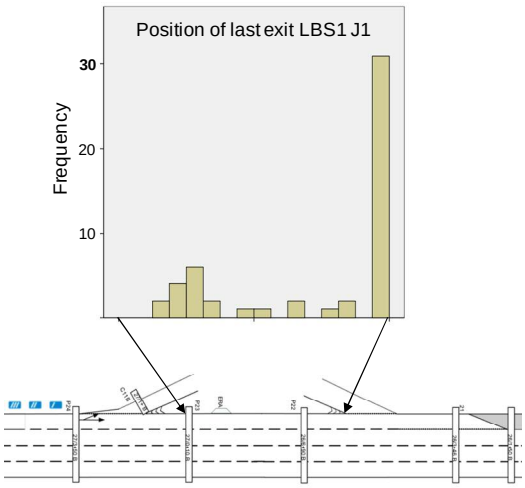


Figure 10 – Frequency distribution of the position of last exit LBS1 within Junction1 for participants driving in LBS1 (n=52).

3.3 Section: A

Section A had 3 Lane VSL running at the national speed limit with light traffic in advance of junction 2, where the participant was instructed to leave the motorway. In this section LBS1 was closed for traffic. The level of contravention was found to be low with only three participants (2 Older, 1 Younger) using LBS1 within Section A.

Throughout the section, participants drove at a relatively constant speed ranging between 65 and 75mph. The vast majority of participants (n=91) used LBS2 only, whereas 2 (Younger) participants used LBS3.

3.4 Section: Junction 2 – (C(O)C)

In this section, participants were instructed to leave the motorway at Junction 2 and drive over the roundabout to rejoin the motorway. Figure 11 shows the mean speed and mean lateral positions across participants in each of the six experimental subgroups. Note that each of the participant groups are identified by the acronyms in the figure legend. The first letter refers to age category (Younger vs. Older). The remainder of the acronyms refer to one of the three confirmatory gantry options, i.e. C1-C3 (see section 1.2). For example, YC1 refers to the group consisting of Younger participants encountering Confirmatory gantry option 1.

The figure shows two adjacent panels; the left panel shows the mean speed of participants in each group section whilst the right panel shows the mean lateral position of the simulator vehicle (with the X-axis gridlines demarcating the lane boundaries). The participants' movement along the route is represented by movement of the trace up the graph in the Y-axis. Although the graph cannot provide detailed information about individual behaviour, it is instructive in relation to the general behaviour of participants within each group.

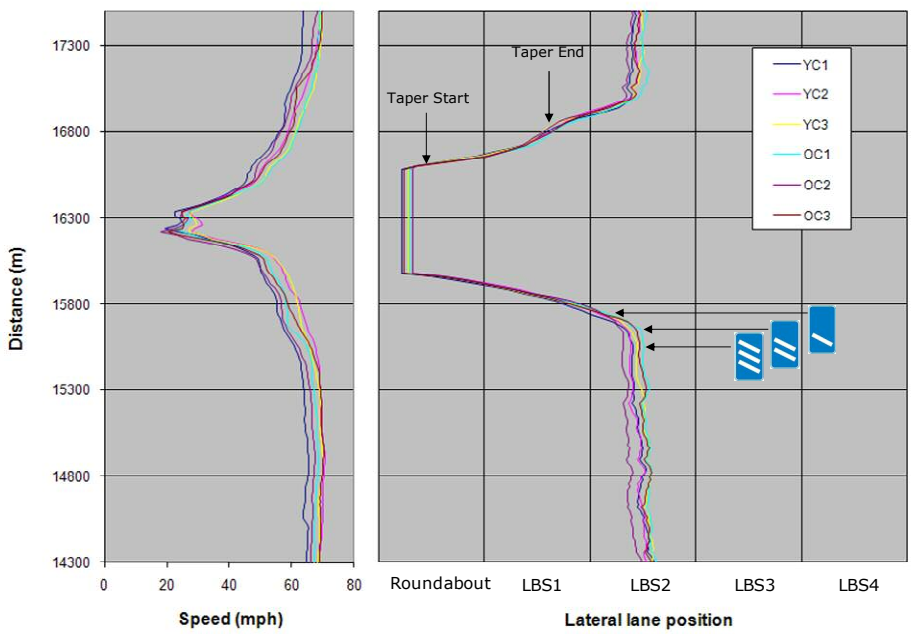


Figure 11 - Mean speed and mean lateral position of participants in Junction 2.

It can be seen that all six groups exited and rejoined the motorway in a similar fashion. Further analysis indicated that there were no statistically significant differences between groups with regard to speed and lateral position upon junction and exit approach.

Participants rejoined the motorway with an average speed of 60.4mph (SD=10.3) with Younger drivers joining the carriageway at significantly higher speeds (65mph) than Older drivers (56mph) ($P<0.05$). Not surprisingly, no significant differences were observed between the different groups based on confirmatory gantry configurations.

Figure 12 shows the frequency distribution of positions at which participants entered LBS2 after rejoining the motorway in junction 2. The majority of participants entered LBS2 just after the 205m taper with only a few participants joining LBS2 within the 75m taper (see Appendix 1 for detailed description of the junction). 5 out of 96 participants failed to enter LBS2 and continued on LBS1 despite this lane being closed for traffic.

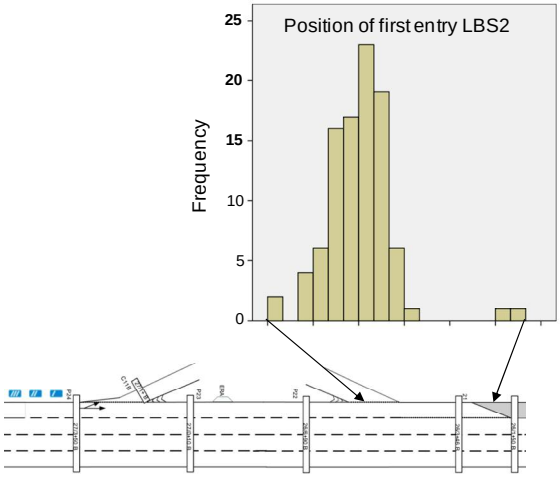


Figure 12 - Frequency distribution of the position of first entry LBS2 after rejoining the motorway in Junction 2 (n=91).

3.5 Section: B

Section B had 3 Lane VSL running at the national speed limit with light traffic. In this section, LBS1 was closed for traffic and provided a link with LBS1 closed in the subsequent junction 3.

4 out of 5 participants who continued on LBS1 after rejoining the motorway in junction 2 kept using LBS1 throughout Section B. This would suggest they were unaware LBS1 was closed for traffic. The remaining participant appeared to have realised LBS1 was closed for traffic soon after arriving in Section B and subsequently performed a lane change into LBS2.

As in Junction 2, no differences were found between the different experimental groups with regard to speed and lateral position. On average, all groups stayed in LBS2 throughout Section B at an average speed of 70mph (SD=4.9).

3.6 Section: Junction 3 (COC)

In this section the participant encountered TJR at the national speed limit. This section was included to investigate behaviour in relation to use of TJR when the preceding and following links had the LBS1 closed.

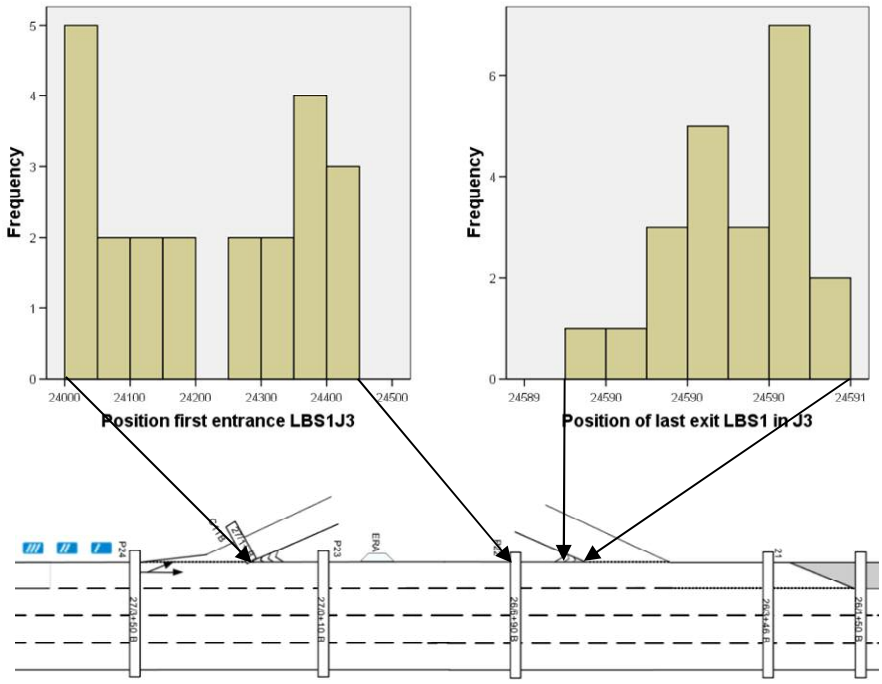


Figure 13 – Frequency distribution of the position of first entry and last exit LBS1 within Junction 3 (n=22).

With LBS1 open within the junction, 22 out of 96 participants (23%) drove on LBS1. Figure 13 shows the frequency distribution of the position of first entry into and last exit from LBS1 within Junction 3. It can be seen that the point of entrance is fairly widely distributed with some participants choosing to use LBS1 from the beginning whereas others enter LBS1 halfway the junction.

Unlike the position of first entry, the position of last exit shows a significantly narrower distribution. All but two participants returned to LBS2 before the start of the 205m taper, the point at which the on slip joins the main carriageway and other traffic merges with traffic on the main carriageway.

3.7 Section: C

Section C had 3 Lane VSL at the national speed limit with light traffic present and provided a link with the LBS1 closed. In addition, the Traffic Officer vehicle was parked on the LBS1 under one of the ten conditions (2 position x 5 vehicle configuration).

Figure 14 shows the mean speed and mean lateral positions across participants in each of the six experimental subgroups in section C. In the left panel, it can be clearly seen that the presence of the TO Service vehicle resulted in a slight decrease in approach speed and this was particularly pronounced in the OC2 group. The lateral position as shown in the right panel indicates that, overall, the presence of the TO Service vehicle led to a considerable deviation with regard to road position in LBS2 and this was consistent across the different groups.

As mentioned earlier, the effects of the TO Service vehicle and the different configurations are not reported here. Further details will be provided in a separate TO Service vehicle configuration report.

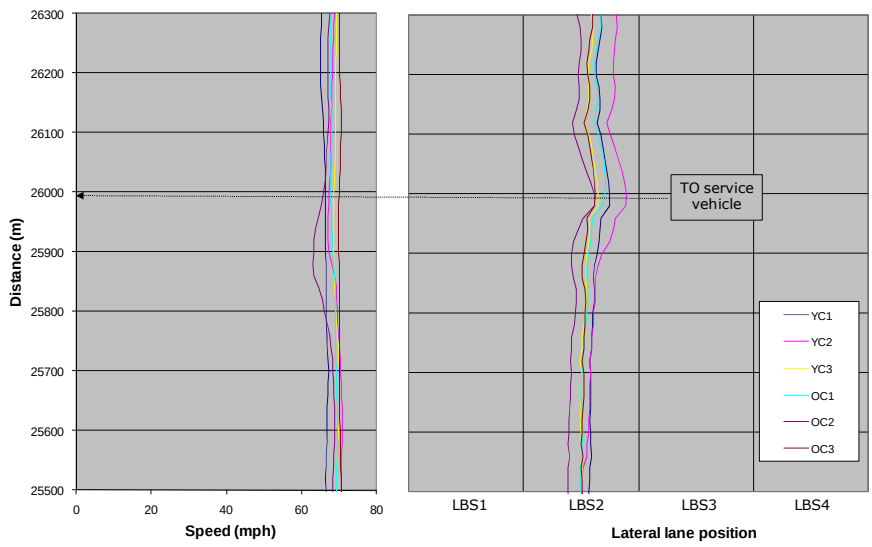


Figure 14 - Mean speed and mean lateral position of participants in Section C.

3.8 Section: Junction 4 – (COO)

In Junction 4, participants encountered TJR at the national speed limit. LBS1 in the preceding section was closed and opened only within Junction 4. A similar picture emerged as observed in Junction 3 whereby a similar proportion of participants (17 out of 96 or 18%) choose to drive in LBS1. All 17 participants subsequently continued their drive in LBS1.

3.9 Section: D

In section D, participants encountered heavy traffic with 4 Lane VSL at 60mph and provided a link with LBS1 open in Junction 5. Figure 15 shows the mean lateral position for each group. It can be seen that following Junction 4, an increasing number of participants choose to drive in LBS1 as indicated by the overall shift towards LBS1. 71 out of 96 participants drove in LBS1 at some stage within Section D, 45 of which used LBS1 throughout the whole of Section D. 24 participants used only LBS2 whereas none of the participants used LBS3 or 4. The average speed in Section D was 59.3mph (range = 54-63mph) indicating that the participants complied with the VSL.

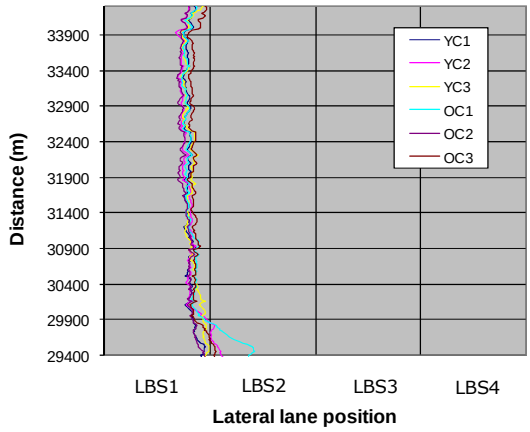


Figure 15 - Mean lateral position of participants in Section D.

3.10 Section: Junction 5 – (OOO)

In Junction 5 participants encountered TJR at 60mph with LBS1 open to traffic in both preceding and following links. The aim of this junction was to evaluate whether participants chose to use LBS1 through the junction and whether they chose to stay in LBS1 through the junction.

The mean speed and lateral position are shown in Figure 16. A small reduction in speed and increased variability in lateral lane position can be seen on approach to the area between the off- (185m taper start) and on-slip (205m taper start) within Junction 5.

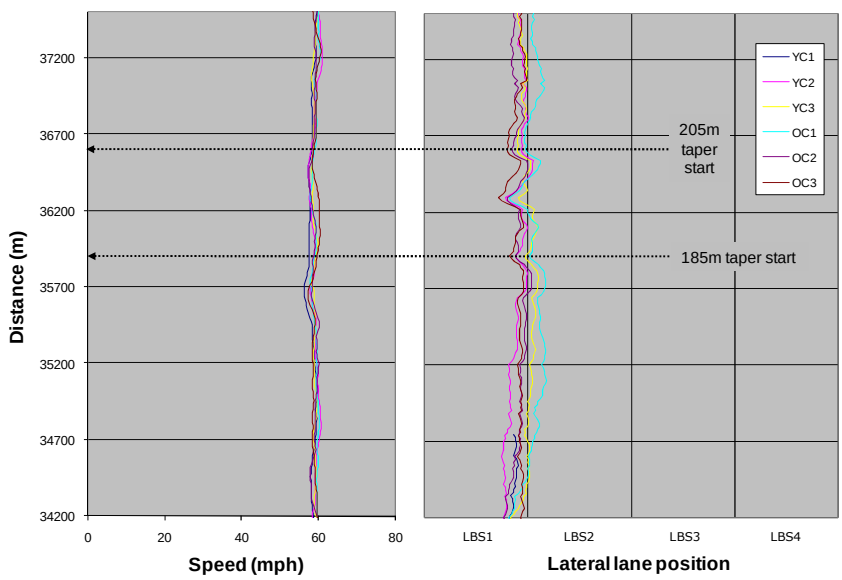


Figure 16 - Mean speed and lateral position of participants in Junction 5.

70 out of 96 (73%) participants drove in LBS1 for an average of 59% of the time. 42 of these participants drove on LBS1 throughout the whole of Junction 5. 53 out of 96 (55%) participants drove in LBS2 for an average of 40% of the time. 25 of these participants drove on LBS2 only.

63 out of 96 (66%) participants drove in LBS1 within Junction 5 between the off- and on-slip for an average of 59% of the time. All but five participants were already in LBS1 when first entering LBS1 within Junction 5 between the off- and on-slip. Only 7 out of 63 participants left LBS1 within Junction 5 before the start of the on-slip. The vast majority (56 out of 63, or 89%) of participants stayed in LBS1 when passing the on-slip.

It can be concluded that the majority of participants driving on LBS1 on approach to the junction remained in this lane within the junction, and continued to do so on passing the on-slip and thereafter.

3.11 Section: E

Section E had 4 Lane VSL at 60mph with heavy traffic conditions. This section provided a link with the LBS1 open in advance of the junction at which TJR was not available. Figure 17 shows the percentage use of LBS1-4 in Section E. It can be seen that the vast majority of participants drove in LBS2 throughout the section. This reason for this was the fact that the VMS sign above LBS1 displayed the text 'Use hard shoulder for Junction 6 only'. As indicated by the results, the vast majority followed the VMS advice. With an average speed of 59.6mph (range = 55.7 - 62.2mph), the participants adhered to the speed limit.

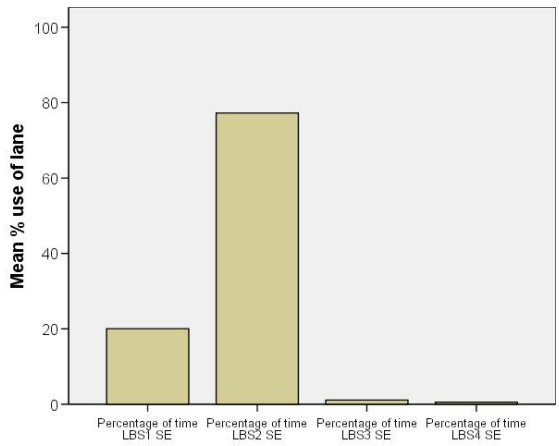


Figure 17 – Percentage use of the four lanes LBS1-4 in Section E.

3.12 Section: Junction 6 - (OCO)

Junction 6 was a non-TJR or standard junction as currently employed in ATM schemes. This section allowed for the evaluation of drivers' behaviour when they had experienced a number of junctions where LBS1 was available as a running lane but unavailable through this junction.

The results showed that none of the participants drove in LBS1 within Junction 6 between the off- and on-slip. Thus, there was no contravention despite the fact that participants had experienced TJR for each of the preceding 5 junctions. This suggests that the signs and lane markings were clearly understood by all participants.

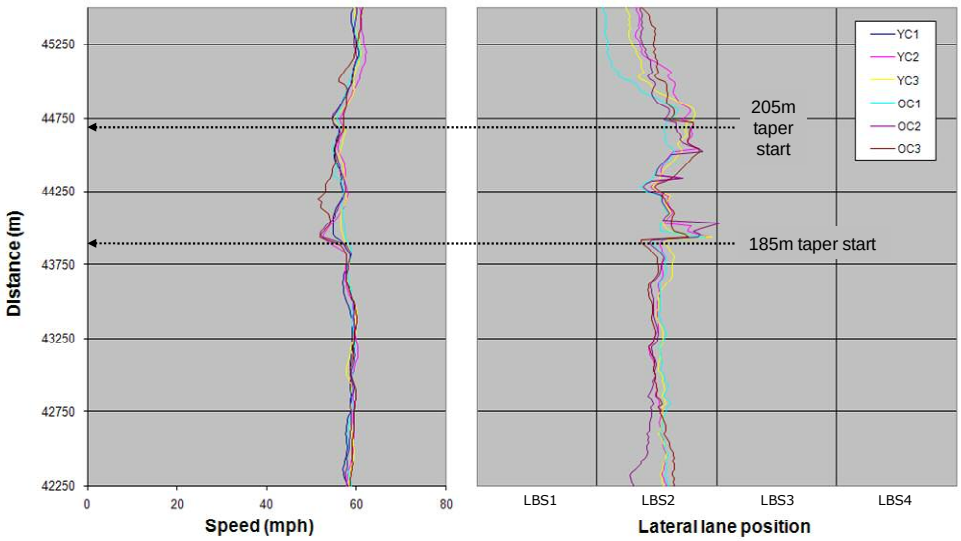


Figure 18 – Mean speed and lateral position of participants in Junction 6.

When plotting mean speed and lateral position within Junction 6 (see Figure 18), it can be seen that the closure of LBS1 between the off-slip (i.e. 185m taper start) and on-slip (i.e. 205m taper start) led to a reduction in speed and divergence in lateral position towards LBS3. This becomes particularly apparent when compared to the observed driving behaviour in Junction 5 (see Figure 16) in which participants encountered TJR at 60mph with LBS1 open to traffic in both preceding and following links.

3.13 Section: F

Section F had 4 Lane VSL at 60mph with heavy traffic conditions and provided a link with the LBS1 open in advance of the junction at which the participant was instructed to leave the motorway for a second time. Figure 19 shows the mean lateral position for each of the six groups.

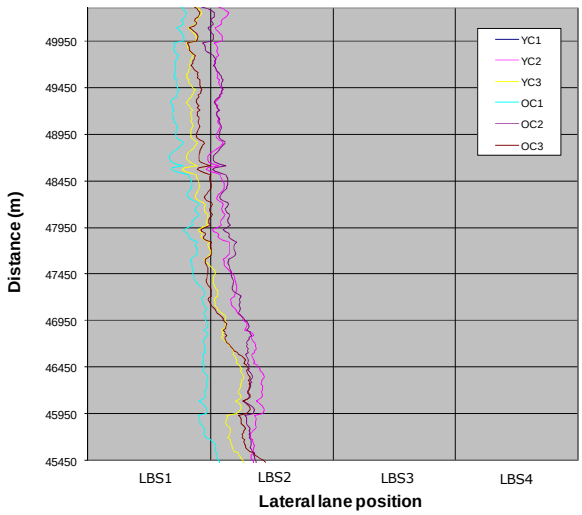


Figure 19 – Mean lateral position of participants in Section F.

It can be seen that the number of participants driving in LBS1 steadily increased on the approach to Junction 7. 68 out of 96 participants drove on LBS1 for an average of 55% of the section. 34 participants drove in LBS1 throughout the entire section.

3.14 Section: Junction 7 – (O(O)O)

Participants were instructed to leave the motorway at Junction 7 and drive over the roundabout to rejoin the motorway. Figure 20 shows the mean speed and lateral position of participants. As was also seen in Junction 2, all six groups exited and rejoined the motorway in a similar fashion. There were no statistically significant differences between groups with regard to speed and lateral position upon junction and exit approach.

Participants rejoined the motorway with an average speed of 54.6mph (SD=9.09). As also observed in Junction 2, Younger drivers joined the carriageway at significantly higher speeds (57mph) than Older drivers (52mph) ($P<0.05$). Again, no significant differences were observed between the different groups based on confirmatory gantry configurations.

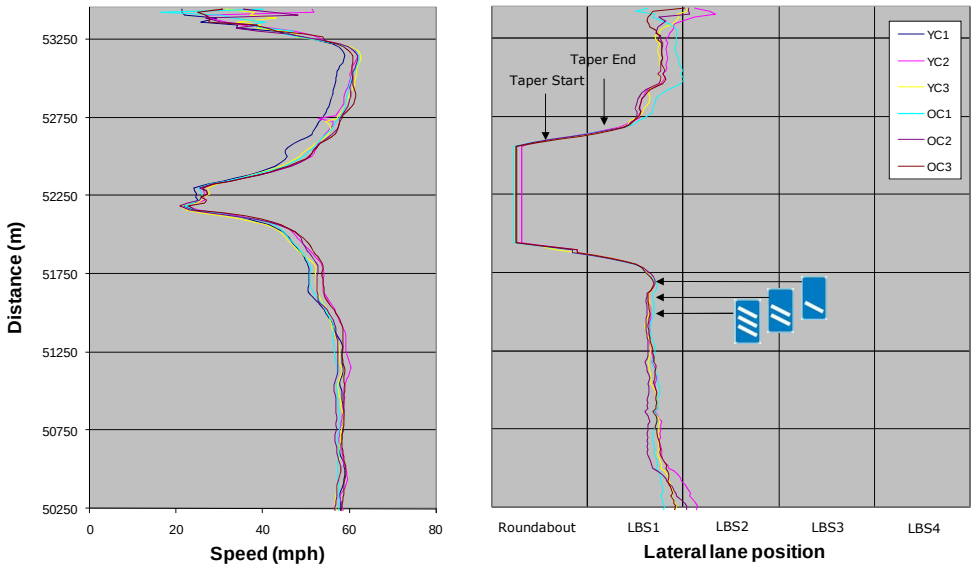


Figure 20 - Mean speed and lateral position of participants in Junction 7.

In Figure 20, it can be seen that towards the end of the section (i.e. distance > 52310m) a stark reduction in speed was observed, in combination with large variability in lateral lane position. The reason for this pattern was that participants were instructed to bring the vehicle to a halt soon after rejoining the motorway and indicates the end of the simulator drive.

3.15 Section: Lead-out

As mentioned in the route details (see section 2.4.3), the lead-out section did not provide any meaningful data and was included to provide a convenient end of the trial only.

4 TJR - Questionnaire results

Upon completing their drives, all participants were asked to complete a series of questionnaires designed to explore their attitudes towards, and impressions of, TJR.

4.1 Impressions of Safety

Participants were asked to rate their impressions of safety (1 = '*Not at all safe*', 10 = '*Very safe*') when the hard shoulder was open and closed, both when leaving the motorway and rejoining the motorway.

4.1.1 Leaving the motorway

The ranges of responses given by participants were used to produce the frequency distributions found in Figure 21. The frequency distribution on the left shows participants' responses when the hard shoulder was closed, whereas the frequency distribution on the right shows responses when the hard shoulder was open.

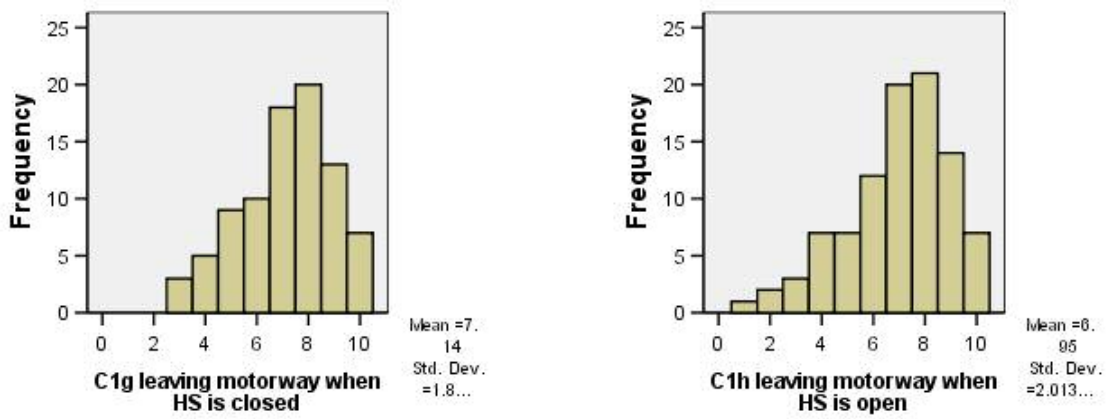


Figure 21 - Frequency distribution of safety ratings when leaving the motorway with hard shoulder open and closed. Note HS = LBS1.

Initial inspection shows little apparent difference in safety impressions when leaving the motorway, regardless of whether LBS1 was open or closed. A paired samples *t*-test was performed on these data, and this showed no significant difference in safety ratings between the two situations ($t(84) = 1.16$, $p = .25$). Therefore, it can be concluded that drivers' impression of safety did not differ when LBS1 was either closed or open when leaving the motorway.

4.1.2 Rejoining the motorway

Participants' impressions of safety when rejoining the motorway are displayed in Figure 22. From this figure we can see that, when LBS1 is closed, there is a peak of scores at 7 and 8. In contrast, the spread of scores is much wider for the second histogram (rejoining the motorway when the hard shoulder is open).

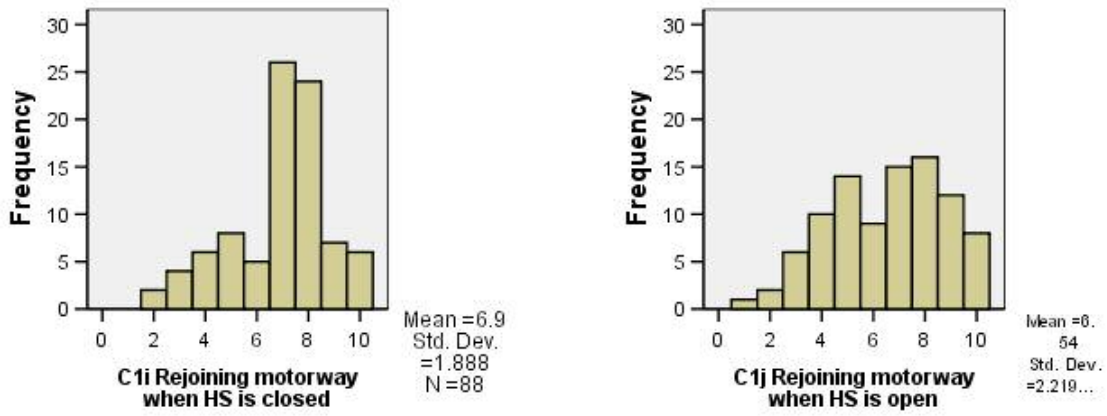


Figure 22 - Frequency distributions of safety ratings when rejoining the motorway with hard shoulder open and closed

A paired samples *t*-test showed no significant differences between the conditions ($t(87) = 1.49$, $p = .14$). However, although there was no statistically significant difference on average, the frequency distributions indicate that rejoining the motorway when LBS1 was open was experienced as less safe.

4.2 Understanding of which lane to use at junctions

Participants were asked to choose which lane(s) they were permitted to use when leaving and continuing on the motorway, either when the prism gantry indicated the hard shoulder was closed, or when it indicated the hard shoulder was open. Note, LBS1 refers to the hard shoulder.

When the hard shoulder is **closed** drivers should use Lane 2 to exit the motorway and use LBS 2, 3 and 4 when continuing on the road ahead.

When the hard shoulder is **open** drivers should use Lane 1 to exit the motorway and use LBS 1, 2, 3 and 4 when continuing on the road ahead.

4.2.1 Hard shoulder closed

All participants indicated they should either have used LBS 1, LBS 2 or both when leaving the motorway with LBS1 closed (see Table 3). As can be seen only a minority of participants correctly reported that they should use LBS 2 (38 out of 95 valid responses).

Table 3 - Participants understanding of which LBS they were permitted to use when leaving the motorway with a closed hard shoulder (E1)

LBS 1 (incorrect)	LBS 2 (correct)	LBSs 1 & 2 (incorrect)
39	38	18

The results in Table 3 might be due to confusion about question E1. The question was intended to determine whether drivers understood the prism sign, i.e. that they were not permitted to use the hard shoulder underneath the prism sign when LBS1 was closed. However, downstream of the prism sign, the hard shoulder is permanently converted to an auxiliary running lane, which drivers use to exit the motorway. This might be why many participants stated that they were permitted to use LBS1 to leave the motorway.

When asked which lane(s) they should use when continuing on the road ahead, there was a greater variety of answers. Table 4 demonstrates that 76 participants correctly reported being able to use LBS 2, 3 or 4. This leaves 19 who were not completely correct, the majority of which (14) thought they could only use LBS 2.

Table 4 - Participants understanding of which LBS they were permitted to use when continuing on the road ahead with a closed hard shoulder (E3)

LBS 1	LBS 2	LBS 3	LBS 4	LBSs 2 or 3	LBSs 2, 3 or 4	LBSs 1, 2, 3 or 4
0	14	1	1	1	76	2

4.2.2 Hard shoulder open

When asked which lane(s) they were permitted to use when leaving the motorway with LBS 1 open, again, all participants reported either being able to use Lane 1, 2 or both. This time a clear majority of participants were correct and reported only being able to use Lane 1 (75 out of 95 participants, see Table 5). This suggests that participants were much clearer about which lane they were required to use when exiting the motorway with LBS1 open to traffic.

Table 5 - Participants understanding of which LBS they were permitted to use when exiting the motorway with an open hard shoulder (E5)

LBS 1 (correct)	LBS 2 (incorrect)	LBSs 1 & 2 (incorrect)
75	4	16

Finally, participants were asked which lane(s) they were permitted to use when continuing on the road ahead when the hard shoulder was open (see Table 6). The spread of scores was broad, however, the majority of participants correctly reported being able to use LBSs 1, 2, 3 and 4 (51 out of 95). A significant minority thought they were allowed to use LBSs 2, 3 and 4, but not LBS 1 (28 out of 95).

Table 6 - Participants understanding of which LBS they were permitted to use when continuing on the road ahead with an open hard shoulder (E7)

LBS 1	LBS 2	LBS 3	LBS 4	LBSs 1 & 2	LBSs 2 & 3	LBSs 2, 3 & 4	LBSs 1, 2, 3 & 4
4	7	0	1	2	2	28	51

The above results suggest that the meaning of the prism gantry was not clear to all participants.

5 Confirmatory Gantry

As discussed in section 1.2, each participant experienced one of three confirmatory gantry configurations:

- **Option 1:** Exit and final gantry information (33 participants)
- **Option 2:** Exit gantry information only (33 participants)
- **Option 3:** No gantry information (30 participants)

5.1 Confirmatory Gantry – Driving behaviour results

The driving behaviour results were presented in section 3 in which the lateral position and speed for each of the six experimental groups (2 age category x 3 gantry options) were compared. As shown in the different graphs, no clear trends were discerned and the gantry configurations were not found to statistically affect any of the measures.

Additional analyses were subsequently conducted on lane occupation (i.e. percentage of lane use) and point speed at the different signs within junctions, with special reference to the confirmatory gantries. As with the previous measures, no consistent trends were observed and no significant effects were found as a function of gantry configuration.

It can be concluded that the different confirmatory gantry configurations did not significantly affect driving behaviour.

5.2 Confirmatory Gantry – Glance behaviour

To assess if and to what extent participants looked at the confirmatory gantry, eye movement recordings were made measuring the number and duration of eye fixations on the relevant signs.

Figure 23 shows the confirmatory gantry configuration option 1 showing both exit information on the slip road (C11B in Figure 23) as well as ahead information on the final signal gantry (P23 in Figure 23). In addition, the ahead sign preceding the confirmatory gantry (P24 in Figure 23) is shown. Since the absence of the confirmatory gantry may lead to increased glances at the remaining ahead information (P24), this sign was also considered in the analysis.

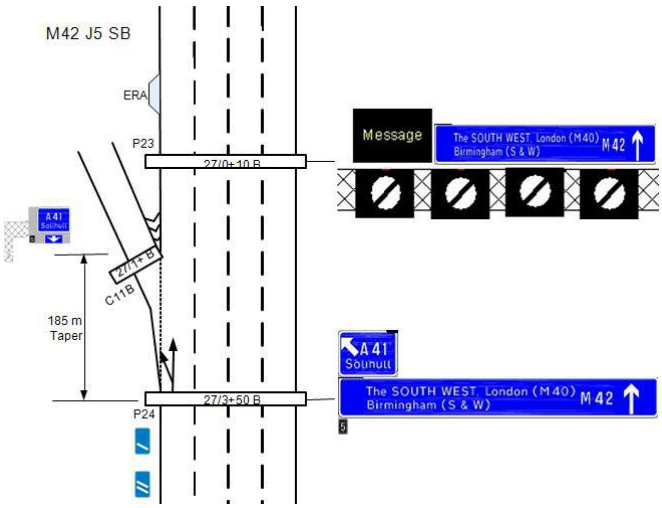


Figure 23 – Diagram showing the confirmatory gantry configuration option 1.

5.2.1 Final signal gantry

Figure 24 (left column) shows the total number of glances and mean glance duration (right column) at final signal gantry (P23) for each of the three confirmatory gantry configurations at each junction. Note that even in the absence of the final signal gantry (P23) in configuration options 2 and 3, it was still possible to determine whether participants looked in the area of the ahead sign as it was marked as a target area for the eye tracker.

As can be seen, even in the absence of the final signal gantry in options 2 and 3, participants looked in its direction. Although this would suggest that participants were looking for the ahead information, it should be noted that, across the three groups, the total number of participants looking at the final gantry sign was very small (11 out of 96) with the vast majority of participants not looking at the sign altogether.

The data show no apparent trend that is either consistent across junctions or experimental groups. Considering the small number of participants, non-parametric statistical tests were performed which subsequently indicated no significant effects on the total number of glances or mean glance duration as a function of confirmatory gantry configuration options 1-3 in any of the 7 junctions.

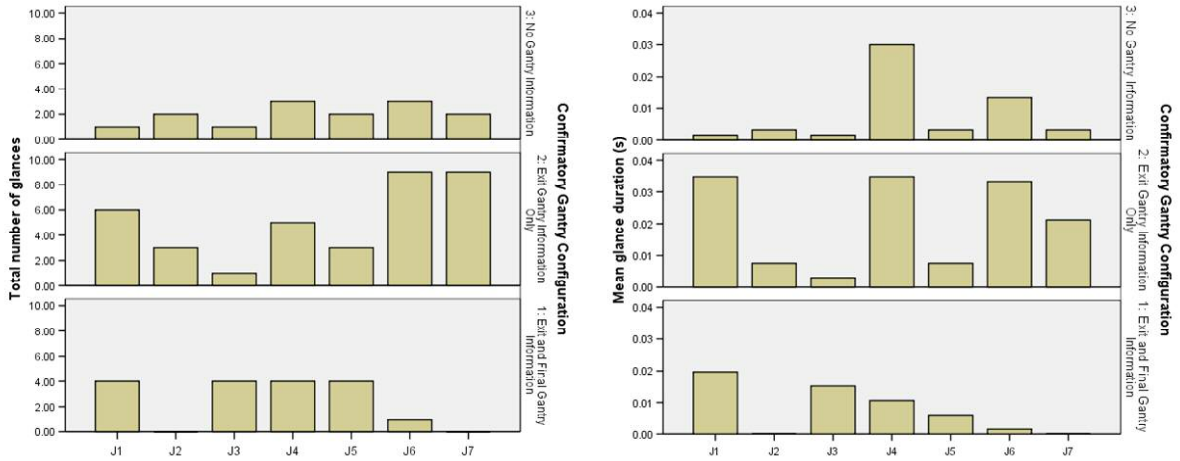


Figure 24 – Total number of glances (left) and mean glance duration (right) at final signal gantry (P23) for each junction and 3 confirmatory gantry configurations.

5.2.2 Exit information sign

Figure 25 (left column) shows the total number of glances and mean glance duration (right column) at the exit information sign (C11B) for each of the three confirmatory gantry configurations at each junction.

It can be seen that in the absence of the sign in configuration option 3, none of the participants looked in the location of the exit information sign. This may not be surprising considering that the whole sign including the cantilever was removed and participants had no way of telling where the sign was supposed to be.

It can further be seen that the number of glances was even lower than that for the final signal gantry which would suggest that the information on the exit information sign is consulted even less frequently. Considering the low response rate, non-parametric tests were performed which subsequently showed no significant effects on the total number of glances or mean glance duration as a function of confirmatory gantry configuration options 1-3 in any of the 7 junctions.

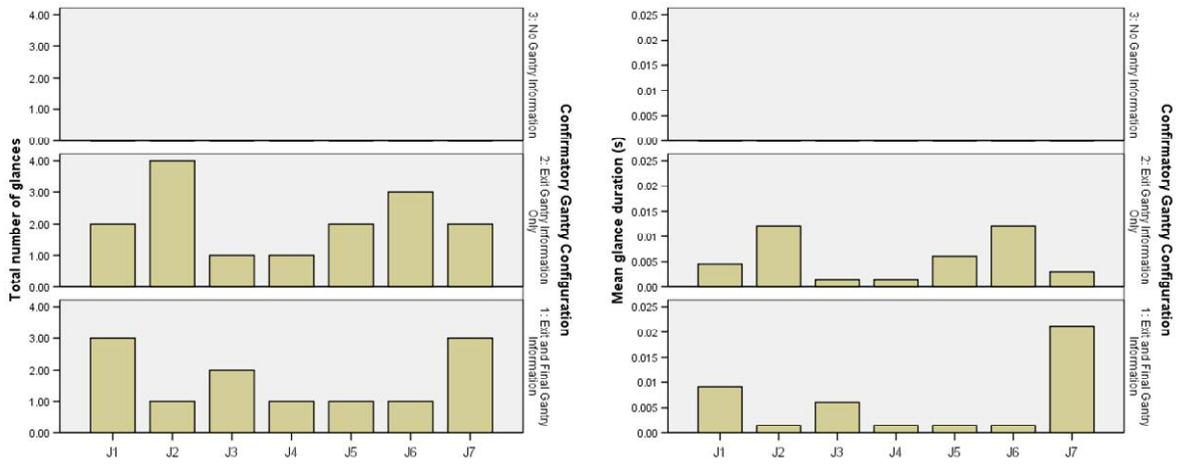


Figure 25 – Total number of glances (left) and mean glance duration (right) at exit information (C11B) for each junction and 3 confirmatory gantry configurations.

5.2.3 Ahead information gantry P24

Figure 26 (left column) shows the total number of glances and mean glance duration (right column) at the ahead information gantry (P24) for each of the three confirmatory gantry configurations at each junction.

As mentioned earlier, the absence of the ahead final signal gantry (option 2 and 3) may have resulted in increased glances towards the ahead information gantry sign P24. The graphs below indeed seem to provide some support for this contention in that the number of glances was consistently higher in the configuration groups 2 and 3 in which the final signal gantry was removed.

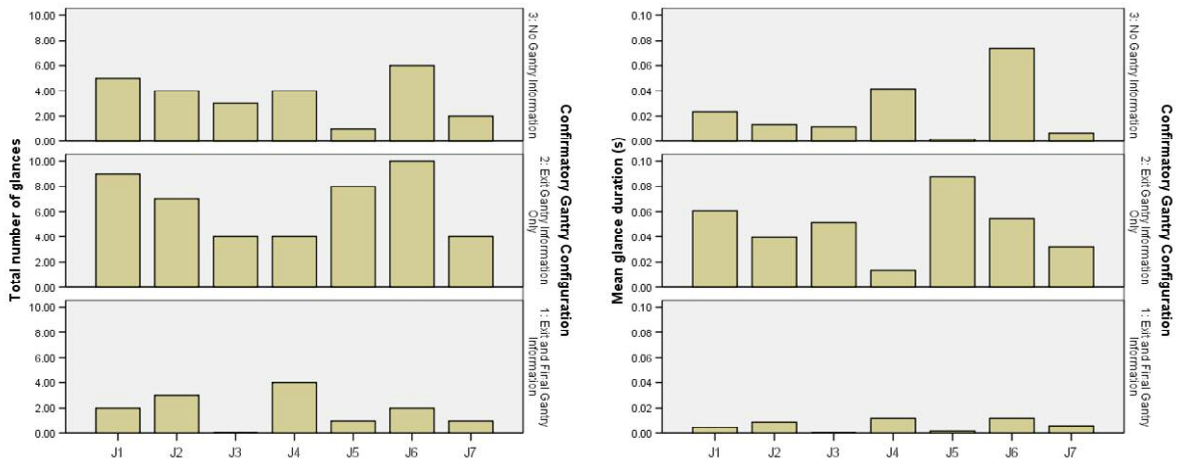


Figure 26 – Total number of glances (left) and mean glance duration (right) at ahead information gantry (P24) for each junction and 3 confirmatory gantry configurations.

When collapsed across the seven junctions, the total number of glances at the ahead information gantry P24 was higher in the configuration groups 2 and 3 as shown in Figure 27. Statistical analysis indicated a significant main effect of gantry configuration

($p<0.05$, Kruskal Wallis test). Post-hoc analysis showed the number of glances in the configuration group 2 to be significantly ($p<0.05$, Mann-Whitney test) higher than in the configuration group 1. No other differences were found to be significant.

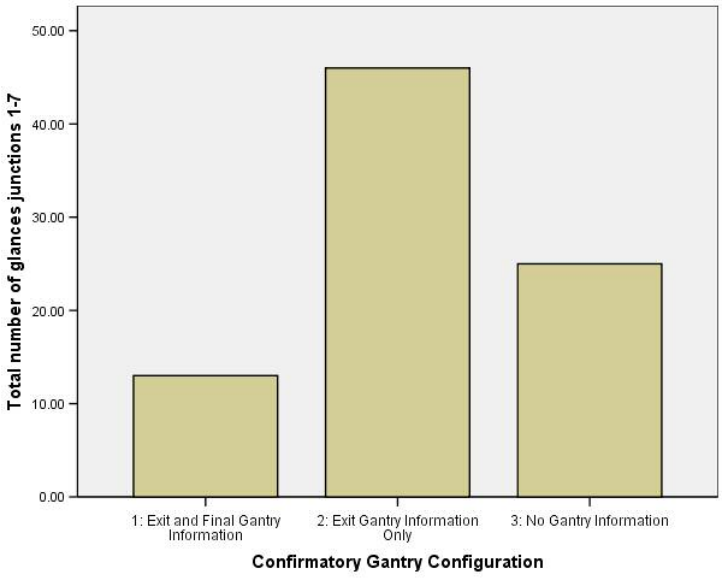


Figure 27 – Total number of glances at the ahead information gantry (P24) summed across the 7 junctions.

5.3 Confirmatory Gantry – Questionnaire results

Three questions were posed to participants to garner their feelings of confidence with regard to exiting and continuing on the motorway in the context of the different confirmatory gantry configurations:

- "During the drive, how confident did you feel that you left the motorway at the correct exits?" (E10)
- "Whilst driving past a junction, how confident did you feel you hadn't missed the exits you were supposed to take?" (E11)
- "Throughout the drive, how confident did you feel you were following the correct directions?" (E12)

Error bar graphs were drawn to investigate the presence of any possible trends in the data. As can be seen in Figure 28 and Figure 29, the mean confidence for the "no gantry information" group is lower than the others for the first two questions; if they had taken the correct exit and if they had not missed any exits. This suggests a trend towards lower confidence with the confirmatory gantry removed.

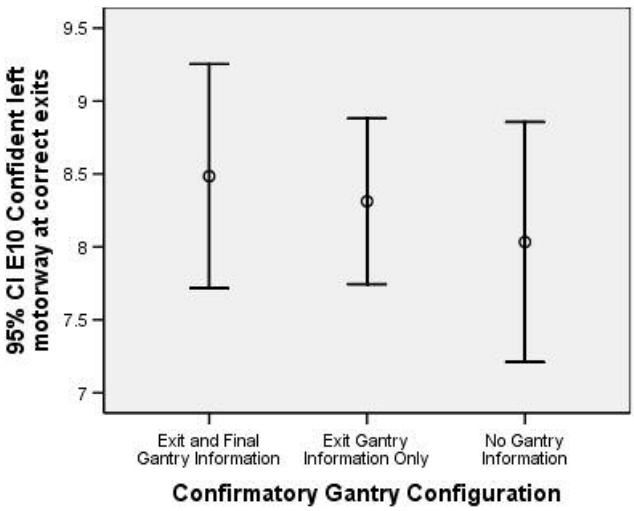


Figure 28 - Confidence in having left the motorway at the correct exits.

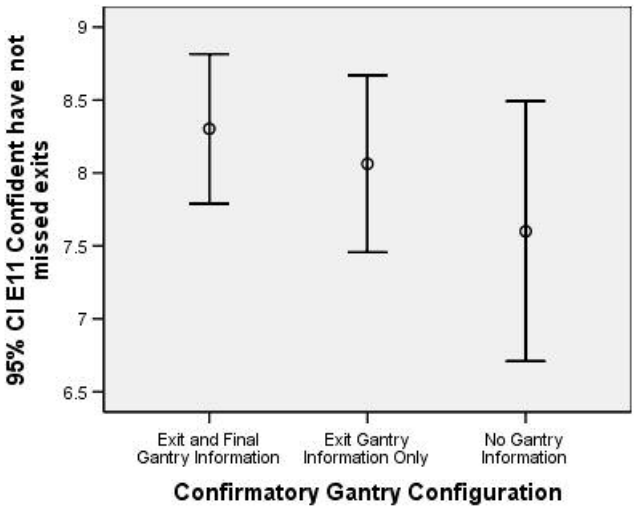


Figure 29 - Confidence in having not missed any exits

In Figure 30 (for participants' confidence that they followed the correct directions) the pattern of results was more mixed and not suggestive of a trend.

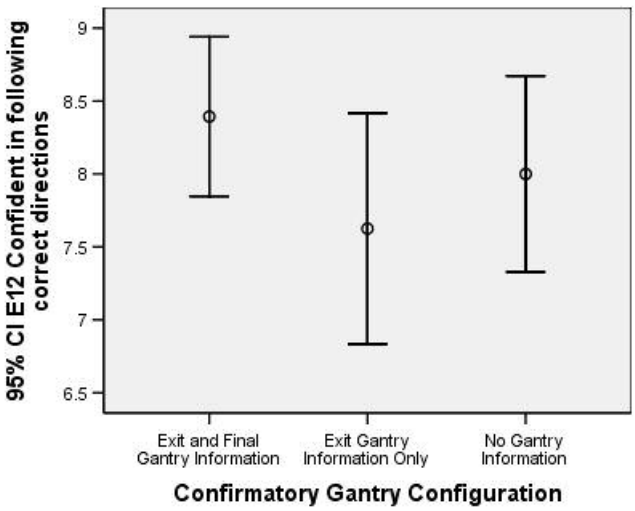


Figure 30 - Confidence in having followed the correct directions

Following visual inspection of these error bar graphs, one way ANOVAS were performed on data for all three questions, none of which achieved a significant result (see Table 7).

Table 7 -One way ANOVAs by confirmation gantry configuration, by question

	df	F	Sig
Confident left motorways at correct exits (E10)	2	.41	.69
Confident have not missed exits (E11)	2	1.14	.32
Confident in following correct directions (E12)	2	1.38	.26

6 Participants' comments

Participants were asked to provide any comments they would have with regard to TJR. The full comments can be found in Appendix 2.

Overall, most participants indicated that TJR might be beneficial in reducing congestion. It was noted by some participants that it was easier to drive TJR junctions compared to the non-TJR junction as no lane changing was required.

However, some concerns were expressed with regard to safety. In particular, several participants mentioned the limited emergency services access with LBS1 being open to traffic and the absence of a safe stopping place in case of vehicle breakdown potentially leading to increased accident risk. Participants further mentioned feeling uneasy whilst being undertaken. Especially with preceding links with LBS1 closed for traffic, TJR may lead to undertaking within junctions.

Finally, several participants mentioned that following initial confusion about what lanes to use and when, once they had experienced the first few TJR junctions they quickly became used to the concept of TJR. Further, extensive and clear information provision as to the workings of TJR was thought to be highly beneficial.

7 Discussion

The aim of this study was to test drivers' behaviour in response to the planned implementation of TJR in terms of the ability to respond to the new signage and road markings in a safe and appropriate manner. A further aim of the study was to evaluate the effect of the removal of the last sign on diverge, also known as the 'confirmatory gantry'. In the text below, the TJR results are discussed first, followed by the confirmatory gantry results. It is concluded with a safety and network performance interpretation.

7.1 Through Junction Running

The first observation was that upon encountering the first TJR junction (Junction 1), 54% of participants drove in LBS1. Three quarters of these participants were already in LBS1 on the approach to junction 1, whereas the remainder entered LBS1 from LBS2. This suggests that a large proportion of users will stay in lane when driving through the junction rather than move into LBS2 out of unfamiliarity with TJR. The finding that approximately 10% of the participants moved into LBS1 within the junction further suggests that a considerable proportion of participants were confident crossing the white line to make use of the additional capacity.

The first TJR junction enabled the evaluation of the position at which participants moved from LBS1 to LBS2 when LBS1 was closed after the junction. The vast majority moved to LBS2 just before the start of the on-slip thereby avoiding any potential conflict with traffic joining the motorway. None of the participants continued in LBS1 following its closure.

The sections A, B, and C in between the first three TJR junctions had LBS1 closed for traffic. Results indicated the level of contravention (illegitimate use of LBS1) to be low. In section A and B only three and five participants drove in LBS1, respectively. None of the participants used LBS1 in section C. This indicates that with regard to the links between junctions, the road markings and signs clearly indicated whether LBS1 was open to traffic.

TJR junction 2 required participants to leave and subsequently rejoin the motorway with LBS1 closed before and after the junction. Overall, participants smoothly rejoined the motorway although the average speed at entering LBS1 was considerably lower (60mph) than the traffic within the junction which was travelling at the National Speed Limit (NSL). This was particularly true for Older participants (56mph) compared to Younger drivers (65mph). With the LBS1 open for traffic within the junction this may lead to braking and lane changing behaviour on behalf of through traffic in LBS1. This, in turn, may negatively affect safety and traffic flow.

It was further found that a small minority of participants (5%; n=5) continued to drive in LBS1 despite it being closed for traffic. The fact that these participants continued to drive in LBS1 throughout the subsequent section B suggests that they were unaware LBS1 was closed for traffic. The signs and road markings may therefore not have been clear to all participants.

Preceding and following the next TJR junction (3), LBS1 was closed for traffic. This permitted an assessment of whether participants would use LBS1 rather than staying in LBS2 within the junction. It was found that 23% of the participants moved from LBS2 to LBS1 to make use of the additional capacity. Similar to the driving behaviour observed in the first junction, in anticipation of closure of LBS1, all participants returned to LBS2 before the start of the on-slip, thereby avoiding potential conflict with joining traffic. It can be concluded that the extra capacity within the junction was effectively used with drivers being able to rejoin the normal running lanes in time.

In the following section (C) with LBS1 closed for traffic, participants encountered the Traffic Officer (TO) Service vehicle parked in LBS1. Inspection of speed and lateral

position indicated that the presence of the TO vehicle led to a reduction in approach speed as well as significant lateral lane deviation. If and to what extent the different TO Service vehicle configurations affected speed and lateral position was not considered in this report. Further details will be found in a separate TO Service vehicle configuration report.

After junction 4, an increasing number of participants chose to drive in LBS1 in section D. 74% of participants drove in LBS1 at some point with 47% of the participants using LBS1 throughout the entire section. This indicates that a large proportion of users are willing and able to use the additional capacity provided by HSR.

With LBS1 open to traffic in the preceding as well as following link in junction 5, 73% of participants used LBS1 at some point. 44% of the participants drove in LBS1 throughout the entire junction. These results suggest that the majority of participants driving in LBS1 on approach to the junction remain in LBS1, and continue to do so on passing the on-slip and thereafter. The majority of participants understood the concept of TJR properly.

Junction 6 was the only non-TJR junction, representing a junction as currently employed in the M42 ATM scheme. Despite the fact that participants had experienced TJR for each of the preceding 5 junctions, none of the participants illegitimately drove in LBS1. This suggests that combining TJR and non-TJR junctions is unlikely to lead to illegitimate use of LBS1 and that the signs and lane markings were clearly understood by all participants.

However, in comparison to TJR junctions, the non-TJR junction was found to affect participants driving speed and lateral position to a somewhat larger extent. The closure of LBS1 between the off- and on-slip led to a reduction in speed and shift in lateral position towards LBS3.

In the questionnaire, participants were asked to rate how safe they thought it was to leave and rejoin the motorway with LBS1 open or closed. Whereas their safety rating did not differ with LBS1 closed or open when leaving the motorway, participants rated rejoining the motorway when LBS1 was open as less safe. Although not directly referred to by participants, this might be related to the larger speed differential as well as the presence of traffic in LBS1.

To evaluate the comprehensibility of the prism sign, participants were asked to indicate what lane they were supposed to use in order to leave or continue on the motorway. With the prism sign indicating the hard shoulder to be closed, a significant proportion of participants (41%) incorrectly thought LBS1 could be used in order to leave the motorway. As evidenced by participants' comments, this confusion may have been created, at least in part, by the presence of the exit sign on top of the prism gantry (see Figure 8) which had some participants made to believe LBS1 was open to traffic. The position of the exit information should be considered in future designs and warrants further investigation. When the prism sign indicated LBS1 to be open to traffic, on the other hand, the vast majority of participants correctly understood the intended meaning of the sign.

Overall, participants' comments indicated that TJR was thought to be beneficial in reducing congestion, although a large number of participants expressed their concerns as to its effect on road safety. In particular, several participants mentioned the limited emergency services access with LBS1 being open to traffic and the absence of a safe stopping place in case of vehicle breakdown potentially leading to increased accident risk. It should be noted, however, that in the simulator database used for the current study, the number of Emergency Refuge Areas (ERA) was limited. Exposure to more ERAs throughout the simulated route may have participants realise that the lack of safe stopping places was, at least to some extent, compensated by the presence of ERAs.

Several participants commented that the TJR junctions were less demanding in terms of attention and driving (i.e. lane changing) than the non-TJR junction.

Participants further mentioned feeling uneasy whilst being undertaken. Especially when preceding links have LBS1 closed for traffic, TJR may lead to undertaking within junctions. In normal driving conditions, undertaking is generally not permitted. Therefore, participants' concerns when being undertaken may be due to a lack of familiarity. It can be expected that if participants were familiar with TJR, they may express less concern at being undertaken as they would not perceive it as an infringement of normal driving rules. This seems to be partly supported by the fact that several participants mentioned that following initial confusion about what lanes to use and when, once they had experienced the first few TJR junctions they quickly became used to the concept of TJR. A large number of participants mentioned that the introduction of TJR would highly benefit from extensive and clear information provision as to the workings of TJR. It should be noted that the participants in the current study were completely naïve as to the workings of TJR and associated signs and road markings. Considering the low level of contravention and largely correct driving behaviour throughout the route, the TJR scheme as implemented in the current study appears to be largely self-explanatory.

7.2 Confirmatory gantry

The different confirmatory gantry configurations (see Figure 6) were not found to affect driving behaviour as indicated by driving speed, lateral position or lane occupation.

There were also no apparent trends with regard to glance behaviour. The first observation regarding glance behaviour was that the overall number of participants and number of glances towards the confirmatory gantry were very low. This would suggest that the information displayed on the confirmatory gantry is not solicited very frequently. However, it should be noted that the current results may underestimate the utilisation of the information displayed on the confirmatory gantry under everyday, natural driving conditions. Participants were asked to exit the motorway at two predetermined junctions. This may be considered a relatively undemanding navigational task and hence not requiring the additional information displayed on the gantry. However, it was found that participants who drove the route under confirmatory gantry options 2 and 3 tended to look at the ahead sign *preceding* the confirmatory gantry ahead sign more frequently. This suggests that participants may have compensated for the absence of ahead information at the confirmatory gantry. However, in the light of the small number of participants looking at the signs in the first place, these results should be interpreted with care.

Participants were also asked to rate the level of confidence that they had left the motorway at the correct exit or had not missed any exits. The lower confidence level, as well as larger variability in confidence ratings in the participant group in which the confirmatory gantry was completely removed (option 3), suggests that the absence of the confirmatory gantry might have an effect, albeit small, on participants' confidence in following the correct direction. This is also in line with the finding that, in the absence of the confirmatory gantry, the number of glances towards the preceding ahead information increased. However, it should be noted that the effects were small and significant differences were found only with regard to the number of glances when collapsed over all junctions. Further research might benefit from varying navigational task demands to evaluate the utilisation of the information displayed on the confirmatory gantry more fully.

7.3 Safety interpretation

Through Junction Running

A simulator study can provide useful indications of potential safety issues arising from the use of TJR based of driver behaviour. This section considers those issues that may

need to be addressed in the future design of TJR layout and signalling. However, from the point of view of safety, the overall findings suggest that safety standards are unlikely to be compromised by the use of TJR.

As pointed out in Section 3.3, when the hard shoulder is closed through a junction, there is a lane drop and vehicles have to merge from left to right of the approach to the off slip. Some of these will be heavy goods vehicles. As they are moving from left to right, other vehicles who wish to leave the motorway at the junction will be moving from right to left.

Near the on slip and downstream of it, some drivers will be moving from right to left to access the hard shoulder lane. This will be broadly at the same time as vehicles are joining the motorway.

These lane changes and conflicting movements might be expected to increase accidents where TJR is not used. However there appears to be no evidence that this is so, and lane drops at junctions on motorways are a common feature already.

Again, from the point of view of drivers slowing down, there appears to be no evidence that this produces a safety problem where TJR is not used, since lane drops are already widely used.

The comparison of junctions without TJR with existing junctions with lane drops, is not wholly straightforward however, since the availability of the use of the hard shoulder as a running lane either within or outside of the junction will vary with time of day and traffic conditions. Thus, the behaviour required of drivers travelling through the junction will vary. It is difficult to know how this uncertainty will affect accidents whether or not TJR is used. In GB, the only direct evidence is from M42 which does not have TJR and there appear not to be safety problems.

Confirmatory Gantry

It can be argued that the most comprehensive provision of information (Option 1, which shows exit information as well as 'ahead' information on the final signal gantry) will, if anything, be likely to be safer than the other two Options. The issue then becomes one of comparing the costs of providing and maintaining the additional signs, with any additional safety benefits. However, the trials showed no statistically significant difference in driver behaviour with the three signing options and this might indicate that there would be no material differences in safety. In a real traffic conditions though, where the mental load on the driver might be greater than on the simulator, there might be safety benefits associated with Option 1 or Option 2, if only to re-assure the driver, thus reducing driver stress and perhaps improving safety over a section of carriageway several kilometres long downstream of the 'ahead' sign.

Given that the driver will have encountered the same information on more than one occasion upstream of the exit slip, if the driver has noticed the information, then it can be argued that there is little point in further repetition. However, if the driver has not noticed the information, but suddenly becomes aware of it on the confirmatory gantry, there may be a tendency to suddenly switch lanes, in particular, to attempt to exit from the motorway at the last moment. The point here is that the driver will be able to see the sign at a location some distance upstream of the gantry. This risky behaviour might well compromise safety and although it seems not to have been observed during the simulator trials, there is no guarantee that it might not occur under more stressed real traffic conditions.

Given these issues, there may be merit in not providing sign information on the gantry or of locating the gantry further downstream of the off slip and providing confirmatory information to the driver that they are on the mainline of the motorway.

7.4 Network performance interpretation

To maximise network performance, any effects that would reduce capacity should be minimised. A reduction in capacity could occur in two ways:

- When the hard shoulder is closed through a junction, there are fewer lanes available to traffic, so the capacity is lower than it would be if the hard shoulder was used as a running lane. In addition, more weaving behaviour was observed with the hard shoulder closed through the junction, thereby reducing the capacity further.

  However, flows within junctions are lower than between junctions, so the reduction in capacity will often not cause any flow breakdown. Through junction running is likely to be of benefit where there are high flows within a junction, i.e. where there are low flows on the exit and entry slip roads.

  Conversely, where there are high flows on an entry slip, it would be beneficial to move the main carriageway traffic out of LBS1 before it interacts with the merging traffic. In this case, closing the hard shoulder through the junction would show a benefit.

- If drivers are uncertain as they approach a junction, then they might slow down, causing following drivers to brake. There are two potential uncertainties associated with the current trial:

  - whether drivers are allowed into the hard shoulder on the approach to a junction; and
  - whether the information on the confirmatory gantry is sufficient for drivers to make a decision, but without overburdening drivers so that they slow down while assimilating information.

  The TJR simulator study suggests that, although driver confidence is not as high as it is with a standard layout, the new layouts do not significantly affect traffic speed. Individual drivers might slow slightly, but this effect is likely to reduce as drivers become more familiar with the new road layout and signing.

8 Conclusions

This study considered participant behaviour in relation to Full Time Through Junction Running and the use of a Confirmatory Gantry. In total 96 participants took part in the trials, the principal findings are:

- People are confident driving through the junctions
- Extra capacity both between and within junctions is used
- People move out of LBS1 after closure
- Signs indicating status of LBS1 between sections are clear
- Older people tend to rejoin the motorway at slower speeds
- Signs on rejoining the motorway are potentially unclear
- Presence of TO Service vehicle affects driving speed and lateral position
- The concept of TJR is understood
- Rejoining the motorway with LBS1 open was perceived as less safe
- Participants considered TJR as beneficial in reducing congestion
- Participants raised concerns regarding negative effects on road safety
- TJR junction experienced as less demanding than non-TJR junction
- Participants were uneasy being undertaken
- TJR scheme was largely self-explanatory
- Different confirmatory gantry configurations did not affect driving behaviour
- Confirmatory gantry signs were solicited infrequently
- Absence of confirmatory gantry might negatively affect participants' confidence in following the correct direction

Acknowledgements

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References

Schlag, B (1993). Elderly drivers in Germany: fitness and driving behaviour. *Accident Analysis and Prevention, 25*, 47-55.

Sultan et al (2008). ATM Monitoring and Evaluation: 12 Month Report *(DOC/1807/V3) Southampton: Mott MacDonald.*

Glossary of terms and abbreviations

ERA: Emergency Refuge Area

HS: Hard Shoulder

HSR: Hard Shoulder Running

LBS1: Lane Below Signal 1 (The Hard Shoulder)

LBS2: Lane Below Signal 2

LBS3: Lane Below Signal 3

LBS4: Lane Below Signal 4

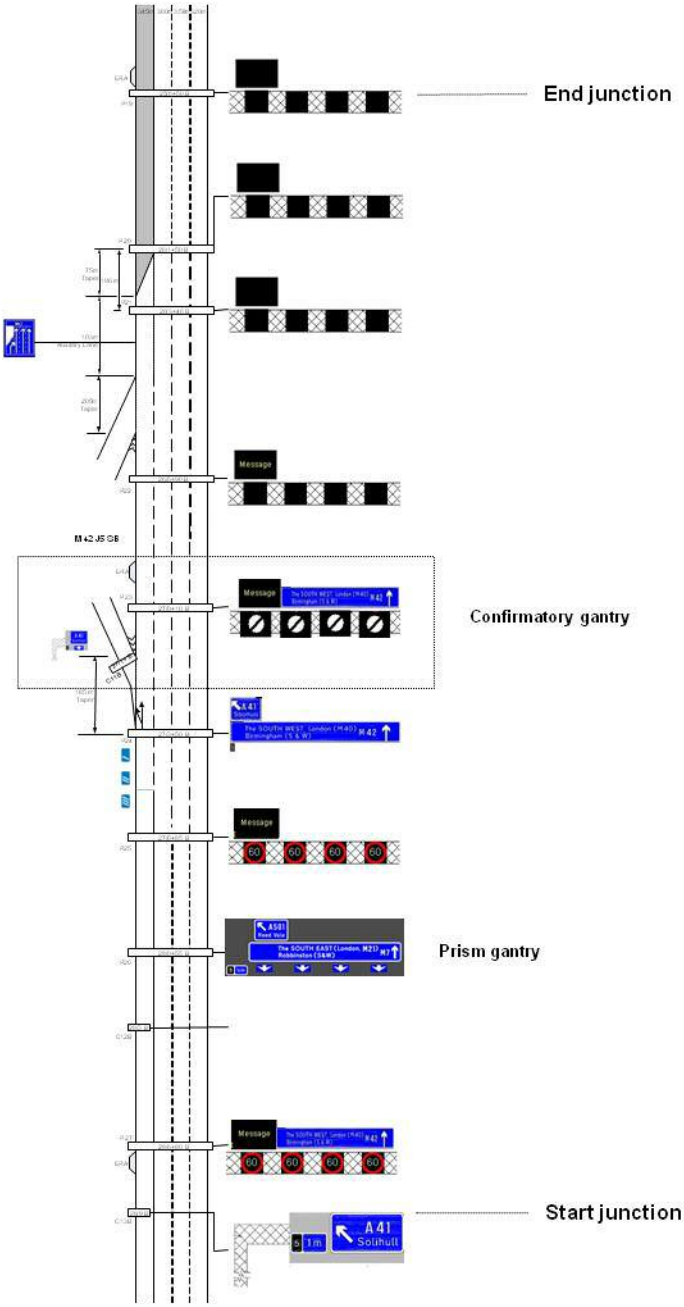
TJR: Through Junction Running

TO: Traffic Officer

VMS: Variable Message Sign

VSL: Variable Speed Limit

Appendix 1 – Schematic overview of TJR junctions including 'prism gantry' and 'confirmatory gantry'



Appendix 2 – Participants' comments

C3 - any comments you have about through junction running.

Participant	Comment
2	I would use the HS (lane 1) until I approached a junction. If the rule of 'no undertaking' still applies this will be a problem if people choose not to use the lane (HS).
3	Not keen on people undertaking me - would expect a lot of people to use an open HS to undertake regardless of whether they wanted the upcoming exit or not. At certain points there might be a lot of people criss-crossing each other. My worry was not reading the signs far enough in advance to know when a HS was closing - with the simulator screen being hard to see I wanted to be careful changing lanes!
4	Very wary about this as you know that up ahead traffic will be joining motorway.
6	I tend to remain in the same lane going through a junction. This is especially the case if I am in lane 2 and lane 1 is a dedicated left turn. This makes it easier for traffic joining the motorway at that junction.
8	I find undertaking throws me and disorientates me a bit. I also try to move from lane one to lane two at an entrance slip to allow other motorists room to join the motorway. I'm not sure that I would feel happy undertaking within a junction.
10	I think this could be a useful means of alleviating congestion.
11	When going on or off at junctions very hazardous of other vehicles. Need extra awareness, a lot going on at once and that was when I was driving alone.
12	Would probably be a short distance so I would keep out of the "former" HS in case it complicated traffic joining motorway.
13	Would require good visibility and moderate speed. Main concern would be when encountering traffic using the joining slip road when passing through the junction.
14	If it is clearly indicated that you can use the HS then it is reasonably safe and simple. Harder and more risky being able to use a HS when approaching an exit to a junction.
16	Seemed fine to me, no big deal.
17	If it eases congestion it is ok. Would need to be 'advertised' in advance.
18	It's dangerous exiting from lane 2 across the new running HS.
19	In the example used in the simulator, the traffic wasn't heavy enough to justify using the HS. Speed limits are also the same on HS and other 3 lanes, however, having a solid white line separating the HS lane is very restricting. If there was an accident or a particularly slow moving vehicle in the HS lane, then all the other vehicles behind them would be held up. In principle, through junction running sounds like a good idea however I did not find beneficial in any way in the simulator.
20	Any uncertainty was only due to it being new.
22	If the law stated that you could undertake in these situations I would be happy to undertake. Given that all vehicles were moving at roughly the same speeds.
24	Would normally not use HS through junctions so traffic entering the motorway had a clear passage on, and prevent me from having to change lanes back suddenly. Through junction running does seem to aide exiting and entering a congested motorway. People should be encouraged into the HS if used, slow traffic must get the idea to move over and allow faster traffic to overtake, or there will be increase in

	undertaking.
25	Considering the standard of current driving I feel that TJR could be dangerous as people do not allow for emergency breakdowns having taken place. Speed limits not being observed and breaking time not considered when there is a hazard.
27	Would be wary of cars cutting across HS to leave motorway.
29	A feeling of uneasiness partly because of the unfamiliarity of the instruction - it being a new/unusual driving experience.
30	Risk of rear collision from someone using HS to exit.
31	While I can understand when this would be appropriate i.e. very heavy congestion, using the HS feels inherently unsafe. Also there is the problem of where a vehicle might go in the event of a breakdown collision etc.
32	Had not encountered or learned anything about this until I found myself in it driving the simulator test - would have liked to have been more prepared.
33	Solid white lines across the start and finish of HSs are a little confusing. Whether or not to use a new left hand lane that appears through a junction is not easy to decide especially in view of traffic potentially joining from downstream link.
34	In my opinion through junction running will cause confusion and potentially dangerous situations to occur where they don't currently exist. Lane discipline is an absolute nightmare on a good day! This will make it worst.
35	Needs more information to help establish which lanes to use on entry and exit e.g. dotted guidance lanes.
37	DANGEROUS. Having the HS as the "exit only" lane gives time for drivers to sort out where they need to be and helps prevent cutting across 2 or more lanes at the last moment. It also reduces frustration for drivers wishing to exit as the exit lane is often free flowing (comparatively) or if it is the cause of the delay it allows traffic in the other lanes to pass safely. Through junction running also puts vehicles into conflict at the end of the entrance slip road as views to and from the HS are reduced.
38	Would feel that other road users wouldn't use left hand mirror and pull into me.
39	Seems a dangerous situation to be put in.
40	Would avoid undertaking where I know traffic would be joining. When HS closed then It didn't seem like there was that much time to make the manoeuvre across to the first running lane. When it is open it is just the same as normal really.
41	Definitely not so safe leaving the motorway when the HS was open and the same rejoining but maybe I would get used to it.
42	The only problem I see, if there is a breakdown.
43	If people do as they should and keep watching, it should be safe.
44	The open inner lane between slip-off and slip-on was totally ridiculous and calculated to cause problems - as it did. No way would I use it in this configuration. Within a junction I regard as from 1 mile BEFORE slip off until AFTER slip-on. I would definitely NOT have use the inner lane between slip-off and slip-on.
45	Could work OK. My concern is how signage was informing of how and WHEN I might move to exit the HS and return to the "normal" left hand running lane. Certainly when rejoining the motorway onto the HS, I think the sign was a bit confusing (not one I recognise from TSRGD!) and may need a "repeater".
46	Need to be aware of undertaking of all cars around.

47	If the traffic in the other lanes is congested and you are using the HS legally to come off at exit then I think this is fine and I would expect it to help reduce congestion in other lanes.
49	There some confusion with white lines across HS. I assume I would get used to that.
50	I prefer not to use the HS. I do not feel safe having to switch lanes as the HS is opened and closed. I also feel it is important to keep the HS free for emergency vehicles and breakdowns.
55	When I last experienced driving on the HS (in Sept 08) on M42 to NEC Birmingham it was only generally allowed if one was getting off at the next junction. In my opinion the speed limit for HS running should be reduced to 50-55 mph to REDUCE THE RISK OF A PILE-UP if a vehicle should suddenly break down.
56	Surely if the HS was open most cars would move over to use it and that would become just as congested.
57	If going straight no problem if leaving was confused on correct lane to be in.
58	Must be carefully explained to drivers. Should be avoided where possible as cars entering lane 1 have to be very careful of, so do exiting lane 1 drivers but if speeds are slow anyway (as in congestion) it's a big problem.
59	Would avoid rather than use voluntarily. Concern about rejoining other lanes when HS running comes to an end beyond the junction. Probably the most dangerous situation of HS use?
60	It’s not bad, but I do prefer the way it is at the moment.
61	I found it effective when undertaking congested traffic in the motorway lanes 2, 3 and 4. It felt like driving on a normal lane.
62	I think with experience you would get used to understanding the road layout and feel more confident in following the HS through the junction.
63	Was very unsure about this on first experience and changed lanes (to lane 2) Once I understood the set up then I was reasonably comfortable although inconsistency is a problem (i.e. some junctions can be run through and some cannot).
64	This is fine when traffic is very heavy.
66	A good idea but drivers will need to be educated in use of lane. Will improve flow of traffic but other drivers will need to be aware that they may be passed by cars in a slower lane when speed restrictions are shown and use of HS is allowed.
69	Makes joining from the slip road more difficult therefore less concentration on what is coming up in front of you. Consequently for traffic stopping more likely to cause accident.
70	A good idea to keep congested traffic moving. However, some drivers will undoubtly use this as a way of lane changing to gain momentum.
73	Am happy to use the HS when encouraged to do so when traffic is heavy or to avoid an accident on other lanes.
76	Confusing as haven't seen before but once I realised I could use the HS as an extra lane it was fine.
77	One extra level of complexity. Didn't feel particularly safe when traffic was coming along the slip-road as I'm not used or expecting it.
80	Will be confusing when first used. New or nervous drivers may find this difficult to cope with.
82	I felt more at ease driving through a junction when the HS was closed. In that situation I did not have to worry about cars on my left undertaking me. I could concentrate on vehicles joining the motorway from the slip road.

84	Depends on the traffic on the HS.
88	Not sure, as am not clear whether undertaking is legal in this country. I thought not!
91	If the rest of the traffic was flowing at a safe speed using the HS but probably not at a junction.
93	I found the road markings confusing. I'm sure if I were more familiar with through junction running this would not be a problem. So for regular users of motorways where this is used I don't see major issues. However, for drivers who use motorways less frequently, through junction running is initially quite confusing.
94	When the HS is available for all and then becomes just for a junction it causes some anxiety when busy. It is unnerving if you're in lane '2' and suddenly lane '1' (formally a HS) 'opens'. If it happens a long way before the junction you're tempted to move left.
95	Good idea and would reduce amount of congestion by traffic spreading out.
96	Was more difficult changing lanes than in real life because rear view mirrors images were hard to make out. Noticed unusual road markings on Motorway exits.

D2 - How clear was the information that you were allowed to use the HS within junctions? Provide comments if unclear.

Participant	Comment
1	Ensure that signs are showing when passing into new junction
2	When the use of the HS is no longer allowed a count down should be given. It is not clear 'use HS for J6 only' - did that mean to exit at J6 or in the area of J6?
3	The simulator has a dullness to it; I think it would be very clear on the actual road signs.
5	It was clear you could use the HS. However there was not a lot of traffic at the time and 3 lanes would have been enough for the traffic on the road. As this was the case I felt guilty using the extra lane.
11	Some of it is getting used to them being open. I might have suggested extra signage but the amount of signage on roads is an issue already. I don't actually think HS should be used.
12	A sign saying "YOU CAN USE HS".
13	Sign would be more visible if placed on gantry to the RHS of the exit sign for the A41.
16	Didn't even think about it, just ploughed on through like it was a 4 lane motorway.
18	Concentrating on traffic you should not have to read so much information on gantries and signage boards.
29	More signage/repetition of signage.
32	Visibility in simulator was generally hazy and off putting- in normal visibility signing would be ok.
34	Only indication was dotted white line where it would normally be solid. As this is currently an "unusual move" what can or can't be done should be made clear.
35	It did not suggest that using the HS was mandatory, where information given further back to suggest that traffic leaving on these particular junctions should use the HS to act as a filter.
36	Reasonably clear - carried on using the lane because the signs did not prohibit me from using it or directed me elsewhere.

37	It was particularly confusing because another lane suddenly appeared, making it seem as if it was a 4 lane carriageway, but the "lane" vanished straight after the junction. I was fooled first time, but after that I felt it was safer to stay in my original lane. BETTER SIGNING OF HOW LONG THE NEW LANE LASTS FOR.
39	Flashing sign giving information maybe and brighter and warnings sign before saying this is an option e.g. like road exit signs, 1 mile, 1/2 mile.
44	There is no HS in the picture. A HS is defined by a solid white line.
45	There is no HS in the picture. A HS is defined by a solid white line.
46	Sign provided all information necessary.
55	Slightly brighter lettering on the black background.
56	Perhaps a sign.
57	Road layout shows lane 1 can be used but sign is too far away.
59	Better signage (perhaps fixed, within junction lights) so it is clearly allowed during HS running periods.
60	A few more lit up signs.
62	An overhead sign showing no entry when it is closed may help confusion if it’s open or closed.
63	Advance lane diagram?
66	Information was clear but needs to be posted well in advance. When roads are busy you may miss signs because you are concentrating on other cars/hazards. May need more than one sign.
68	By just saying HS open, instead of saying more words.
74	It was clear, but maybe if the wording was flashing it would stand out even more.
76	Wording stated use HS in congestion, it wasn't clear if it could be used all the time or only when road was congested.
77	Seemed ok?
82	Perhaps the overhead sign could say "HS open through junction".
88	By saying to stay in this lane (i.e. HS) even at junctions.
91	Depending on the overhead sign as to whether it was still in use - proceeded with caution.
92	Don't know how signage could be clearer, I think the lack of clarity is due to lack of experience in this kind of road use rather than lack of environmental info.
96	No pictures available to re-view.

D7 - comments regarding signs and road markings.

Participant	Comment
1	Road markings at junctions are confusing as it is not clear whether you are allowed to still be in the HS.
2	When you are not allowed to use the HS but the turn off signs for a junction are indicated I found it confusing. I wasn't sure if I was allowed to move over or if I had to wait until the turn off to take the exit. Looking back now I don't think I should have but at the time I wasn't sure because of the on/off usage of the HS as lane 1.
4	The signage will probably be ok once it is recognised. Obviously being a new thing does make it a bit confusing.
5	You would have to take notice of junction numbers to be sure the instructions were understood and may not know where or what number you are driving or approaching.
8	The signage was clearly marked above each lane with a cross if you weren't allowed to use it and a speed limit/clear instructions "use HS" if

	you were.
11	Big, bold, clear. 1st time didn't realise had to get into lane 1 when I did from HS.
13	Detail of availability of HS within junctions should be BOLDER and earlier i.e. before the exit sign.
15	At one point, signs referred to the HS as only being available for junction 6 however thereafter instructions were given to use the HS the entire time.
17	Use HS signs need not need to say 'between junctions'. Either the HS is to be used or not.
18	Being not used to such road markings it was hard to decipher and get used to it.
19	If I understand it correctly the white line separating lane 1 (HS) from the rest, still means that one cannot enter or exit that lane. Therefore if one chooses to use the HS lane one must stay in it until the road marking change. This strikes me as being odd since these people using the HS will be at a disadvantage to rest off road users. The solid white line should not be solid if the lane is to be used as lane 1.
24	Road markings very clear. When the HS was only to be used for Junction 6 would it be possible to put J6 and a destination, and not everybody uses junction numbers and this may cause sudden last minute lane changes.
29	Some drivers are not so familiar with their junction number, so such as the name of the town/city, therefore with signs saying (for example) "Lane for J6 only" with no mention of the town name , some drivers may be unsure if it is their junction or not.
30	Road markings not so easy to read as signage.
31	I felt that overall signage and markings were very clear though I feel that flashing or blinking signs would further improve understanding.
35	Solid lines defining the HS give the impression that re-entry to the motorway will be illegal.
37	Road markings: As D2 the extra "lane" should be marked as a HS which would also give a longer entry slip on the far side of the junction.
39	Road markings don't really matter too much if signs clear.
40	VMS sign that said "HS closed ahead" was a bit unclear. I wasn't sure if it meant now closed to running traffic or closed as in blocked and you can't stop on it.
41	Yes I thought that it was obvious you could use HS from road markings.
42	There was a lot of them, more than needed.
43	Signs and gantries and road markings very clear.
44	There were no HSs within junctions. There were no solid white lines, therefore they were open lanes. By "end connections" they had the feel and expectation of HS, hence I did not use them. This configuration was totally ridiculous.
46	All very clear.
47	There seemed to be more signs than you would have driving on "real" motorway.
49	The diagonal lines in the HS I think pushed you out into lane 1. This would not occur in heavy traffic.
56	Perhaps they could be painted another colour. I feel that when you are travelling at 60mph it can be quite difficult to take in the road markings frequently changing.
57	Main confusion was joining motorway, fixed sign implies HS is closed only for gantry sign to say it is open.
59	As for D2. Otherwise quite clear.

60	They were pretty clear; I just was not used to them at first.
61	The only signs which I thought clearly stated use of the HS were the black boards above the bridges and gantry reading "Congestion HS in use" I didn't even know there were road markings telling me that the HS was in use.
64	You always need plenty of warning when coming up to an exit. They need to be repeated in case you missed the first warning sign.
65	The first time I used the HS within the junction I was unsure but I felt more confident when I came to another junction.
66	Was not sure from the signs if I could use the HS between junctions when there was a dotted rather than solid line to mark the lanes.
67	To use it was clear but it was easy to not notice that you couldn't use it anymore.
68	Make it more clear when you have to stop using the HS like a sign saying it has ended.
71	Rather than having just road markings to indicate that you can use the HS between junctions maybe a sign should accompany this make it more obvious.
80	Must be very clear to cars travelling at speed, as this is not a normal procedure on motorways.
83	I didn't find the general lighting on the road bright enough.
84	Coming up to a junction with the HS running was not very good.
88	Could specify "At all times".
91	The HS markings went from solid to dashed which did confuse at times.
92	See answer to D2 as this applies again.
95	Signs could have been clearer to indicate when HS was open or closed.

E9 - Comments regarding Prism gantry.

Participant	Comment
2	Because of the positioning of the exit details it is unclear if I am allowed to use the HS.
3	Picture 3 allows all traffic in lane 1, not just those leaving at exit, it would stop people weaving in and out to undertake as they could legitimately use lane?
6	Both pretty clear. Picture 2 might be clearer with no overlap of blue boxes (see diagram).
8	It's took me about a minute of looking at the photos to see the difference!! But now I've spotted it, it's clear!!
11	Doubt starts to come in as not sure of HS open/closed. Different roads make you go off in lane 1 others you can still go on motorway.
13	2) If the HS is in use spasmodically, then an X over it would confirm that traffic should not use it. 3) The arrow could carry a logo to the side stating "traffic use HS".
14	Picture 2 - not clear if you can use lane 1.
18	Picture 2 is not very clear.
27	Only noticed the additional vertical arrow on comparison of both pictures.
29	Picture 2 signage is more ambiguous than picture 3 signage. Sign in picture 3 are more "obvious" to follow.
31	These signs seem clear to me.
32	Position of A208 sign over lane 1 is confusing if this lane is not meant to be used.
33	In picture 2 it is not clear whether the signs refer to normal motorway

	use or busy periods (HS in use). Picture 3 signage is more clear, but could imply that HS should be used at non-busy periods.
34	Picture 2 gives best info regarding exiting and staying on motorway but Picture 3 could be interpreted the same way.
35	Picture 1 indicates that the HS is the exit lane only, the other picture suggests that lane 2 could be used for either.
37	Picture 3 - no problems. Picture 2 - you will get people in LANE 2 trying to exit because the blue panel for the exit overlaps the blue panel for straight ahead.
38	Picture 2 doesn't make it clear that the HS is open and can be used for exiting.
39	Picture 3 would cause problems if someone wanted to leave exit quickly and didn't realise it was straight on as well.
40	Different to the Red X used to indicate HS closed on the M42.
41	I feel they are obvious with the arrows as to which lane you should drive in.
42	Picture 2. Shows LANES 2, 3, 4 open. Picture 3. Shows LANES 1,2,3,4 open.
43	Displayed clearly.
44	Picture 3 is a contradiction of definition, YOU CANNOT have a HS as a PERMANENT through lane, it would no longer be a HS. The gantry and the road lines are a contradiction.
45	No confirmatory X (down arrow) displayed, so you have to remember whether the HS is meant to be open or closed?
46	Signs appear to be clear and provide all information required.
47	Picture 2 clearly shows lane 2, 3, 4 are to be used to continue on M7. Picture 3 has arrow over HS which I do not think should be there.
48	Not quite what I'm used to.
52	Picture 3 doesn't instantly explain the HS is in use. There should be an extra lit up notice when it is.
56	The pictures do not show that the HS is open or closed. Only difference one arrow missing for the closed! Would have to be very observant.
57	Both clear.
59	Picture 2 is not so obvious until you have encountered picture 3!
62	As mentioned in C3 a no entry sign above the HS may prevent confusion whether it’s open or closed.
63	Picture 3 Weaverton sign - not sure if it half covers lane 2 or not.
64	Lane 1 is generally for emergency but in this case the heavy traffic lane 1 was clearly open. Picture 3 has an arrow indicating lane 1 to continue on the motorway. As Picture 3 arrow are only 2-4. This is better.
66	Picture 3. Arrow over lane one could only show when HS is being used as running lane.
68	I can't see the prism in picture 2 saying that the HS is closed, or 3 saying it is open.
70	Very clear and self explanatory.
71	Picture 2 indicates that lane 1 is still a congestion lane that is used for leaving at the next junction. Picture 3 is less clear.
74	I think the junction numbers should be bigger. The signs should tell you that you can use the HS for the junction, on the blue signs as well as the black signs.
76	Picture 2 is how I normally see sign travelling on M3. Picture 3 although clear I have not seen before.
77	Not very clear. A bit like spot the difference.
78	Picture 2 not clear that you can use the lane.
80	Drivers would exit on lane 2 as this is the normal procedure.
83	The signs suggest in picture 2 that lane 1 is for leaving the motorway

	and lane 2, 3, 4 are for staying on motorway. The sign in picture 3 suggests that lane 1 can be used both for leaving the motorway or for continuing on.
84	Picture 2 shows lanes for ahead 2, 3, and 4 but picture 3 shows all 4 lanes for ahead?
87	In picture 2 where the HS is closed there should be an X or closed sign as it's tempting to use it when exiting at the junction.
88	Picture 3. When using HS was not sure whether to go into lane 2 at junction - then back to lane 1 after junction.
90	Exit sign in picture could be confusing.
91	The main difference is the flow arrows, 3 in picture 2 and 4 in picture 1 - however is still a solid line indicating HS - I would still proceed with caution.
93	Picture 2 if lane 1 is for exiting the motorway only, an arrow pointing down at the lane would be clearer.
94	I think it would be helpful for something along the lines of "use all four lanes for continuing on motorway" on a matrix sign would be helpful.
95	Lanes were clear as to which lanes could be used to leave the motorway.
96	No pictures provided.

I21 - Comments on media to promote/explain TJR.

Participant	Comment
13	Free CDs sent from say AA/RAC to members.
16	Inclusion in Highway Code theory test?
18	To be implemented in driving tests, and car and a leaflet in the car tax reminder.
37	The people who want to know will find out, the above relate to the majority who don't even know the basics of the highway code!
38	Implementation into highway code and driving theory test.
41	Posted bill boards.
42	Signs on "A" road before motorways.
44	Through junction running will CAUSE accidents and congestion.
46	Leaflets/newspapers would need to be sent to all. Signage on a motorway may distract people.
51	Training during driving lessons for licence.
55	Getting DVLA to send leaflet of through junction running with the car tax reminder form to every motorist.
66	Leaflet drop with road tax renewal/council tax bills.
70	For new learners as part of training.
74	On your driving test. Highway code booklet.
80	Billboard posters.
86	Mail shot to every licence holder. Posters in public places, hospitals, doctor/dental surgeries, hospitals or car related places i.e. garages.
91	Sat nav notification.
92	Visual demonstration most appropriate.
95	Optional courses for drivers to take to learn about new system.
96	Enclose in DVLC letters e.g. tax renewal letter.

I3 - Any comments about through junction running.

Participant	Comment
2	I didn't like it especially considering joining the motorway it effectively gives you two slip roads one after the other this is dangerous.
3	My only worry is undertaking and how dangerous it can be - needs to be policed or enforced.
4	Being a new thing will bring confusion, but with time, education and training by driving instructors will ease this and become a norm to motorway driving. I feel sure this will ease congestion.
5	I am sure that with more experience I would get used to it. I did find it a bit confusing and I feel that older road users might not be able to cope with the lane changes at busy times as their reactions are slow and may cause more accidents using this system.
9	I would welcome it.
10	I felt the through junction running was a good use of motorway and the signs were well placed. Providing it was monitored well I think it could help with congestion at certain times. However my concern would be for emergency services gaining un-prohibited access to the scene of an accident.
11	My concern is safety, how would the emergency services get in. Lives could be at risk. Accidents take longer to clear so congestion would increase. The lane causing accidents congestion normally at worst when been an accident. I do not think it will solve any of the issues it is trying to, in fact it will add to them. I DO NOT think using the HS is a sensible even practical idea.
12	I don't think the idea of HS usage for other than emergencies is good especially when there is no indication of how congested it needs to be to use it.
13	This is obviously a more dangerous procedure than HSR between junctions. Discipline and signage has to be good and coupled with strictly enforced variable speeds to ensure maximum driver confidence. If successfully implemented there would be definite benefits such as a reduction in congestion, accident risk and harm to the environment. The caveat is that the rate of introduction synergies with driver confidence for all not just those who drive on the motorway daily. This poses a major problem given the aging demography's of our population and also the increasing number of foreign lorry drivers on our roads (do other EU countries have such contingencies currently! If so can we transpose what they have learned from their motorway systems?
15	The idea is good in order to reduce congestion however undertaking would be a big issue and therefore increased observation would be needed.
17	If it eases congestion it is a good idea. Presumably trials on certain motorways will give the answer.
18	A whole new way of motorway driving which must include undertaking which I believe is illegal at the moment.
19	I am unclear on what the line markings mean in TJR. Does a solid white line still mean that there is no entry or exit to and from the lane? If so, then it would make driving in the HS lane and lane 2 more dangerous and frustrating. Also the exit from lane 2 onto an exit slip road needs be longer since now one must cut across a lane of traffic which would take longer (if done safely) than just exiting from lane 1 as normal without TJR.
20	If it prevents vehicles being forced to change lanes at junctions where the HS disappears that would also be an added advantage.
21	An insecure experience.

22	I think if presented in the correct way it would work between the junctions. I found within the junctions a bit confusing at first but after a while it was ok. Coming off and joining the motorway was probably easier using the running junction.
24	Good idea in theory. However many may not use the HS for fear of the debris often found there - more relevant if HS is only used some of the time. Also there must be a safe place to get out of everybody's way in the event of an emergency. I would use if in existence, my biggest concern as someone who regularly transports horses is that the HS is good if there is a concern over anything and it is not safe to continue to a service station, or as has happened in the past someone has cut in front of me while braking and used up my safe stopping distance - instead of risking an emergency stop the nose of the car can be pointed into the HS slightly, protecting all concerned.
25	Historically the HS is for emergency stops only and to educate drivers of TJR I believe would be a nightmare. The interim period I believe we would experience more accidents and I don't believe it's a price worth paying. A further outside lane would be more beneficial.
27	Made me feel uncomfortable, don't trust other drivers to not cut across to leave the motorway.
28	No issue provided road markings are clear involving lane markings.
29	If there are benefits without increased risk, then this needs to be shown and clearly demonstrated for a sceptical public to accept this new practice. On the face of it, it seems a risky thing! So the benefits need to be shown.
30	I would only really see this necessary when there is congestion or the need for emergency services to get through. I think it will take time to get used to it!
31	As in my previous comment this feels "not right" and would only feel comfortable at low speeds - say 20 - 30 mph. I think it absolutely necessary to have frequent safe or refuge areas in the event of accident or breakdown. I think drivers could be confused when leaving or joining the motorway.
32	Am concerned that reducing congestion will just result in increasing traffic on motorways at cost of reduced safety.
33	I am completely against the use of the HS as a cheap way of enlarging our motorway for anything other than emergency use. The prospect of breaking down or getting a puncture while the HS is in use as an extra lane doesn't bear thinking about.
34	It would eventually make a difference but could be let down by the public's bad attitude and practices as displayed and experienced every day on Britain's roads.
35	It would be effective if it was institutionally installed on motorways. Spasmodic introduction would be confusing and not allow for time calculations of journeys. Time spent leaving or joining motorways has always been a difficulty as so many other circumstances affect this e.g. weather, conditions, hold-ups, this would not alter anything in the time difference of using the proposed system.
36	Although I am happy with my own confidence with the use of between junction running and through junction running it would be the actions/lack of knowledge of the other road users that would cause me concern.

37	It is very dangerous and requires awareness and concentration by ALL drivers in all lanes and on the slip road. As a police officer I have had to drive marked cars down the HS with "blues and twos" due to congestion (10-15 mph on all other lanes). For safety at junctions speed is slowed to a crawl, and still people pull out without looking. It is in my view dangerous and should be avoided if at all possible as far as the general motorway public are concerned.
38	Has the potential to ease traffic congestion during busy times. However increases potential for minor accidents caused by undertaking. It could be argued that if we don't need HSs in certain areas then why have them at all. I feel that by using them it compromises safety and reduces the response times of emergency service vehicles to accidents.
39	Depending on whether people entering at the junction where pre-advised you have cars already on HS - although driving slower - probably have nowhere to go if congestion bad and filtering in could be a problem speeds would have to be less than 60 . Signs advising people earlier about exiting to allow them time to move across and possibly overhead as well as normal road signs on left. Signs on road itself works if enough and maybe spaces signs suggesting distances to keep clear from car in front would help. Overhead speed signs should not be used when not required.
40	I would have left the HS as soon as I saw the sign to say use only for J6 but I wasn't sure if this was my junction so stayed in until I saw the sign. Slow moving lorries or people undertaking in the HS could make it more difficult to enter safely from the slip road.
41	I think that it is something that would take time for us to get used to but once we are familiar with it - should be no problem.
42	I can see that in Rush hour and at times of the day when traffic is congested it would work very well, giving another lane to let CARS on and off the motorway should keep the outside lanes flowing even if the lanes 1 and 2 are slow moving i.e. M3 junction to the M25 London bound this still lets the lane 3, 4 flow. I have never quite worked out why ALL lanes stop when there is a Junction on the motorway. I have always thought it to be people moving over too soon when joining. I drive in Belgium a lot and they have a solid white line on LANE 2 to stop this and it seems to work, this will run for a good half mile, the motorway keeps running in LANES 3, 4.
43	When we're all got used to it I'm sure it will be fine.
44	It would CAUSE accidents and congestion. The safest junctions are those which reduce a lane between junctions. SEE DIAGRAM DRAWN ON SHEET.
45	If DfT decides to roll this out, I think standardisation across all schemes would be ESSENTIAL. - warning sign at start of "through junction running" extent?
46	It is a good idea but there is the possibility of increased risk of accidents. I am not sure how comfortable people would feel with it. If there was an accident, it would not be moved on to the HS if it was being used this may cause problems.
47	The concept in itself is ok but I feel safer when not in HS. It goes against the norm so it would have to be clearly signed. Also if it changes frequently, from use to non-use, I think it may cause confusion and therefore be dangerous. People expect to be able to use HS if there has been an accident but may be wary of doing so on other occasions.
48	Personally uncomfortable with the idea!

49	Having experienced M42, M25 at congested times, I believe a very good idea. Driver education will be a problem. I am sure, however they will learn. Next step "undertaking" please. It works in other countries. Too many drivers use the outside 2 lanes whether there are 3, 4, 5 lanes on motorways. Undertaking will stop this.
52	It would seem quite a risk for the potential savings in time etc. I would have thought accidents at junctions with through running of HS will increase.
55	I feel that the speed limit should be reduced to 50 mph to lessen the risk of a pile up or other rear-end collision if a vehicle were to suddenly break down or have an emergency. Also, over-head street lighting could be increased for night driving.
56	I think it could be quite dangerous unless the traffic is going at a very slow speed. Found the whole experience quite confusing.
57	In heavy traffic not much of a problem. Need to move traffic leaving the motorway into lane 1 as early as possible - no solid line between lane 1 and 2 for 500 yards before exit? Heavy traffic joining motorway would cause issues in lane 1 maybe need 50mph on lane 1 and traffic joining alternately.
59	Rather live without it.
60	Not much to say, apart from that I didn't like it. Just found it confusing. Maybe after some time I would get used to it, but for now I don't think there's much point for it.
66	Appears to be a good idea. drivers would need to be aware of how to use the system and when to use the HS as a running lane.
69	Number + signs + gantries required give rise to more distraction + increased confusion for those not familiar with motorway driving. Lack of safe area/emergency services access a concern. Cost to do properly likely to outweigh benefits?
70	Overall I feel that with the increased level of traffic that TJR would be of benefit. However, I would be concerned with the added risk of vehicles stopping on the HS during breakdown emergencies etc. This could lead to increased accidents as vehicles would have no option but to take avoiding action or stop completely during periods of heavy congestion
71	I found it quite distracting having cars overtake me on both sides, felt less safe. I would also be concerned about not having a safe place to do an emergency stop.
74	Could help relieve congestion, somewhere for slower drivers to drive so traffic could flow easier.
76	To me it just another word for 4 lane motorway. I think if it was to be called extra lane it would be much clearer. I think however if a car was to break down it will now cause much more congestion than when the lane was a HS.
77	I'm not a fan.
80	I left at first exit from lane 2, realising that I was in the wrong lane too late. So signage MUST be very clear to avoid collisions at exits/entries onto motorways.
82	My main concern is the safety of users when the HS is open. Drivers in lane two will have to contend with being undertaken by those using the HS and vehicles joining the motorway on the slip road who may be confused whether the HS is open or not.
84	In my opinion I felt unsafe at junctions, wasn't very clear what lane you should be in. Would be a great idea at times of heavy traffic, but only between junctions. You would also need quite a few refuge areas.
85	If someone breaks down in lane 1 would cause more congestion and accidents.

86	A programme of education needs to accompany any new initiative for driving especially motorways, lane discipline isn't good now, without introducing a new method of using lanes. many people especially older ones, are uncomfortable with change and unlikely to feel confident in using HS as a temporary lane.
88	Unless it is used everywhere and people become used to it and do it automatically there will be confusion if it is only used piece-meal. Some will understand it and others wait which will result in accidents as people hesitate and others don't (who are very confident).
90	Would be good if undertaking was allowed or there was better lane discipline. Through junction running would be very effective in these scenarios.
91	It is a good idea as long as it is clear when it is in place. The speed is clarified before and after and the traffic joining the motorway is also aware that it is in place - this wasn't always clear during the test. Controlled speed would also alert drivers to a change in normal conditions. VAS signs upon entry to the motorway would be effective.
92	I have concerns about safety of having no HS section for emergency stopping however I think that through junction running would be safer as it will operate more like normal motorway running and require less lane changing which I expect would lessen the accident rate.
93	Plenty of signage that the HS is closed to through running to allow drivers to change lanes safely.
95	Good idea to reduce congestion but keep traffic safe.