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Drivers' attitudes to distraction and other motorists' behaviour: a focus group and observational study

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TRL Limited

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DRIVERS' ATTITUDES TO DISTRACTION AND OTHER MOTORISTS' BEHAVIOUR: A FOCUS GROUP AND OBSERVATIONAL STUDY

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Executive summary

This study was designed to investigate two hypotheses about typical driving behaviours: (1) the majority of motorists engage in behaviours that could be considered unsafe, on a daily basis. These behaviours include unsafe in-vehicle activities (e.g. driving with one hand on the steering wheel, eating/drinking/smoking, using a mobile phone, interacting with systems) and unsafe driving techniques (e.g. speeding, failure to check mirrors/blind-spots, tailgating); (2) these unsafe behaviours may be, at least partly, due to social pressure; for example, strict compliance to the Highway Code is avoided in the belief that this may provoke frustration on behalf of other road users.

To establish the typical unsafe behaviours in which drivers frequently engage and the behaviours that motorists (and non-motorists) find annoying in other road users, a focus group discussion was held. Twenty members of the public were recruited to take part in the study from a range of ages and backgrounds, eighteen of whom (nine male; nine female) actually attended the meeting.

Four key questions were discussed: (1) What unsafe driving behaviours do you engage in?; (2) What are your main distractions as a driver?; (3) What do other road users do that annoy you?; (4) Do you do anything in response to annoying behaviour by other road users?

Participants identified a large number of items in response to each question. For each response to question 1, participants were asked to come to an agreement as to how unsafe that item was on a scale of 1 to 10. Similarly, for questions 2 and 3, participants were asked to agree ratings of how distracting and how annoying each item was respectively. Contradictions and disparities between perceived and actual risk were discussed in the report and comparisons were made with other research that has investigated such behaviours.

The results of the focus group study were subsequently used to steer an observational study in which thirty drivers were asked to complete a 30-40 minute route on public roads in the TRL area (Crowthorne, Berkshire). Each participant was asked to complete the route under two conditions. To evaluate what unsafe behaviours drivers engage in, participants were asked to complete the route driving as they would normally (*normal drive*). To evaluate other motorists' responses to drivers complying with the Highway Code, participants were asked to drive obeying the Highway Code as closely as possible (*instructed drive*).

To record driver behaviour, distractions, and responses by other road users, a Driving Standards Agency (DSA) Approved Driving Instructor and an experimenter accompanied each participating driver. In addition, video recordings were made and participants' heart rate was monitored as an index of stress. Between the two drives, participants were asked to fill out a questionnaire.

Results of the observational study showed that, when asked to drive as they would normally, more than 80% of the participants exceeded the speed limit, failed to check mirrors and blind spots, and left an insufficient gap distance ("tailgating"). Also, more than 50% of the participants displayed poor lane discipline, failed to indicate, and drove with one hand on the steering wheel at some stage during the drive. Unsafe in-vehicle activities such as eating, drinking, or mobile phone use were not observed. When asked to drive according to the Highway Code, there was a greater than fourfold increase in the incidence of tailgating on behalf of other road users when compared to the normal drive. Other behaviours observed included under-/overtaking and cutting in, but these occurred only rarely.

The results of the observational study provide support for the proposition that the majority of motorists engage in behaviours that could be considered unsafe. Furthermore, the considerable increase in the incidence of aggressive driving behaviour (i.e. tailgating) in the instructed drive, can be interpreted as providing support for the idea that the high prevalence of unsafe driving behaviour may, at least partly, be the result of social pressure. That is, individuals may engage in unsafe driving behaviour (e.g. speeding) in the belief that this may prevent frustration on behalf of other road users.

1 Introduction

Passing the current UK car driving test represents a watershed in the life of a driver. Thereafter, there is no requirement for drivers to have any follow-on training and driving behaviour is no longer governed by an instructor or experienced co-driver. The driving style of the newly qualified driver is therefore subject to drift over time.

Experience gained on the roads can lead to improved driver behaviour with drivers better able to predict and deal with the typical hazardous situations that arise on UK roads (Maycock, Lockwood and Lester, 1991). However, without third party guidance, drivers are also free to adopt unsafe driving behaviours, sometimes as an expression of their own personality (see Reason, 1990); sometimes in an attempt to conform to perceived norms; and sometimes in response to perceived pressure from other sources, whether from passengers or from the behaviour of other vehicles (see Sharpley, 2003). Furthermore, the newly qualified driver is free to engage in practices that may have been forbidden as a learning driver and may cause distraction such as listening to loud music (see Brodsky, 2001) or talking on a hands free mobile phone (see Parkes, Luke, Burns and Lansdown, 2007).

The objective of this study was (1) to understand typical drivers' perceptions of these factors, and (2) to investigate drivers' behavioural reactions to, and attitudes towards, Highway Code compliant and non-compliant driving.

More specifically, this study aimed to validate the proposition that the majority of motorists break the rules of the road/ Highway Code on a daily basis, and that this may be, at least partly, due to social pressure. Stated differently, strict compliance to the Highway Code is avoided as this may provoke frustration on behalf of other road users.

In the first phase of the study, a focus group meeting was held to determine a range of drivers' subjective views of:

1. common unsafe practices:
    - driving techniques (e.g. speeding, failing to check mirrors/blind spots);
    - in-vehicle behaviour (e.g. eating/drinking, using a mobile phone);
2. signs of annoyance at other road users behaviour;
3. any actions in response to perceived aggression by other road users;

The outcomes of the focus group were used to direct attention to salient items to be monitored in a subsequent observational study of driver behaviour.

The aim of the observational study was to provide empirical data with regard to actual driving behaviour under conditions in which individuals drive as they would normally (normal drive), and drive in compliance with the Highway Code (instructed drive). It was expected that in the normal drive, a considerable proportion of participants would violate the Highway Code. Driving in compliance with the Highway Code, on the other hand, was expected to induce frustration on behalf of other motorists, possibly translating into aggressive driving behaviour such as cutting in, flashing lights, or tailgating. The observational study therefore comprised the recruitment of thirty participants from a range of backgrounds who each completed two drives in their own vehicle on a varied route in which their behaviour and that of other road users was observed and recorded to understand the prevalence common driving errors, the circumstances under which they occur, and the behaviours that provoke annoyance in other road users.

2 Focus Group Study

2.1 Method

2.1.1 Participants

The aim was to recruit 20 UK car driving licence holders (licence category B) from TRL's participant database of more than 1000 local members of the public. Participants were to be from a range of ages and an approximately equal mix of male and females. It was also desirable if there were participants holding motorcycle (licence category A) and/or commercial vehicle (licence category C1, C, and C+E) driving licences so that their perspectives could be included.

2.1.2 Questions

Four key questions were discussed:

1. What unsafe driving behaviours do you engage in?
2. What are your main distractions as a driver?
3. What do other road users do that annoys you?
4. Do you do anything in response to annoying behaviour by other road users?

These questions were posed on a whiteboard. Discussion of each question was moderated by a facilitator who noted the answers to each question as delivered by the group participants. For questions 1 to 3, participants were asked to reach a consensus on a rating out of 10 for each item proposed:

- For question 1, participants' ratings were to estimate how unsafe that item was with a rating of 10 indicating that the item was very unsafe and a rating of 1 indicating that the item was not very unsafe.
- For question 2, participants' ratings were to estimate how distracting that item was with a rating of 10 indicating that the item was very distracting and a rating of 1 indicating that the item was not very distracting.
- For question 3, participants' ratings were to estimate how annoying that item was with a rating of 10 indicating that the item was very annoying and a rating of 1 indicating that the item was not very annoying.

No ratings were applied to question 4.

Any disagreement in rating was resolved through negotiation across the group until a majority agreement was reached.

The meeting was to be held at TRL's head office in Wokingham, Berkshire and was scheduled to last for two hours.

2.2 Results

2.2.1 Participants

20 participants were recruited for the focus group of which 18 (9 male; 9 female) arrived at TRL to participate at the arranged time. Each participant was paid £25 to cover their time and expenses incurred in participation.

The distribution of participant ages and is shown in Table 1.

Table 1. Age distribution and years since driving licence acquisition amongst participants in the focus group

Age group (years)	Number of participants	Years since licence acquisition	Number of participants
17-30	2	0-5	1
31-43	5	6-20	4
44-56	4	21-40	6
57-69	6	41+	6
70+	1	Total*	17
Total	18		

* One participant failed to complete the questionnaire and did not indicate the year in which they passed their driving test.

Three participants indicated that they were also licensed to drive motorcycles.

Two participants indicated that they were also licensed to drive commercial vehicles.

2.2.2 Question 1: What unsafe driving behaviours do you engage in?

Table 2 shows the responses obtained to question 1, ranked by participants' ratings of how unsafe they felt each item was.

Table 2. Focus group response to question 1, ranked by unsafe rating

Item	Rating 10 = very unsafe 1 = not very unsafe
Tiredness	10
Text messages: Writing	10
Text messages: Reading	10
Going through traffic light at red	10
Poor vehicle maintenance*	Up to 10
Tail-gating	8
Not using indicators (early enough)	8
Mobile phone use: Hand held	8
Racing to junction exit	7
Not securing children	7
Not allowing windscreen to clear on cold morning	7
Rubber necking	6
Eating or drinking	6
Too fast for conditions	5
Sweets	5
Not wearing seat belt	5
Cornering too fast for pleasure	5
Cigarette	5
Undertake on motorway	3.5
Mobile phone use: Hands free	3
Going through traffic light at amber	3
Fiddling with radio	3
Braking for speed cameras	3
Not keeping number plate clean	2
Mind wandering**	?

* Dependent upon the type of vehicle maintenance that had been neglected - for instance defective brakes was an issue that participants agreed would be rated as 10 whereas a single rear light failure was seen as less serious.
** No agreement was reached about how unsafe this issue was.

2.2.3 Question 2: What are your main distractions as a driver?

Table 3 shows the responses obtained to question 2, ranked by participants' ratings of how distracting they felt each item was. Each item has been categorised post-hoc as to whether the distraction is 'Internal' or 'External'; referring to whether the source of the distraction originates inside or outside the driven vehicle.

Table 3. Focus group response to question 2, ranked by rating

Item	Source of distraction (I = Internal, E= External	Rating 10 = very distracting 1 = not very distracting
Children	I	10
Low sun	E	9
Time pressure	I	9
Main beam	E	8.5
Arguing	I	8
Passenger interfering with controls	I	8
(Un) Attractive pedestrians	E	7
Slowing to view an accident ('rubber-necking')	E	7
Fog lights	E	7
Flashy/interesting cars	E	7
Unsafe loads e.g. hay	E	7
New area/maps/directions	I	6
Unusual behaviour of other road users	E	6
Wild animals on the road	E	6
Bad/unpredictable driving by others	E	6
Trying to put on seat belt	I	6
Satellite navigation systems: responding to instructions	I	1-6
Mobile phone ringing	I	5
Too few/many road signs	E	4
Advertising on billboards	E	4
Advertising on vehicles	E	4
Emergency vehicles lights/sirens	E	4
Music too loud	I	3
Pets	I	3
Vomiting/car sickness	I	3
Low flying aircraft	E	3
DVD players in other cars	E	3
Boredom	I	3
Unusual noise from car	I	3
L drivers	E	2.5
Talking to passengers	I	2
Satellite navigation systems: fiddling with controls	I	2
Speed camera warnings	I	2
Warning signals from the instrument panel	I	2
Surroundings/estate/rural/scenery	E	2
Advertising or hot air balloons	E	2
Animals at the side of the road	E	1

* It was felt that satellite navigation instructions, although usually helpful (hence the rating of 1), could some times be very distracting (hence the rating of 6).

2.2.4 Question 3: What do other road users do that annoys you?

Table 4 shows the responses obtained to question 3, ranked by participants' ratings of how annoying they felt each item was.

Table 4. Focus group response to question 3, ranked by rating

Item	Rating 10 = very annoying 1 = not very annoying
Tail gating	10
Too slow	10
Cutting up/in	10
Illegitimate parking (e.g. occupying two spaces, illicit use of disabled space)	10
Using handheld mobile phone	10
Cyclists: Not having lights	10
Not indicating	9
Approaching vehicle not dipping main beam	9
Coaches/HGVs overtaking slowly	9
Other driver takes your intended parking space	8
Lane changing aggressively	8
Poor choice of parking place (e.g. pavements, bends)	8
Speed up when overtaking	8
Centre/outside/any lane huggers	7
Front/rear fog light – brake light in jam	7
Hesitant/indecisive	7
Cyclists: Not using cycle lanes	7
Cyclists: Not observing traffic lights	7
Erratic driving	7
Inconsiderate to emergency vehicles	6.5
Hooting	6
Inconsiderate driving	6
Driving on pavements (to gain advantage at junctions)	6
Speeding by others	4
Caravans	3
Inconsiderate to buses	3
Headlights in day	2
Hand gestures	2
Litter	2
Learner drivers	2
Slow vulnerable road users	2
Motorcyclists weaving through traffic	1
Intimidation of learner/provisional drivers*	?

* No agreement was reached about how unsafe this issue was.

2.2.5 Question 4: Do you do anything in response to annoying behaviour by other road users?

Table 5 lists the items the participants identified as thing that they might consider doing in response to annoying behaviour by other motorists. These have been categorised post-hoc into three groups: direct aggression towards the aggravating party; indirect aggression towards the aggravating party likely to cause a hazardous situation; and indirect aggression towards the aggravating party unlikely to cause a hazardous situation.

Table 5. Focus group response to question 2, ranked by rating

Item	Category
Carry a baseball bat/shackle lock in the car	Direct aggression towards the aggravating party
Vandalism to aggravating party's vehicle – use key/brake fluid to damage paint work, let down tyres	
Stopped to confront the aggravating party	
Road rage	Indirect aggression towards the aggravating party *likely* to cause a hazardous driving situation
'Brake test' a close following vehicle	
Cut in front of aggravating party's vehicle	
Less courteous overtake	
Under/overtake	
Speed up if intimidated	
Flash headlights	
Put hazards on	Indirect aggression towards the aggravating party *unlikely* to cause a hazardous driving situation
Driver gets upset/emotional	
Hand gestures towards aggravating party	
Leave note on the windscreen of the aggravating party's vehicle	
Report to police/employer	
Moan/swear	
Slow down in response to tail-gating	
Continuously sound horn	
Blow a kiss	

2.3 Discussion

A focus group meeting attended by eighteen members of the public from a range of ages and backgrounds was successfully convened at TRL. It revealed a number of interesting perceptions among the participating motorists.

The first issue discussed related to unsafe driving practises in which participants were willing to admit that they engaged. Two items given the least safe rating were reading and writing of text messages whilst driving. Given recent high profile court cases leading to convictions of death by dangerous driving in which text messaging has been implicated in causing driver distraction (Regina vs. Browning, 2001; Regina vs. Coultas, 2008), it is somewhat surprising that drivers are still willing to admit that they use this form of communication whilst driving. It is less startling to see that participants admitted to driving whilst tired. Maycock (1995) found that driver tiredness was implicated in around 10% of all accidents whilst Horne & Reyner (2000) suggested that fatigue was a factor in 20% of accidents on motorways. The final item to receive the highest rating of danger was driving through a red light. This behaviour was also a factor in the Regina vs. Coultas (2008) since the cyclist that was killed failed to stop at a red light, highlighting the danger of both the distraction by text messaging (the driver) and ignoring red traffic lights (the cyclist).

Although it is alarming to see that drivers admit to these actions, there is some comfort in the fact that each was recognised as being very unsafe. At the other end of the table are actions that participants consider relatively safe. However, research into driver behaviour has shown that there can be a disparity between actions that drivers perceive as unsafe and those that are actually are unsafe. For instance, use of a handheld mobile phone whilst driving is rated 8 out of 10 whereas use of a handsfree mobile phone whilst driving is rated at 3 out of 10. Burns, Parkes, Burton, Smith and Burch (2002) demonstrated that the impairment to certain driving behaviours caused by both handheld and handsfree conversations was significantly worse than that caused by being at the legal limit of alcohol. These results replicate those found in the Direct Line study "The Mobile Phone Report" (2002) in which a MORI survey of 2,000 drivers found nearly 80% of drivers agreed that using a

handheld mobile phone was distracting whilst fewer than 30% of drivers agreed that using a handsfree mobile phone was distracting.

Another striking result relates to participants' perception of the dangers of excessive speed. Participants reported driving 'too fast for the road conditions' and 'driving fast through corners for pleasure' but each of these activities were given a perceived danger rating of only 5 out of 10. When compared to other items given similar ratings such as 'eating sweets', the contribution of excessive speed as a factor in accidents is likely to be far higher (see for example, Taylor, Lynam & Baruya, 2000).

Participants' responses to question 2 were interesting in that a large number of distracting items was generated in a relatively short time, indicating that they recognised there are many different distractions to drivers that may adversely affect their driving behaviour. Consequently, experimenters in the observational study were vigilant in order to assess distraction by any of the listed items over the course of the monitored drives. The item given the highest rating of distraction was 'Children' and from the discussions at the focus group meeting, it was clear that two (confounding) factors contributed to this rating. The first was that the safety of child passengers is the highest priority of the drivers and therefore any distraction that put them at risk was considered significant. However, the second factor was that a child's needs were deemed very important and therefore, tending to those needs may reduce attention to the driving task, resulting in increased risk of an accident. Unfortunately it would be difficult to define an ethical procedure in which children could be included as a distraction in an observational study. The items given the second highest rating were 'Low sun' and 'Time pressure'. These are relatively common features of the driving experience for many motorists. Hill (2004) demonstrated that the sun's position has a significant effect on accident rate whilst time pressure influences drivers' willingness to drive aggressively resulting in raised accident risk (see Shinar & Compton, 2003).

A distraction identified by the focus group but that remains relatively unstudied is that caused by in-vehicle displays (such as DVD players) in other vehicles. This was rated as more distracting than 'Talking to passengers' and so further work could be done to investigate the true level of distraction caused by such displays. Manipulation of satellite navigation systems whilst driving was deemed relatively undistracting. Given the visual, manual, and cognitive demands placed on the driver in operating such systems whilst driving, this is somewhat surprising. However, this corresponds with results reported in other studies (e.g. Burnett, Summerskill, & Porter, 2004) and possibly suggests that either the distraction is underestimated or the benefits of navigation systems, such as not having to refer to paper maps whilst on the move, are included in the overall assessment of distraction.

The third question asked participants to identify behaviours that other road users do that they found annoying. As with question 2, a long list was generated rapidly and many items received high ratings (more than half the list of items gained annoyance ratings of 7/10 or above). Six items received the highest rating of annoyance. Two of these ('Tail gating' and 'Cutting up/in') relate to driving actions by other motorists that are perceived as aggressive and could result in a dangerous driving situation. These correspond with the two items most frequently rated as 'Extremely annoying' in a 2005 survey of 2,700 drivers by the AA Motoring Trust[1] (Tailgating and flashing of headlights: 71% extremely annoyed, 21% very annoyed; Risky overtaking manoeuvre: 65% extremely annoyed, 27% very annoyed). Three of the items rated most annoying reflect frustration with other drivers' behaviour. However, whilst the participants find them annoying, neither 'Driving too slow' or 'Poor parking' (such as misuse of a parking space reserved for disabled motorists) would directly lead to an increased accident risk. The third item that was rated most annoying was 'Using a handheld mobile phone' (by another driver). This could lead to increased accident risk through impairment to the behaviour of the driver using the phone (see Burns et al. 2002).

The final item given the maximum rating was 'Cyclists not having lights'. This reflected the group's feelings that it was inconsiderate of cyclists to place themselves at significant risk of accident/injury through failing to use appropriate lights. Cyclists' behaviour also appeared in other items with non-

[1] The AA Motoring Trust is now known as the IAM Motoring Trust

use of available cycle lanes and failure to observe traffic light signals (a factor in the Coultas vs. Southampton Crown Court (2008) discussed above) featuring. Given this negative attitude towards cyclists, it would suggest that participants' behaviour in response to such road users might be an informative item to monitor in the observational study. Similarly, caravans and large commercial vehicles were referenced as engaging in annoying behaviour. Although encounters with these vehicle types cannot be guaranteed in the observational study, drivers' conduct in relation to any such vehicles that are encountered should be closely scrutinised within the observational study.

In question 4, participants were asked to state how they respond to being annoyed by other road users. Three broad categories of response were identified. Firstly, responses that imply direct aggression towards the aggravating party. This category included confrontation and violence/vandalism towards the road user responsible for the annoyance and that drivers admit to considering such actions is of concern. The second category reflected indirect aggressive acts that may cause a hazardous driving situation. This included many of the behaviours commonly identified as 'road rage' such as 'brake testing' (applying a vehicle's brakes unpredictably to panic/frustrate a following driver) and 'cutting in front of the aggravating party's vehicle'. The third category contained items that could be considered aggressive but were unlikely to result in a hazardous driving situation. Examples include anti-social hand gestures and moaning/swearing. Although seemingly trivial, there remains the concern that drivers in a heightened emotional state may have less control over their vehicle (Fuller, 2004).

The focus group study has identified a large number of unsafe behaviours, distractions, annoyances, and responses to annoyance that should be monitored in the planned observational study. Many of the unsafe behaviours and distractions will not be relevant because they cannot be ethically included in a real world study. Furthermore, it is likely that the presence of observers will inhibit participants from engaging in some unsafe behaviours and encourage them to drive with more care then they would otherwise. However, given that participants recognised a large number of items for each question, it is likely that drivers in the observational study will, out of habit, partake in some, or many, of the listed items and vigilance shall be required to ensure that each is recorded accurately.

3 Observational study

The aim of the observational study was to investigate actual driving behaviour under conditions in which individuals drive as they would normally (normal drive), and drive in compliance with the Highway Code (instructed drive). In particular, the following issues were addressed:

- Validating the proposition that the majority of motorists engage in behaviours that could be considered unsafe on a daily basis;
- These behaviours include unsafe in-vehicle activities (e.g. driving with one hand on the steering wheel; eating/drinking/smoking; using a mobile phone; interacting with systems etc);
- Identifying unsafe driving techniques (e.g. speeding; failure to check mirrors/blind-spots; braking whilst turning etc);
- Whether these unsafe behaviours may be, at least partly, due to social pressure, that is, strict compliance to the Highway Code is avoided in the belief that this may provoke frustration on behalf of other road users.

The outcomes of the focus group were used to direct attention to salient items that should be monitored in the observational study. Before presenting the results, a brief overview of the methods employed in the observational study is provided.

3.1 Methods

3.1.1 Participants

Thirty drivers (14 male; 16 female) from our dedicated participant database of over 1,000 local members of the public were recruited representing a cross section of the driving public. Each participant was paid £50 to cover their time and expenses incurred in participation. The distribution of participant ages and years since driving licence acquisition are shown in Table 6.

Table 6: Age distribution and years since driving licence acquisition amongst participants in the observational study

Age group (years)	Number of participants	Years since licence acquisition	Number of participants
17-35	9	0-5	3
36-55	11	6-20	7
56+	10	21-40	12
Total	30	41+	8
		Total	30

Two participants indicated that they were also licensed to drive motorcycles.

Eight participants indicated that they were also licensed to drive commercial vehicles.

3.1.2 Procedures

The procedure adopted in this study was largely based on a special traffic behaviour observation method referred to as the ‘Wiener Fahrprobe’ (Vienna Driving Test) (Risser, 1985). In this method, car drivers are accompanied by two observers who register not only errors in behaviour of drivers but also their communication and interaction with other road users.

To ensure participants were driving as naturally as possible, they were asked to use their own private cars. Participants completed a 30-40 minute route on public roads in the TRL area. The route had a total length of 27 kilometres (16.8 miles) and was split up into 5 sections according to road condition:

Section 1 (S1) – Built-up/minor road (Crowthorne – Sandhurst)

Section 2 (S2) – Dual carriageway (Sandhurst – M3)

Section 3 (S3) – Motorway (M3 eastbound, junction 4-3)

Section 4 (S4) – Dual carriageway (A322)

Section 5 (S5) – Single carriageway/A-road (Nine Mile Ride)

Note that in the section between TRL and S1 Crowthorne no measures were taken to allow participants to get used to the situation of being observed.

A Driving Standards Agency (DSA) Approved Driving Instructor and an experimenter accompanied each participating driver. To observe and record the driver's actions through the drive in further detail, a video camera was installed in the participant's vehicle by means of a suction clamp. In order to allow participants to get used to the situation of being observed and start to behave as usual (Risser, 2002), no data was collected in the first part of the route and an attempt was made to make participants feel at ease in spite of the experimental situation. Data collection started upon arrival at section 1 (S1).

Using a repeated measures design, each participant was asked to complete the route under two conditions:

- *Normal drive:*

In the normal drive, participants were asked to complete the route driving as they would normally. Participants were instructed that if they would normally engage in activities such as eating, listening to the radio, smoking, and disobeying the Highway Code (e.g. speeding, tailgating, lane discipline, and undertaking), they should do so. Participants were also told that the study focussed on other road users' responses and that their driving performance was only of secondary interest. This instruction was included to reduce participants' feeling of being observed and tested and, as a consequence, display less naturalistic behaviour as a consequence thereof.

- *Instructed drive:*

In the instructed drive, participants were asked to drive obeying the Highway Code as closely as possible. If necessary, the instructor helped the participants to obey the road regulations and to concentrate on the driving task.

To assess differences in the level of stress between the normal and instructed drive, participants' heart rate was measured (see 3.1.3.3 for details). It was anticipated that, irrespective of condition (i.e. normal vs. instructed), the first drive would be more stressful than the second drive due to the presence of experimenter and instructor and unfamiliarity with the route. To eliminate an order effect regarding heart rate, the order of the two drives was balanced; half the participants completed the normal drive first, whereas the other half completed the instructed drive first.

Between the two drives, participants were asked to fill out a questionnaire whilst participants' resting heart rate (baseline) was monitored for a period of 20 minutes. Following the second drive, participants were asked to fill out a final questionnaire. The total duration of each trial (reception, first drive, baseline measurement, and second drive, debriefing) was approximately 1.5 hours.

3.1.3 Measures

3.1.3.1 Observed driving behaviour

A Driving Standards Agency (DSA) Approved Driving Instructor and an experimenter accompanied each participating driver. In the normal drive, the driving instructor's task was to record violations, errors, and lapses by the driver including:

- *Non-adherence to Highway Code regulations*: speeding, failure to indicate, not observing two-second gap to lead vehicle[2], blocking access/crossings, disobeying traffic signs
- *Poor control*: lane discipline, control of the steering wheel, gear selection
- *Driver distraction*: internal (e.g. music, eating and smoking, mobile phone) and external (e.g. pedestrians, broken down vehicles, shops)
- *Conflict involving other road users*

Both the instructor and experimenter used a separate checklist for each of the five sections listing the different driving behaviours described above. A copy of the checklist is provided in Appendix A.

Besides providing assistance in the recording of drivers' behaviour, a key role for the additional experimenter was the monitoring of any aggressive action by other motorists, particularly if this was in response to the instructed driving style. A copy of the checklist used by the observer during the instructed drive is provided in Appendix A. The experimenter also ensured that all monitoring equipment functioned correctly throughout each drive.

To allow participants to get used to the situation of being observed and start to behave as usual, observations started upon arrival at section 1 (i.e. after approximately 5 minutes).

3.1.3.2 Video recordings

A digital video camera was installed in the participant's vehicle by means of a suction clamp to observe and record the driver's actions through each drive. The camera was mounted in the lower left corner (passenger's side) of the front windscreen inside the vehicle. It was ensured that the camera did not unnecessarily block the driver's view. The camera's field of view included the driver's face, upper torso, and upper part of the steering wheel (Figure 1). As for the observations, video recordings started upon arrival at section 1. The primary aim of the video recordings was to provide the opportunity to investigate driver distraction in more detail.

Distraction was defined as one of the following: (1) driver engagement in secondary tasks, i.e. tasks not necessary to the primary task of driving such as operating the radio or heater; (2) driving-related inattention to the forward roadway such as monitoring the rear-view mirror; and (3) non-specific eye glance away from the forward roadway. An attempt was made to relate each distraction to internal and external factors wherever possible.

[2] Drivers' violations regarding gap distances were based on rule 105 of the Highway Code. In recognition of the fact that driving too close to the vehicle in front increases accident risk, the Department for Transport advices in the Highway Code (rule 105) that as a driver you should: (1) "Leave enough space between you and the vehicle in front so that you can pull up safely if is suddenly slows down or stops. The safe rule is never to get closer than the overall stopping distance". (2) "Allow at least a two-second gap between you and the vehicle in front on roads carrying fast traffic. The gap should be at least doubled on wet roads and increased still further on icy roads" (TSO, 2004).

Figure 1: Sample frame of the in-vehicle video recording.

3.1.3.3 Heart rate measurement

Throughout the trial, participants' heart rate was recorded using a commercially available heart rate monitor (Polar RS800-SD). The measure of interest was heart rate variability, or more specifically, the variability of RR intervals, i.e. the intervals between consecutive R peaks. The regulation mechanisms of heart rate variability originate from the sympathetic and parasympathetic nervous system and can be used as a quantitative marker of the autonomic nervous system. Hence, heart rate variability (RR interval variability) is frequently used as an indicator of the level of stress, whereby decreases in heart rate variability are associated with increased stress levels (Berntson & Cacioppo, 1999). Although heart rate was recorded continuously, heart rate data obtained during the time before arrival at section 1 were discarded in the analysis.

3.1.3.4 Questionnaires

A questionnaire was developed in which participants were asked to respond to a number of issues in relation to their driving and response to other road users and consisted of three sections and was filled out between the two drives. Upon return of their second drive, participants were asked to fill out a final questionnaire (*post-drive questionnaire*). The questionnaires are provided in Appendix B and are discussed below

- *Section A.* The presence of instructor and experimenter can be expected to change participants' driving in a way not dissimilar to when driving with passengers. Hence, this section assessed if, how, and to what extent individuals change their behaviour when driving with passengers. Items were scored on a six-point Likert scale.
- *Section B.* Largely based on the findings of the focus group study, in Section B, participants were asked to respond to a number of issues in relation to their driving and response to other road users. Participants were asked to provide answers to the below questions by rating a number of response categories (items) on a six-point Likert scale.

  B1. "What unsafe behaviours they engage in?"

  B2. "What are your main distractions as a driver?"

  B3. "What do other drivers/road users do that annoys you?"

  B4. "If another driver had driven in a way that had really annoyed you, would you consider doing any of the following?"
- *Section C.* This section assessed participants' assessment of their own driving performance and attitude towards driving using an abridged version of the Manchester Driving Behaviour Questionnaire (DBQ) (Reason et al., 1990). The DBQ provides an index of how likely individuals are to engage in Highway Code violations and aggressive violations.
- *Section A "post-drive questionnaire"*. Upon return to TRL following their second drive, participants were asked to fill out a final questionnaire which asked them to indicate (1) how

stressful they found the normal drive compared to the instructed drive; (2) whether they feel intimidated by the behaviour of other drivers; (3) whether they drove more safely in the instructed drive compared to the normal drive; (4) how difficult it was to drive according to the instructions.

3.2 Results

3.2.1 Normal drive

3.2.1.1 Observed behaviour

Figure 2 shows the percentage of participants engaging in each of the different unsafe driving behaviours. The number of instances observed for the different behaviours is displayed above each bar. It can be seen that the most prevalent unsafe driving behaviour observed was insufficient gap distance ("tailgating"). When participants were asked to drive as they would normally, 90% of the participants tailgated at least once on the route. In total, 175 instances of tailgating were observed. Furthermore, 83% of the participants failed to check mirrors or blind spots, whereas 80% of the participants sped at least once when asked to drive as they would normally. 77% of the participants displayed poor lane discipline which predominantly consisted of cutting corners (crossing lanes) on roundabouts. 67% of participants failed to indicate at least once when changing lanes or when approaching or exiting roundabouts. Over half the participants (57%) also engaged in poor vehicle control which referred mainly to steering with one hand on the wheel. Other observations related to vehicle control included lax grip, reduction of speed before arriving at exit slip, and harsh braking. The remainder categories of unsafe behaviour (i.e. conflict with other road users, cutting up/in, blocking access/crossings, disobeying traffic signs) were engaged in by only a small percentage of the individuals.

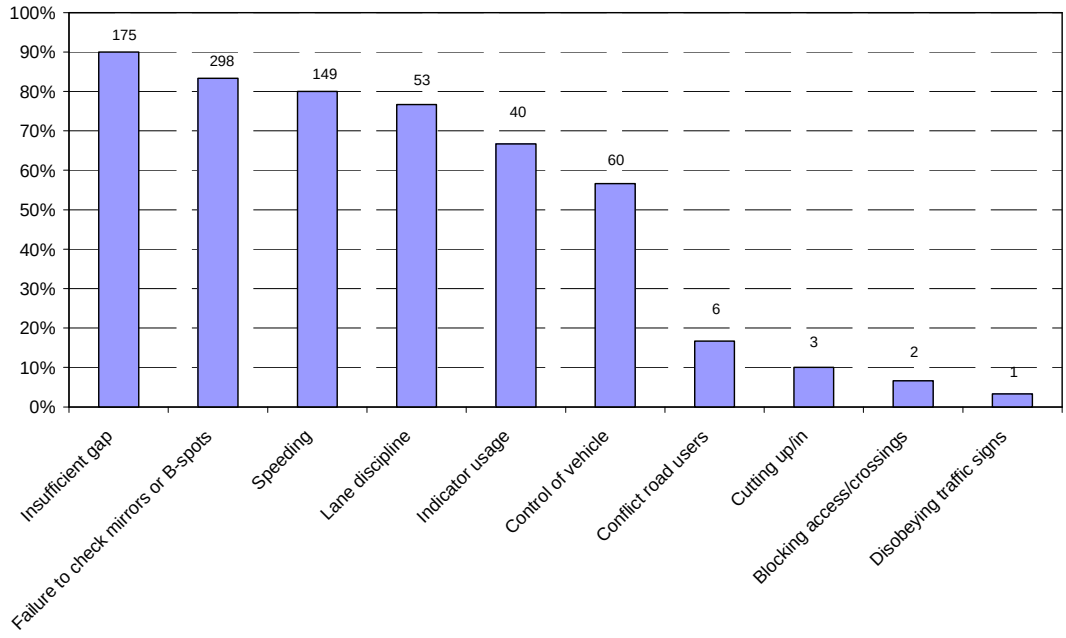

Figure 2: Percentage of participants (N = 30) displaying unsafe driving behaviour. The number above each bar indicates the number of instances.

The percentage of participants engaging in each of the unsafe driving behaviours for each of the 5 sections (S1 – S5) of the route individually is shown in Appendix C. The number above each of the bars indicates the number of instances. Inspection of the individual sections shows that "insufficient gap distance", "failure to check mirrors and blind spots", and "speeding" are the three most prevalent categories across the different sections. It can be seen that poor lane discipline was most often observed in section 2 (S2 – Dual carriageway). This may however not be surprising considering that this section included the largest number of roundabouts. As already mentioned above, lane discipline was found to be particularly poor at roundabouts.

3.2.1.2 Self-rated behaviour

Figure 3 shows participants' response to the question "what unsafe behaviour do you engage in?" It can be seen that the most prevalent self-reported unsafe behaviour is "Braking for speed cameras". Note that the *observed* prevalence of tailgating (i.e. leaving insufficient gap to car in front) as presented in Figure 2 is not reflected in the self-report of unsafe behaviour. When ranked according to frequency of occurrence, it can be seen in Figure 3 that participants rate their own tailgating behaviour as infrequent.

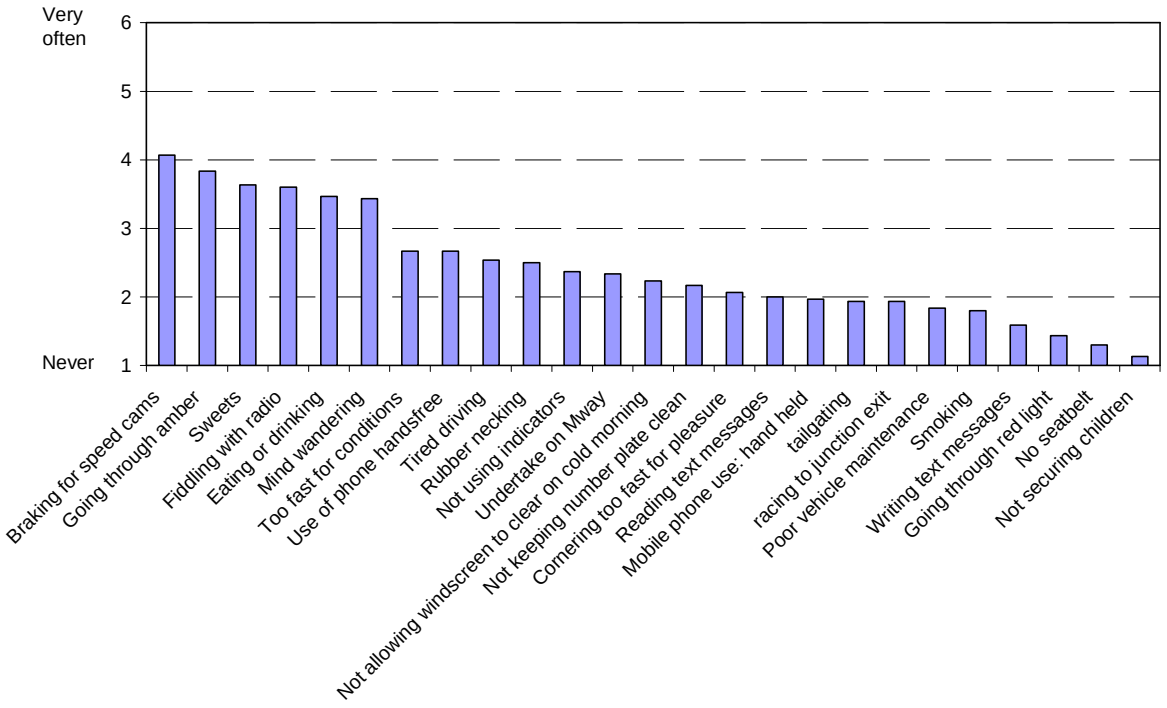

Figure 3: Participants' mean responses to the question "What unsafe behaviour do you engage in?" (1 = never, 6 = very often).

3.2.2 Instructed drive

3.2.2.1 Observed road users' responses

The main aim of the instructed drive was to investigate other road users' responses to those who drive according to the Highway Code. Following the focus group study, a number of responses were identified that were subsequently used to steer the observations in the instructed drive. Out of the list of possible responses (Table 7), in the observational study only three responses were observed:

"tailgating", "under/overtaking", and "cutting in" (see Figure 4a). By far the most prevalent response to participants driving according to the Highway Code was tailgating with no less than 93% of the participants being tailgated at some point on the route. A total of 82 incidences of tailgating were recorded in the 30 instructed drives.

Table 7: Possible responses of drivers to annoying behaviour by other road users as identified in the focus group study.

Possible responses	
Tailgating	Hand gestures
Under/overtake	Toot horn
Cut in front	Put hazards on
Brake test	Flash headlights

It should be noted, however, that tailgating of the driven vehicle by other road users was not limited to the instructed drive, and was also observed during the normal drive. The prevalence of tailgating in the normal drive was however considerably lower. In Figure 4b it can be seen that only 47% of the participants were being tailgated at some point on the route with a total of 18 tailgating incidences observed.

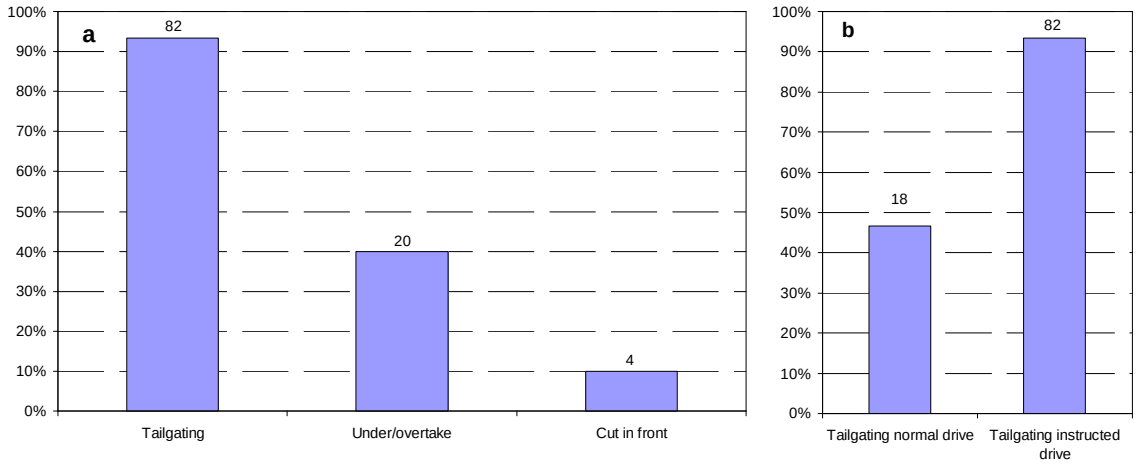

Figure 4: (a) Other road users' response to participants driving according to the Highway Code; (b) Percentage of participants being tailgated in the normal drive and instructed drive[3].

In the instructed drive it was further observed that 40% of the participants were under- or overtaken at some point on the route. Five incidences of undertaking were recorded which involved participants driving in the fast lane at the national speed limit. In the remainder of instances (15), it involved aggressive overtaking manoeuvres. In the majority of cases (12), these instances were preceded by close following.

Finally, in the instructed drive four instances of cutting in were recorded. However, these could not be directly related to the participants' driving behaviour.

None of the other possible responses as presented in Table 7 were observed. This may however not be too surprising in that everyday experience would suggest that these behaviours are rather rare. The

[3] The number above each bar indicates the number of incidences observed.

limited observation period in the current study may have been insufficient to detect any such behaviour.

3.2.2.2 Annoying behaviour by other road users

Table 8 shows the ten most annoying behaviours by other road users as rated by the participants. It can be seen that tailgating was rated to be the most annoying behaviour. The full list of other road users' behaviours ranked according to the level of annoyance is shown in Appendix D.

Table 8: Ten most annoying behaviours by other road users.

Item	Rating (1 = not very annoying; 6 = very annoying)
Tail gating	5.03
Chasing/tailgating	5.00
Cutting up/in	4.97
Approaching vehicle not dipping main beam	4.87
Driving on pavements	4.73
Inconsiderate to emergency vehicles	4.60
Inconsiderate driving	4.60
Centre/outside/any lane huggers	4.57
Not indicating	4.47
Cyclists not having lights	4.43

3.2.2.3 Response to annoying behaviour by other drivers

Table 9 shows participants' response to the question "*If another driver had driven in a way that had really annoyed you, would you consider doing any of the following?*". The items are ranked according to the likelihood participants would engage in each of the behaviours.

Table 9: Participants' response to the question "If another driver had driven in a way that had really annoyed you, would you consider doing any of the following?" (1 = definitely would not; 6 = definitely would).

Item	Mean rating	Item	Mean rating
Moan/swear	3.77	Report to police/employer	2.37
Flash headlights	3.40	Drive more aggressively	2.10
Slow down in response to tail-gating	3.37	Less courteous overtake	2.10
Toot horn	2.90	Stop to confront the driver	1.70
Hand gestures	2.66	Cut in front of the driver	1.70
Brake test a close following car	2.50	Put hazards on	1.67

Speed up if intimated	2.50	Leave note on windscreen	1.50
Undertake driver	2.40	Vandalise their car	1.10
Get emotional upset	2.40		

3.2.3 Heart rate data

Participants' heart rate (HR) was monitored continuously throughout the trial. Figure 5 shows a typical HR recording (bpm) for one participant over the duration of the trial. The red vertical bars (tags) on the x-axis indicate arrival at each of the five sections (S1 to S5). Visual inspection of the HR data clearly shows the different phases during the trial.

The participant started with the normal drive. Note that the first part of the route was not included in the analysis and was used to allow participants to get used to the situation of being observed. Upon return to TRL (tag number 7; t = 0:32:00), the participant was asked to step out of the car and walk to the medical room within the TRL building. As a consequence, an increased HR can be observed, followed by a decrease upon arrival at the medical room during which the participant was asked to sit down and complete the questionnaire. During this time, a 20 minutes baseline HR measurement was obtained. The participant was then walked back to the car (note the increased HR) and the second drive commenced (instructed drive).

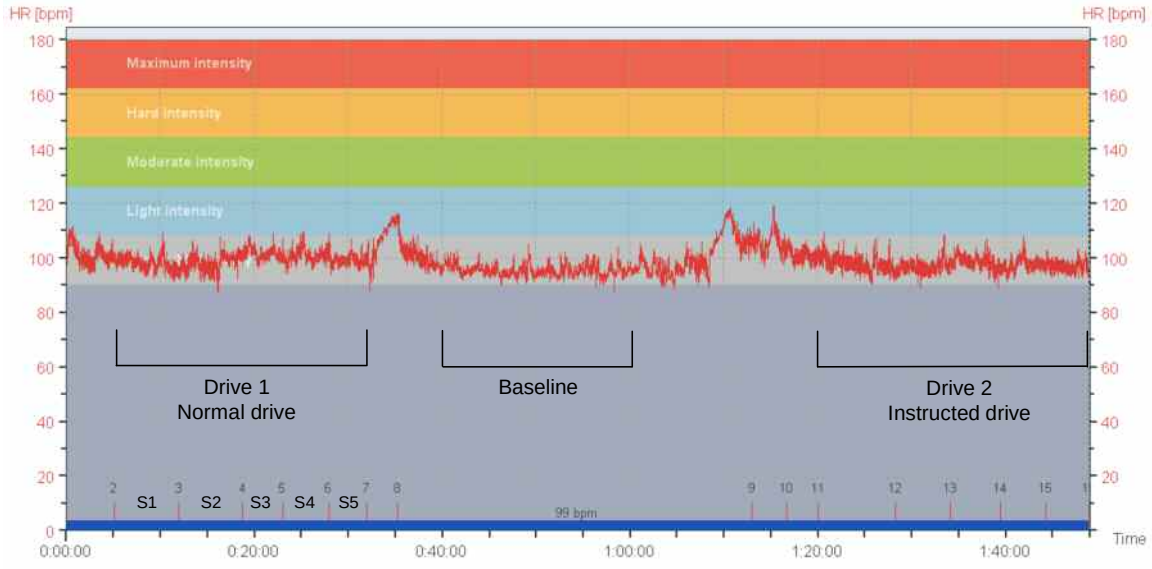

Figure 5: Heart rate data (bpm) from one participant during the trial[4].

Figure 6a shows the mean RR interval (s) variability for the normal drive, baseline period, and instructed drive. During the baseline period, the RR interval variability was found to be significantly higher (paired samples t-test, $p < 0.05$) than during the normal and instructed drive. As decreases in RR interval variability are associated with increased stress levels (e.g. Berntson & Cacioppo, 1999), these data indicate increased stress levels in both drives when compared to the baseline period. No significant difference in RR interval variability was however found between the normal drive and

[4] The participant started off with Drive 1 (normal drive), followed by a 20 minutes break during which the participant's baseline heart rate was measured and a questionnaire was completed. Following a brief break, the second drive commenced (instructed drive). Red vertical bars (tags) on the x-axis indicate arrival at each of the five sections (S1 to S5).

instructed drive which suggests that there was no difference in stress level between the two drives as indicated by heart rate data.

The heart rate data appear to be in accordance with participants' subjective response. To the question "*How stressful did you find the normal drive compared to the instructed drive?*", participants responded with an average rating of 3.7 on a scale from 1 (not at all) to 6 (very much so). Thirteen out of the 30 participants rated the instructed drive as more stressful (item rating ≤ 3), whereas the remaining seventeen rated the normal drive as more stressful (item rating ≥ 4). Based on these data, it can be concluded that there is no substantial difference in the level of stress induced by the two drives.

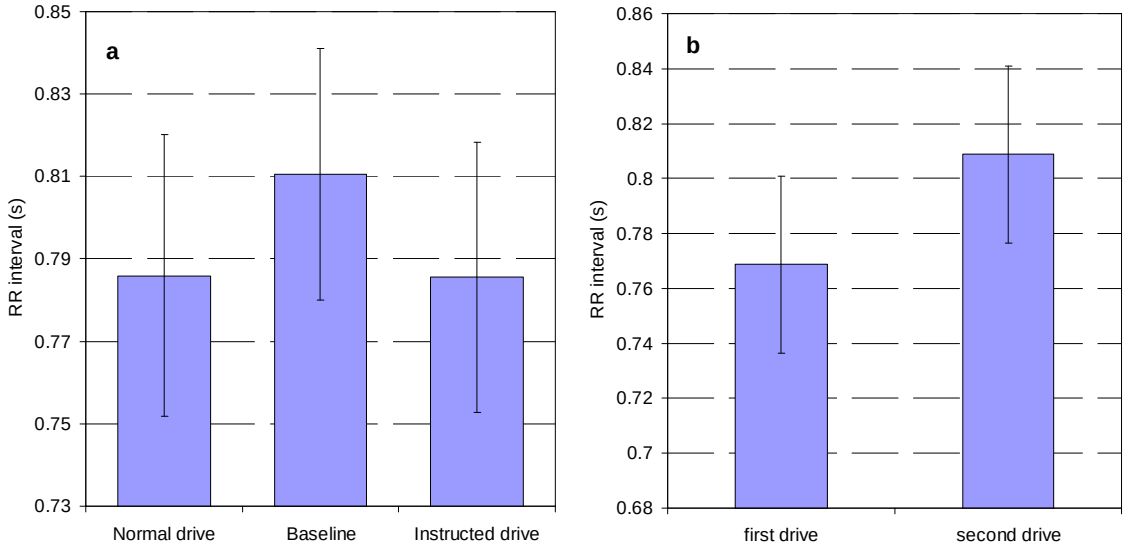

Figure 6: (a) Mean and standard error (SE) of the RR interval (s) for drive 1 (normal drive), baseline period, and drive 2 (instructed drive). (b) Mean (SE) RR interval (s) for the first and second drive.

It is however noteworthy that a number of participants commented that the instructed drive was experienced as more stressful. One participant commented that she felt under pressure to behave correctly and more stressed when having to drive slowly. A further participant reported she felt less relaxed and had to think more in the instructed drive. Finally, it was commented by one participant that during the normal drive, he was better able to pick up information, was less distracted, and felt more relaxed.

Figure 6b compares the mean RR interval (s) for the first and second drive to investigate the effect of presentation order. Statistical analysis indicated a significantly lower RR value (i.e. higher stress level) during the first drive in comparison to the second drive. This indicates that participants tended to be more stressed in the first drive, irrespective of whether this was the normal or instructed drive.

This is also illustrated in Figure 7 which shows the heart rate (bpm) over time for one participant. The participant started with the instructed drive and shows the increased heart rate in comparison to the normal drive. Figure 7 also illustrates the direct effect that tailgating may have on some individuals. In this particular instance, the participant was closely followed throughout the first section in the instructed drive. Both the instructor and observer noted that the participant checked the rear-view mirror with increasing frequency and became slightly annoyed and stressed from being tailgated. Referring to the heart rate data, this observation appears to tie in with the steady increase in heart rate in section 1. Similarly, in section 3 and 5 the participant was driving slightly below the national speed limits or following the recommended speed limit (section 5) and, as a consequence, was again being tailgated. Combined with the observational data, the temporal correspondence between the occurrence of tailgating and increased heart rate suggests tailgating to increase the level of stress in some individuals.

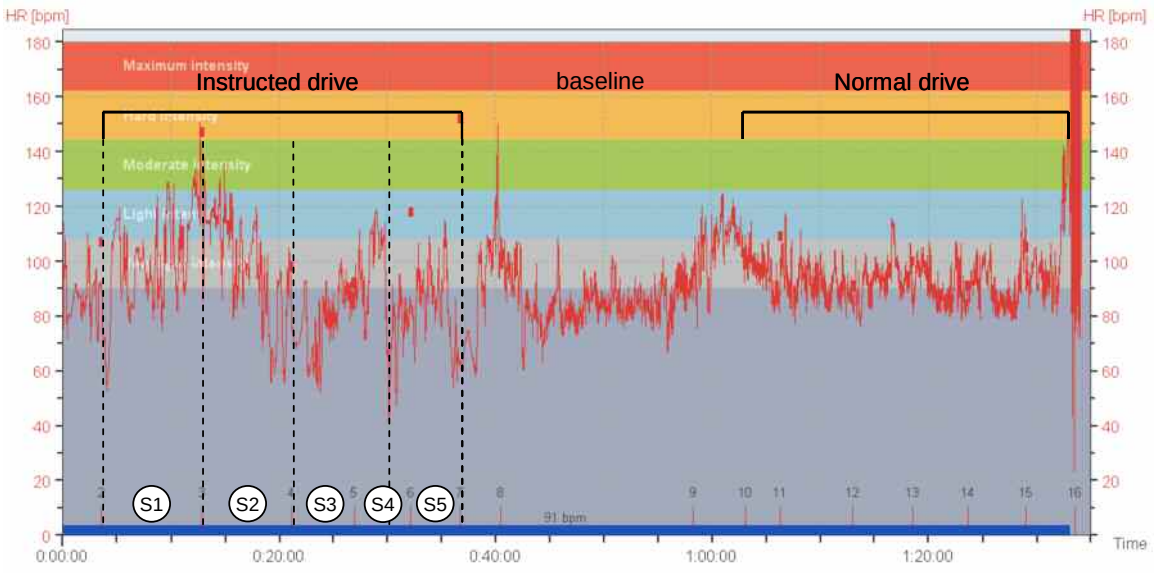

Figure 7: Heart rate data (bpm) of one participant as a function of time[5].

3.2.4 Driver distractions

Driver distraction was analysed on the basis of both the observational data and video recordings. The percentage of participants distracted by internal and external distractions are displayed in Figure 8. Above each bar, the number of observed incidences per category is displayed. It can be seen that all participants were distracted at some point during the two drives, either by internal or external factors.

Internal distractions

Internal distractions were categorised into radio, heater, conversation with passengers, and other. Radio was categorised as an internal distraction on 6 and 8 occasions during the normal and instructed drive, respectively. During both the normal and instructed drive, only four participants drove with their radio on. In one of the normal drives, this involved the traffic information turning on automatically only.

Operating the heater in the centre console formed a further distraction that occurred with some regularity as drivers sought to counteract the windows misting, caused by the respiration of the individuals present in the car.

In Figure 8 it can be seen that the most prevalent internal distraction was conversation with passengers, i.e. experimenter and observer. Note that this distraction could have been avoided by instructing the participant not to speak during the trial. However, it was decided to allow normal conversations to take place to make participants feel as comfortable as possible under the circumstances. This, in turn, was thought to facilitate participants exhibiting more natural behaviour. It can also be assumed that these conversations were relatively typical of those that might be held if/when the driver carries passengers.

Other internal distractions observed included participants' phones ringing, dashboard lights unexpectedly turning on, adjusting sun-visor due to low sun, operating electric windows switches, looking at the camera, and looking down in the area of the gear stick. The latter in particular occurred relatively frequently and 14 out of 30 participants looked at their gear stick on a number of occasions, possibly to check current gear selection.

[5] The participant started off with the instructed drive, followed by a 20 minutes break (baseline). Following this, the second drive (normal drive) was commenced. The dashed vertical lines separate the periods during which the participant's heart rate steadily increased. These periods coincided with those during which the participant was tailgated. Red vertical bars (tags) on the x-axis indicate arrival at each of the five sections (S1 to S5).

Returning to Figure 3, it can be seen that participants indicated relatively frequent engagement in unsafe behaviours that may distract from the driving task such as eating and drinking, use of (hands-free/held) phone, reading text messages, and smoking. Considering the presence of TRL staff members, it may perhaps not be surprising that none of these behaviours were observed in this study. Hence, the prevalence of unsafe behaviours that may cause drivers to be distracted as observed in the current study can be expected to be a conservative estimate.

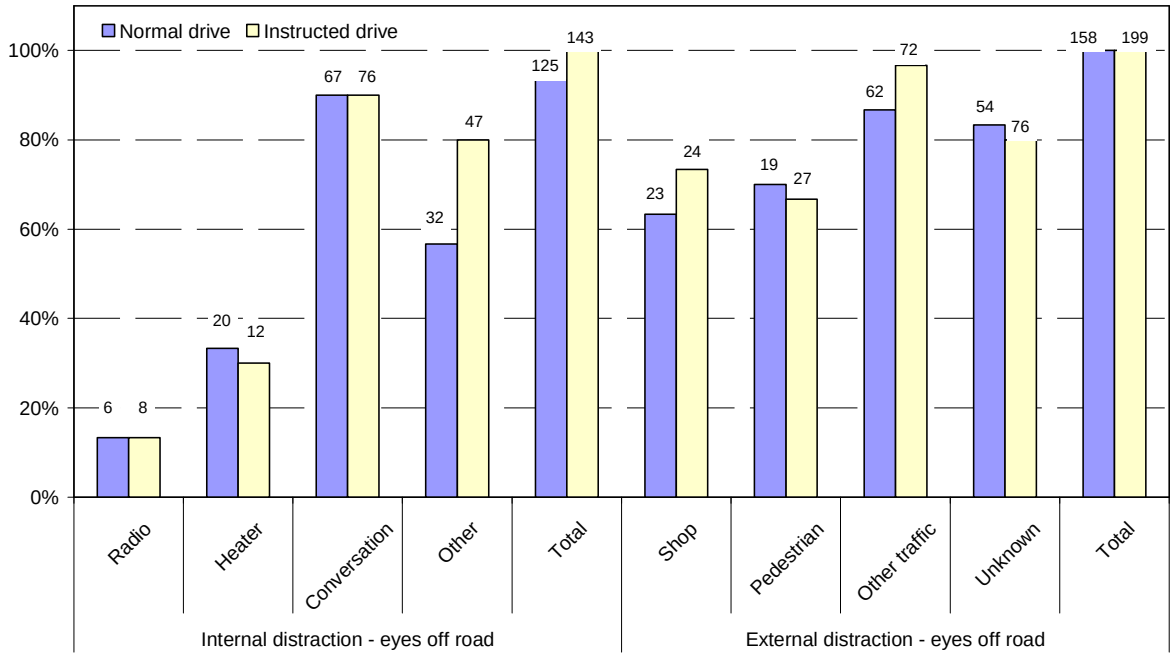

Figure 8: The percentage of participants being distracted by internal and external factors resulting in eyes off road during the normal (blue bars) and instructed drive (yellow bars). The number above each bar indicates the number of incidences.

External distractions

External distractions were categorised into shops, pedestrians, other traffic, and unknown. Figure 8 shows that more than half of the participants were distracted by shops and pedestrians. It can further be seen that the most prevalent distraction in terms of the number of participants and instances was caused by other traffic. This included disturbing bright lights of other cars, low sun, emergency and maintenance vehicles' sirens and lights, broken down vehicles, accidents, road works, cars left unattended, horns tooting, aggressive driving behaviour by others (cutting in, excessive speeding, and tailgating), and unusual driving behaviour by others (driving with brake lights on, fuming exhaust, hesitant pulling out manoeuvres).

An interesting finding was that being tailgated tended to increase the frequency with which participants checked their rear mirrors. In effect, tailgating may therefore not only increase the risk of rear-end collisions due to insufficient gap distances, but may also in itself constitute an external distraction causing an increase in the time eyes off road. This, in turn, increases the risk of missing critical external events.

Self-rated distractions

Table 10 shows the main distractions as a driver as rated by the participants ranked in order of importance.

Table 10: Questionnaire mean ratings in response to the question "*What are your main distractions as a driver*?", ranked according to item score (rating of 1 = not at all; 6 = very much so)

Item	Mean rating	Item	Mean rating
Low sun	4.47	Warning signals	2.90
Bad/unpredictable driving by others	4.30	Children	2.83
Emergency vehicles lights/sirens	4.30	Fog lights	2.80
Main beam from other car	4.13	Advertising on bill boards	2.80
Unusual behaviour of other road users	4.07	Rubber necking	2.77
Unusual noise from car	3.97	Flashy/interesting cars	2.77
New area/maps/directions	3.63	Passenger interfering with controls	2.70
Time pressure	3.53	Boredom	2.70
Too few/many road signs	3.53	Balloons advertising	2.67
Animals on the side of the road	3.43	Advertising on vehicles	2.53
Unsafe loads	3.40	Low flying aircraft	2.50
Wild animals	3.20	Arguing	2.47
Phone ringing	3.17	Vomiting/car sickness	2.40
Talking to passengers	3.17	Sat-nav: fiddling with controls	2.28
Speed camera warnings	3.10	Pets	2.13
Attractive pedestrian	2.93	Sat-nav: responding to instructions	1.96
L drivers	2.93	DVD players in other cars	1.77
Surrounding/estate/rural/scenery	2.93	Trying to put on seatbelt	1.53
Music too loud	2.90		

3.2.5 Drivers' response to passengers

Figure 9 shows participants' response to the question "*when driving with passengers, if, and to what extent do you change your driving?*" It can be seen that, on average, individuals tend to adapt their driving style in a way that renders their driving safer, e.g. reduce their speed, drive more cautiously, and increase gap distance.

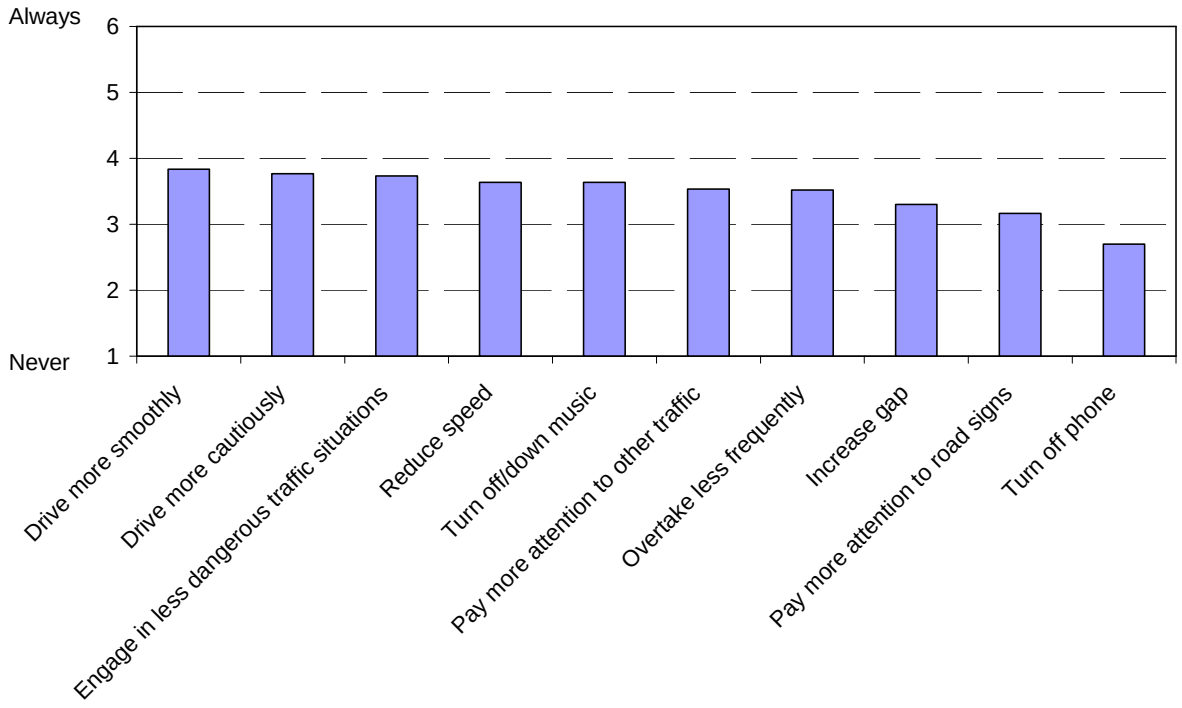

Figure 9: Participants' mean response to the question "*When driving with passengers, if, and to what extent, do you change your driving?*" (rating of 1 = never; 6 = always).

3.2.6 Anecdotal reports

Below are listed some of the comments participants made about the normal and instructed drive.

- Normal drive, Section 5: In response to being tailgated, one participant commented that she was reluctant to slow down in line with the recommended speed limit (30 mph) and instead drove faster than she normally would have done.
- Instructed drive, Section 3: Participant commented that when you adhere to the national speed limit at roadworks you are usually being tailgated.
- Normal drive, Section 4: Participant commented she was unaware of the speed limit on dual carriageway. Rather than 70mph, participant thought it was 60mph.
- Normal drive, Section 4: Participant commented that signage provision with regard to the national speed limit is sparse, inconsistent, and sometime unclear.
- Instructed drive: Participant commented that she felt much more stressed when having to drive according to the Highway Code and felt under pressure to behave correctly. Further noted she feels stressed when having to drive slowly.
- Instructed drive, Section 5: In response to being tailgated, participant mentioned he was reluctant to slow down at points where the recommended speed limit was lower than the national speed limit.
- Participant commented it is harder to adhere to speed limits, particularly to 30 mph speed limits on the outskirts of towns.
- Participant commented that during the normal drive, she was better able to pick up information, be less distracted, and feel more relaxed.

3.2.7 Relationship between driver characteristics and driving behaviour

Correlation analysis indicated no significant effect of gender, age, or annual mileage on unsafe driving behaviour including speeding and tailgating. For example, in Figure 10a-c it can be seen that there was no clear trend between gender, age, annual mileage, and the prevalence of speeding. Note, however, that those individuals not committing any speeding offences (Figure 10b) tended to be older.

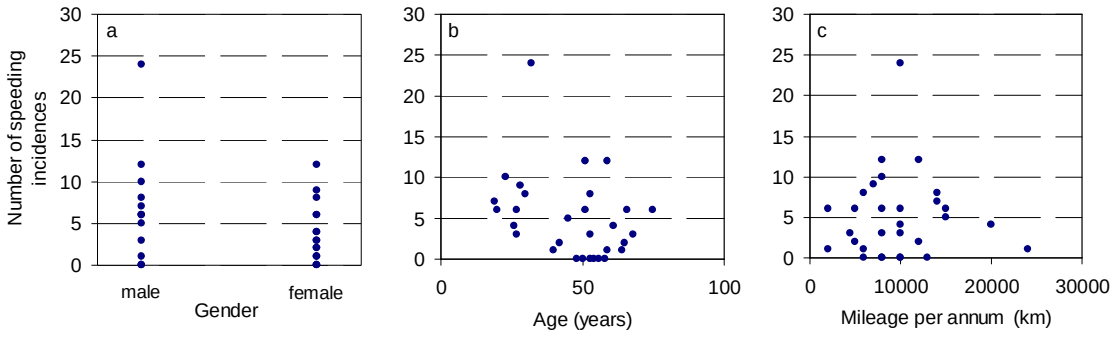

Figure 10: Scatter plots of gender (a), age (b), and annual mileage (c) versus the number of speeding incidences recorded during the normal drive in the observational study.

Further, the correlation analysis substantiated the validity of the abridged Driver Behaviour Questionnaire (DBQ). Those individuals scoring higher on the DBQ, indicating to be more likely to engage in Highway Code violations and aggressive violations, also tended to speed ($R_p(30) = -.568$, $p = .000$) and leave an insufficient gap (tailgate) ($R_p(30) = -.386$, $p = .035$). Finally, older drivers indicated that they were less likely to engage in Highway Code violations and aggressive violations than younger drivers ($R_p(30) = -.461$, $p = .010$).

3.3 Discussion

3.3.1 Adherence to rules

One of the main aims of this study was to validate the proposition that, on a daily basis, the majority of motorists engage in behaviours that could be considered unsafe. The results of the observational study provide convincing support for this proposition in that a large proportion of participants (>80%) exceeded the speed limit, failed to check mirrors and blind spots, and left an insufficient gap distance ('Tailgating'). Also, more than 50% of the participants displayed poor lane discipline, failed to indicate, and drove with one hand on the steering wheel at some stage during the drive.

It should be noted that the results of the observational study are likely to be conservative estimates of actual behaviour. The mere presence of the instructor and observer was likely to have changed participants' driving behaviour to some extent. Support for this contention comes from a study by Rathmayer et al. (1999) in which it was shown that participants driving in an instrumented car in the presence of an experimenter lowered their mean speed with 1-2 km/h, smoothed their acceleration and deceleration, and cornered less sharply. Similarly, participants in the current study indicated that they drive more safely when driving with passengers (see Figure 9).

3.3.2 Responses of other road users

A further question underlying the current study was whether the high prevalence of unsafe driving behaviour may, at least partly, be the result of social pressure. For example, individuals may engage in unsafe driving behaviour (e.g. speeding) in the belief that this may prevent frustration on behalf of

other road users. Stated differently, strict compliance to the Highway Code may provoke frustration and aggressive driving behaviour on behalf of other road users.

The current study indeed lends some support for this contention. The most striking difference between the normal and instructed drive was the large increase (factor 4.5) in the number of incidences of participants being tailgated in the instructed drive. This can be mainly ascribed to the reduced driving speed in the instructed drive on behalf of the participants. As also observed in the normal drive in the current study, drivers frequently adopt speeds above the national speed limit. Following slower moving vehicles that adhere to national or recommended speed limits in turn may cause some level of frustration.

It is however not always clear whether tailgating is motivated by the desire to speed up the car in front, or simply a lack of judgement or awareness of one's own driving behaviour. In this context, an interesting finding in the current study was that tailgating not only created the most annoyance, but paradoxically, was also the most prevalent unsafe driving behaviour individuals engaged in. However, when asked what unsafe behaviour individuals normally engage in, tailgating was rated as one of the least frequently displayed driving behaviours. On debriefing, it also became clear that individuals were often unaware of their own driving style, errors, and violations including tailgating. It therefore appears that individuals may not always be aware of their own (unsafe) driving behaviour.

Besides tailgating, other responses observed in the study included "under/overtaking", and "cutting in". Undertaking was only observed when participants drove in the fast lane at or slightly below the national speed limit. Aggressive overtaking manoeuvres occurred more frequently and in most cases were preceded by participants being tailgated. Finally, in the instructed drive, four instances of cutting in were recorded. However, these could not be directly related to the participants' driving behaviour. Many of the possible responses that were identified following the focus group were not observed to happen in the observational study. This may however not be too surprising considering that, in everyday life, these more aggressive or salient responses occur rather incidentally. The observation period/duration in the current study may have been too brief to pick up on theses instances.

3.3.3 Driver characteristics

Previous research has shown that younger drivers and male drivers not only express a lower level of normative motivation to comply with traffic laws than do female and older drivers, but also drive more quickly, and are more likely to partake in manoeuvres that they consider risky (Simms, 1993; Thornton, Reed, and Gordon, 2005; Yagil, 1998). The results of the current study showed that, although older participants indicated to be less inclined to engage in Highway Code violations and aggressive violations as assessed by the Driver Behaviour Questionnaire (DBQ), this was not reflected in the observed driving behaviour. It should be noted, however, that those individuals not committing any speeding offences also tended to be older. Unlike previous research, the current study showed no gender effect with regard to either normative motivation to compliance or actual observed behaviour. The absence of a clear effect of age and gender may be, at least partly, be explained by the relatively small sample size, the fact that drivers were less inclined to engage in risky driving behaviour when driving with passengers, as well as the mere fact of being observed.

3.3.4 Driver distraction

Driver distractions form a major contributing factor in road accidents. In a recent naturalistic driving study, 100 instrumented vehicles were studied over 2,000,000 miles (Neale et al., 2005; Klauer et al., 2006). Complete information on 69 crashes, 761 near-crashes (conflict situations requiring rapid, severe evasive manoeuvres) and 8,295 incidents (requiring less-severe evasive manoeuvres than near-crashes) was collected. The results showed that distraction due to a secondary task accounted for 22% of accidents. Overall, results suggested that engaging in secondary tasks whilst driving increases the risk of having an accident by two times that of normal baseline driving for simple tasks, and three times for complex tasks (Klauer et al., 2006).

In the current study, distractions were categorised into two broad categories: internal and external distractions. In turn, internal distractions were further categorised into radio, heater, conversation with passengers, and other. In line with previous research, conversation with passengers was found to be the most prevalent internal distraction. Stevens and Minton (2001) also found passengers to be the greatest single source of distraction, followed by interacting with the radio/cassette player and handling food, drink and cigarettes. In the current study, handling food, drink and cigarettes, nor use of mobile phones was observed even though participants indicated that they occasionally engage in such unsafe behaviours. Considering the presence of TRL members of staff during both drives, it may not be surprising that none of these behaviours were observed. Consequently, the prevalence of internal distractions can be assumed to be a conservative estimate. It should further be noted that some distractions expose drivers to distractions for different lengths of times. For example, passengers may represent a distraction for the entire period they are in the vehicle, whereas adjusting the radio is only a momentary distraction.

It is acknowledged that internal distraction by passengers could have been avoided by instructing the participant not to speak during the trial. However, it was decided to allow normal conversations to take place to make participants feel as comfortable as possible under the circumstances. This, in turn, was thought to facilitate participants exhibiting more naturalistic behaviour. It can also be assumed that these conversations were relatively typical of those that might be held if/when the driver carries passengers.

Other internal distractions observed included participants' phones ringing, dashboard lights unexpectedly turning on, adjusting sun-visor due to low sun, operating electric windows switches, looking at the camera, and looking down in the area of the gear stick. The latter in particular occurred relatively frequently and 14 out of 30 participants looked at their gear stick on a number of occasions possibly to check current gear selection.

External distractions were found to be more prevalent than internal distractions. External distractions included shops, pedestrians, and other traffic. A fourth category - "unknown" - was added as it was not always possible to relate participants' behaviour (i.e. taking the eyes off road) to specific external events. Furthermore, it should be noted that taking the eyes off road may not exclusively imply the individual being distracted, and, on the contrary, be an indicator of heightened situational awareness. In the current study, it was however not always possible to differentiate between the two and the prevalence of external distractions may thus be inflated to some extent.

In comparison to internal distractions, external distractions may play a particularly important role in accident causation. Previous research has shown that external distractions – outside persons, objects or events, are at 29.4% the most frequently reported source of distraction related accidents, followed by making adjustments to the radio/cassette/CD player (11.4%) and other occupants in the vehicle (10.9%) (Stutts et al., 2001). Furthermore, external distractions are largely independent of individual behaviour and outside the drivers' control. Internal distractions, on the other hand, are largely voluntary distracting behaviours such as eating, drinking, smoking, mobile phone use, or adjusting the radio. As such, their role in crashes may vary as a function of roadway, environmental, and vehicle conditions. Drivers may be less likely to engage in these types of behaviours when driving task demands are high (e.g. driving in poor weather conditions).

In the current study, the most prevalent external distraction consisted of other traffic. This included disturbing bright lights of other cars, emergency and maintenance vehicles' sirens and lights, broken down vehicles, accidents, road works, cars left unattended, horns tooting, unusual driving behaviour by others, and aggressive driving behaviour by others. Referring to the latter, tailgating was found to be particularly common. In the normal drive, 90% of the participants left an insufficient gap distance, whereas in the instructed drive the incidence of being tailgated increased with a factor 4.5 when compared to the normal drive. Based on the video analysis and observations made during the two drives, it was observed that participants who were being tailgated also tended to increase the frequency with which they looked into their rear mirror. Consequently, in addition to a *direct* negative effect on road safety by increasing the risk of rear-end collisions, tailgating may also have an *indirect* negative effect in that tailgating can be regarded as a distraction in itself leading to an increase in the

eyes off road time. This, in turn, raises the chance of missing critical external events and increases crash risk (Green, 2007; Klauer et al., 2006). According to Klauer et al. (2006), glances away from the road for more than two seconds significantly increase the risk of being involved in a crash, or near-crash.

3.3.5 Tailgating

Considering that tailgating not only forms a major cause of irritation but also plays an important role in accidents and congestions (e.g., Evans and Wasielewski, 1982; Postans and Wilson, 1983; Van Winsum and Heino, 1996; Fairclough et al., 1997; Gorell et al., 2003), there is a strong motivation to reduce the prevalence of tailgating. Several behavioural intervention strategies have been adopted that can broadly be classified into two main categories: consequences and antecedents. Consequence interventions involve manipulation of conditions following a target behaviour. Its effectiveness depends on how soon it occurs after the target behaviour, how likely it is to follow target behaviour, and whether people are aware of the behaviour-consequence relationship (Michael et al., 2000). Antecedent interventions, on the other hand, involve manipulations of conditions before the occurrence of a target behaviour (e.g. signs signalling curve ahead), and are effective when they provide valid information about important consequences.

Following a consequence intervention strategy, the Dutch Ministry of Transport recently commissioned a study into the effectiveness of awarding positive driving behaviour[6] in an attempt to reduce tailgating and speeding (Mazureck & van Hattum, 2006). In this study, a lease company fitted 62 lease cars with telematic equipment (i.e. "black boxes") that recorded whether drivers maintained sufficient distance from the car ahead and drove within the posted speed limit. The equipment included a display that continuously showed drivers their following distance and speed. The lease company rewarded lease-car drivers for good driving behaviour over a 16-week period. It was found that feedback and rewards had a strong positive effect on safe driving behaviour in that the percentage of kilometres covered at a safe distance from the car in front and within the national speed limit significantly increased (Mazureck & van Hattum, 2006).

Following an antecedent intervention strategy, Michael et al. (2000) investigated the effect of roadside signs cautioning drivers not to tailgate. Results showed that signs referencing the consequences of tailgating (i.e. "Help prevent crashes please don't tailgate") significantly increased drivers' headway. Signs merely drawing attention to the phenomenon of tailgating (i.e. "Please don't tailgate"), on the other hand, failed to affect drivers' behaviour significantly, reinstating the idea that this type of information is more effective when referencing valid information about important consequences. It is further of interest to note that, in line with the findings in the current study, a large proportion of drivers were reported to follow with a headway that is considered unsafe (i.e. < 2 sec). Measuring headway for more than 25,000 vehicles on urban roads, the most common headway observed was between 1.4 and 2.2 seconds. More than half the drivers were not in compliance with the 2-seconds rule, whereas approximately 5% of drivers allowed for a headway of less than 1 second which was subsequently labelled as "aggressive driving."

Under normal circumstances, it appears that drivers travel with a time headway of between 0.5 s and 4.0 s, and in general, drivers attempt to maintain a minimum of 2.0 s (Rockwell, 1972). It should be noted, however, that these values refer to a relatively old American study and may not directly be comparable in the UK. More recent research indicates that the average appears to be between 1.2 and 1.6 seconds (van Winsum & Heino, 1996; Allen et al., 1997; Fancher, 1999). An important question in this context is what exactly constitutes a safe gap distance? Ohta (1993) suggested four distinct headway zones: the danger zone (within 0.6 s of the vehicle ahead), the critical zone (0.6 s to 1.1 s), the normal driving zone (1.1 s to 1.7 s), and the pursuit zone (> 1.7 s). Note, however, that there currently exists no agreement on what can be defined as a safe gap distance. The reason for this is that there is no simple rule which can be used to define what distance from the vehicle in front is "too

[6] Note that this study distinguishes itself from standard practice in that behaviour of road users is typically influenced through punitive measures.

close" under every possible set of driving conditions. Safe gap distance will depend on a number of interrelated factors including driver behaviour and response, and the physics of stopping the vehicle which in turn depends on a number of conditions such as the weather. This also makes it difficult to identify an offence per se of tailgating and forms a particularly important issue if enforcement of minimum gaps is proposed (Chequer et al., 2007).

One convention, as also adopted in the Highway Code (TSO, 2004), states that a safe headway should be at least 2 seconds (Evans, 1991), the so-called "2-second rule". A problem with the 2-second rule, however, is that drivers may find other cars pulling in between them and the car in front. This can be a cause of frustration and does not encourage drivers to keep their distance and, as a result, tailgating may become the norm. The results of the observational study indeed seem to support this contention.

3.4 Conclusions

The majority of motorists break the rules of the Highway Code. More than 80% of the participants exceeded the national speed limit, left insufficient gap distances to the car in front (i.e. tailgating), and failed to check mirrors and blind spots.

These traffic violations and errors may be partially attributed to the attempt to avoid frustration and aggressive driving behaviour on behalf of other motorists. This is supported by the observation of a fourfold increase in the incidence of being tailgated when asked to drive according to the Highway Code.

Tailgating was not only rated as the most irritating driving behaviour but was also observed to be the most prevalent unsafe driving behaviour in which they engaged. This was however not reflected in self-ratings and suggests that individuals may not always be aware of, or admit to, their own (unsafe) driving behaviours.

Apart from increasing the risk of rear-end collisions directly, tailgating forms an external distraction in itself and may indirectly affect road safety. Individuals being tailgated monitor their rear-view mirror with increasing frequency. Glances away from the road (time eyes-off road), subsequently, increase the risk of being involved in a crash, or near-crash.

A large proportion of participants admitted to engage in distracting in-vehicle activities such as mobile phone use, eating and drinking. However, these were not observed in the study. The presence of TRL members of staff during the drives may have prevented participants from displaying such behaviour. As such, the results of this study are likely to be conservative estimates of unsafe driving behaviour.

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Appendix A. Observation checklists

Instructor and observer checklist used in the normal drive (sample below refers to the checklist used in section 1).

Section 1 Crowthorne - Sandhurst High St Arrival time_____

	NSL	Avg Speed	Fast	Good	Slow	Obs	MSM	B/spot	Control	Gap	Lane	Indicators	Comments
Jnc approach to High St	30 mph												
Crowthorne High St	30 mph											na	
R/about High st	30 mph											na	
C/thorne - Sandhurst	30 mph											na	
C/thorne - Sandhurst	40 mph											na	
Sandhurst Jnc app	30 mph											na	
S/hurst High St - r/about	30 mph												

	Count	Comments
Disobeying Traffic Signs		
Blocking access/crossings		
Cutting up/in		
Distracted internal		
Distracted external		
Conflict		

Other :

Observer checklist used in the instructed drive (sample below refers to the checklist used in section 1). The instructor checklist was the same as that used in the normal drive.

SECTION 1 Crowthorne – Sandhurst Arrival time: _____		
Category	Count	Comments
Flash headlights		
Put hazards on		
Toot horn		
Hand gestures		
Cut in front		
Under/overtake		
Brake test		
Being tailgated		
Other		

Appendix B. Questionnaires

INTER-DRIVE QUEST		
To be completed by TRL		
Participant number: _____	Date of trial: _____	Drive:

SECTION A: YOUR RESPONSE TO DRIVING WITH PASSENGERS

A1. When driving with passengers, if, and to what extent, do you change your driving?

Please tick the number you feel is most appropriate

	Never				Always	
	1	2	3	4	5	6
Reduce your speed						
Increase distance to other cars						
Drive more cautiously						
Turn off your mobile phone						
Pay more attention to other traffic						
Turn off/down the music						
Overtake less frequently						
Engage in less dangerous traffic situations						
Pay more attention to road signs						
Drive more smoothly (accelerate and brake less severe)						
Other (please specify) ……..						

SECTION B						
B1. What unsafe driving behaviour do you engage in?						
Please tick the number you feel is most appropriate						
	Never				Very often	
	1	2	3	4	5	6
Tired driving						
Writing text messages						
Reading text messages						
Going through traffic light at red						
Poor vehicle maintenance						
Tail-gating						
Not using indicators (early enough)						
Mobile phone use: Hand held						
Racing to junction exit						
Not securing children						
Not allowing windscreen to clear on cold morning						
Rubber necking						
Eating or drinking						
Too fast for conditions						
Sweets						
Not wearing seat belt						
Cornering too fast for pleasure						
Smoking						
Undertake on motorway						
Use of mobile phone hands free						
Going through traffic light at amber						
Fiddling with radio						
Braking for speed cameras						
Not keeping number plate clean						
Mind wandering						
Other (please specify) ……						

SECTION B						
B2. What are your main distractions as a driver?						
Please tick the number you feel is most appropriate						
	Not at all				Very much so	
	1	2	3	4	5	6
Children						
Low sun						
Time pressure						
Main beam from other car						
Arguing						
Passenger interfering with controls						
Attractive pedestrian						
Rubber necking						
Fog lights						
Flashy/interesting cars						
Unsafe loads e.g. hay						
New area/maps/directions						
Unusual behaviour of other road users						
Animals on the side of the road						
Bad/unpredictable driving by others						
Trying to put on seat belt						
Satellite navigation systems: responding to instructions						
Mobile phone ringing						
Too few/many road signs						
Advertising on billboards						
Advertising on vehicles						
Emergency vehicles lights/sirens						
Music too loud						
Pets						
Vomiting/car sickness						
Low flying aircraft						
DVD players in other cars						
Boredom						
Unusual noise from car						

	Not at all					Very much so
	1	2	3	4	5	6
L drivers						
Talking to passengers						
Satellite navigation systems: fiddling with controls						
Speed camera warnings						
Warning signals						
Surroundings/estate/rural/scenery						
Balloons (hot air) advertising						
Wild animals						
Other (please specify) ……..						

SECTION B

B3. What do other drivers/road users do that annoy you?

Please tick the number you feel is most appropriate

	Not very annoying				Very annoying	
	1	2	3	4	5	6
Tail gating						
Too slow						
Cutting up/in						
Poor parking						
Chasing/Tailgating						
Using handheld mobile phone						
Cyclists: Not having lights						
Not indicating						
Approaching vehicle not dipping main beam						
Coaches/HGVs overtaking slowly						
Other driver takes your intended parking space						
Lane changing aggressively						
Poor parking pavements, bends						
Speed up when overtaking						
Centre/outside/any lane huggers						
Front/rear fog light – brake light in jam						
Hesitant/indecisive						
Cyclists: Not using cycle lanes						
Cyclists: Not observing traffic lights						
Erratic driving						
Inconsiderate to emergency vehicles						
Hooting						
Inconsiderate driving						
Driving on pavements (to gain advantage at junctions)						
Speeding by others						
Caravans						
Inconsiderate to buses						
Headlights in day						
Hand gestures						

	Not very annoying					Very annoying
	1	2	3	4	5	6
Litter						
Learner drivers						
Slow vulnerable road users						
Motorcyclists weaving through traffic						
Intimidation of learner/provisional drivers						
Other (please specify) ……..						

SECTION B: YOUR RESPONSE TO OTHER DRIVERS						
B4. If another driver had driven in a way that had really annoyed you, would you consider doing any of the following?						
Please tick the number you feel is most appropriate						
	Definitely would not					Definitely would
	1	2	3	4	5	6
Vandalise their car						
Stop to confront the driver						
Drive more aggressively						
'Brake test' a close following vehicle						
Cut in front of the driver who has annoyed you						
Less courteous overtake						
Undertake driver who has annoyed you (on motorway)						
Speed up if intimidated						
Flash headlights						
Put hazards on						
Get emotional upset						
Hand gestures						
Leave note on the windscreen						
Report to police/employer						
Moan/swear						
Slow down in response to tail-gating						
Toot horn						
Other ……..						

SECTION C: YOUR DRIVING						
C1. Compared to the general driving population, how safe do you believe your driving to be?						
Please circle the number you feel is most appropriate						
	Very unsafe					Very safe
	1	2	3	4	5	6

SECTION D: YOUR DRIVING Cont.
The following questions concern your ways of acting in different situations. Please express your agreement or disagreement with the following questions.

1-Never 2-Hardly ever 3-Occasionally 4-Quite often 5-Frequently 6-All the time

D1. How often do you become angered by another driver and give chase with the intention of giving him/her a piece of your mind?

Please circle the number you feel is most appropriate

	Never					All the time
	1	2	3	4	5	6

D2. How often do you drive when you suspect that you might be over the legal blood alcohol limit?

Please circle the number you feel is most appropriate

	Never					All the time
	1	2	3	4	5	6

D3. How often do you stay in a lane that you know will be closed ahead until the last minute before forcing your way into the other lane?

Please circle the number you feel is most appropriate

	Never					All the time
	1	2	3	4	5	6

D4. How often do you overtake a slow driver on the inside?

Please circle the number you feel is most appropriate

	Never					All the time
	1	2	3	4	5	6

D5. How often do you pull out of a junction so far that the driver with right of way has to stop and let you out?

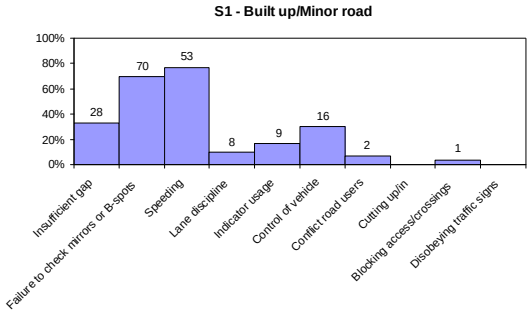
Please circle the number you feel is most appropriate

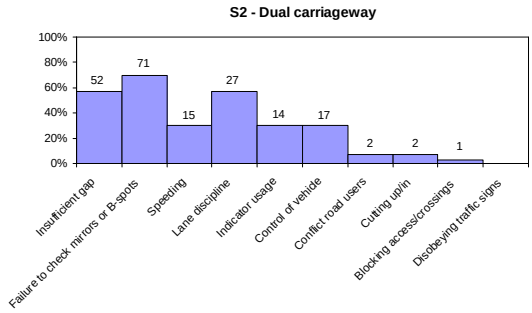
	Never					All the time
	1	2	3	4	5	6

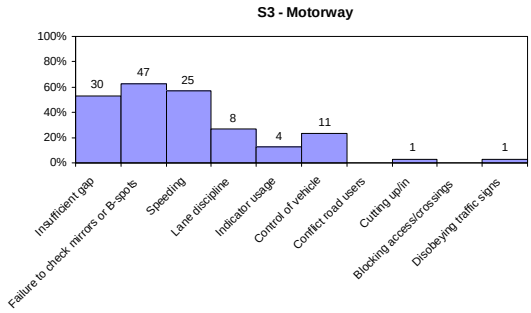
POST-DRIVE QUEST							
To be completed by TRL							
Participant number: _____	Date of trial: _____				Drive:		
SECTION A: YOUR RESPONSE TO DRIVING WITH PASSENGERS							
Please circle the number you feel is most appropriate							
A1. How stressful did you find the first drive compared to the second drive?							
	Not at all				Very much so		
	1	2	3	4	5	6	
A2. Do you feel intimidated by the behaviour of other drivers?							
	Very rarely				Very often		
	1	2	3	4	5	6	
A3. Do you think you drove more safely in the second drive compared to the first drive?							
	Les safe				More safe		
	1	2	3	4	5	6	
A4. How difficult was it to drive according to the instructions?							
	Not at all				Very much so		
	1	2	3	4	5	6	
A5. Please note down any other comments you have about the study below.							

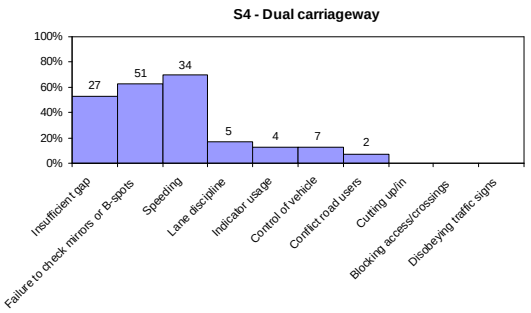
Appendix C. Unsafe driving behaviour in sections 1-5.

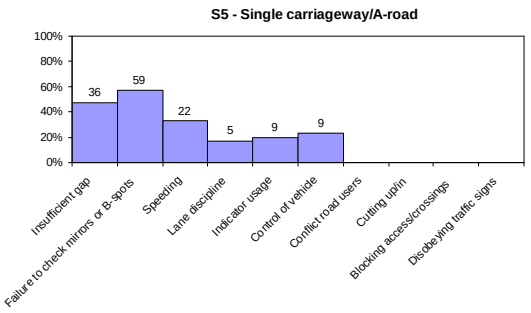
Percentage of participants displaying unsafe driving behaviour for sections (S) 1 to 5. The number above each bar indicates the number of instances.











Appendix D. Annoyance level to other road users' behaviour.

Other road users' behaviour ranked according to their annoyance.

Item	Rating (1 = not very annoying; 6 = very annoying)
Tail gating	5.03
Chasing/tailgating	5.00
Cutting up/in	4.97
Approaching vehicle not dipping main beam	4.87
Driving on pavements (to gain advantage at junctions)	4.73
Inconsiderate to emergency vehicles	4.60
Inconsiderate driving	4.60
Centre/outside/any lane huggers	4.57
Not indicating	4.47
Cyclists: not having lights	4.43
using hand held phone	4.31
Erratic driving	4.27
Speed up when overtaking	4.20
Lane changing aggressively	4.17
Too slow	4.13
Litter	4.10
Coaches/HGVs overtaking slowly	4.03
Poor parking	3.90
Other driver takes your intended parking space	3.90
Motorcyclists weaving through traffic	3.83
hesitant/indecisive	3.77
Hand gestures	3.73
poor parking pavements, bends	3.70
Intimidation of learner/provisional drivers	3.57
Hooting	3.50
Front/rear fog light - brake light in jam	3.45
Cyclists: not observing traffic lights	3.37
Cyclists: Not using cycle lanes	3.30
Speeding by others	3.13
Slow vulnerable road users	2.90
Inconsiderate to buses	2.80
Caravans	2.70
Learner drivers	2.33
Headlights in day	2.27

Appendix E. Additional statistics and data RBS report - Driver Attitudes to Distraction and other Motorists' behaviour: a Focus Group and Observational Study

1. Top ten reasons for failure

Based on 2003-2004 data Driving Standards Agency (DSA)

http://dsa.gov.uk/General.asp?id=SX39B3-A77F5363

1. Observation at junctions - ineffective observation and judgement
2. Reverse parking - ineffective observation or a lack of accuracy
3. Use of mirrors - not checking or not acting on the information
4. Reversing around a corner - ineffective observation or a lack of accuracy
5. Incorrect use of signals - not cancelling or giving misleading signals
6. Moving away safely - ineffective observation
7. Incorrect positioning on the road - at roundabouts or on bends
8. Lack of steering control - steering too early or leaving it too late
9. Incorrect positioning to turn right - at junctions and in one way streets
10. Inappropriate speed - travelling too slowly or being hesitant

1.1 TRL driving instructor comments Top Ten:

Careful analysis of the reasons listed above shows that there are strong links between them and that many of the errors recorded by driving examiners are closely related.

From this, two main problem areas can be identified:

1. The approach to road junctions and roundabouts:

Many learner, and indeed experienced, drivers do not plan their approach to junctions and roundabouts and instead try to react as things happen. This results in inadequate mirror use and all round observation, incorrect signals, poor positioning, loss of steering control and hesitation.

2. Reversing:

Many drivers are not confident when reversing and as a result concentrate too much on controlling the vehicle instead of looking around to see what is happening.

The overall reason for drivers failing to plan their actions, and for not being confident when reversing, is lack of practice and proper instruction.

The reason learner drivers fail the test is mainly lack of practice - taking the test before they are ready and before they have developed the confidence necessary to cope with test nerves or driving unsupervised in modern road conditions.

The same problems affect experienced drivers as well. Most drivers never have any training once they have passed the driving test and do not even bother to read the Highway Code. They assume they know it all and do not realise that driving skills, like all others, occasionally need brushing up!

In our leisure pursuits we happily pay for our personal trainers, golf pros, tennis coaches, ski instructors, life coaches etc., but only a tiny minority of drivers even consider paying for a little additional driver training that could save their lives.

2. Tailgating

Final report page 29:

"Considering that tailgating not only forms a major cause of irritation but also plays an important role in accidents and congestions (e.g., Evans and Wasielewski, 1982; Postans and Wilson, 1983; Van Winsum and Heino, 1996; Fairclough et al., 1997; Gorell et al., 2003), there is a strong motivation to reduce the prevalence of tailgating."

Evans & Wasielewski (1982): Based on their observed closer following in freeway traffic it is concluded that accident-involved drivers and drivers cited for violations exhibit higher levels of risk in everyday driving than accident-free and citation-free drivers.

Knipling et al. (1993): Rear-end collisions accounted for 23.8% of all accidents on American roads. Following an analysis of 74 rear-end collisions accident case-file data, two principle antecedents of rear-end collisions emerged:" driver inattention" and "following too closely". The category of "driver inattention" was broadly applied to a scenario where the driver did not perceive or react to a hazard. "Driver inattention" accounted for 66.3% of the accident sample as the sole contributory factor. "Following too closely" to the lead vehicle accounted for only 7.1% of the accident sample as a sole factor. However the analysis also revealed that inattention combined with close following accounted for 19.4% of the accident sample.

Mosedale et al. (2005): Based on STATS19, the UK national system of collection of information on road accidents involving human injury, Mosedale et al. showed that tailgating is a contributory factor in 7% of all accidents, in line with earlier American findings. When considering accidents that involve failure to avoid vehicle in the carriageway (which form 28% of all accidents), 15% of these accidents can be attributed to tailgating.

3. Distractions

Final report page 28:

"In comparison to internal distractions, external distractions may play a particularly important role in accident causation. Previous research has shown that external distractions – outside persons, objects or events, are at 29.4% the most frequently reported source of distraction related accidents, followed by making adjustments to the radio/cassette/CD player (11.4%) and other occupants in the vehicle (10.9%) (Stutts et al., 2001). Furthermore, external distractions are largely independent of individual behaviour and outside the drivers' control. Internal distractions, on the other hand, are largely voluntary distracting behaviours such as eating, drinking, smoking, mobile phone use, or adjusting the radio. As such, their role in crashes may vary as a function of roadway, environmental, and vehicle conditions. Drivers may be less likely to engage in these types of behaviours when driving task demands are high (e.g. driving in poor weather conditions)."

Klauer et al. (2006): Study that investigated the impact of driver inattention on near-crash/crash risk based on the data obtained in the so-called "100-car naturalistic study". This study has provided an unprecedented level of detail concerning driver performance, behaviour, environment, driving context and other factors that are associated with critical incidents, near crashes and crashes for 100 drivers across a period of one year. A primary goal was to provide vital exposure and pre-crash data necessary for understanding causes of crashes, supporting the development and refinement of crash avoidance countermeasures, and estimating the potential of these countermeasures to reduce crashes and their consequences.

In the 100-car study, the relative near-crash/crash risk of engaging in various types of inattention-related activities were calculated. It was shown that driving while drowsy increases an individual's near-crash/crash risk by four to six times, engaging in complex secondary tasks increases risk by three times, and engaging in moderate secondary tasks increases risk by two times that of normal, baseline driving. It was calculated that driving while drowsy was a contributing factor for 22 to 24 % of the

crashes and near-crashes and secondary-task distraction contributed to over 22 % of all crashes and near-crashes.

Direct Line mobile phone study

http://info.directline.com/xxx/news.nsf/475ba3176e407b8200256a6f0037c686/bec9c738833c7fb180256b84002dec5f/$FILE/Mobile%20Phone%20Report.pdf

Commissioned by Direct Line, TRL undertook extensive research on the dangers of using a mobile phone when driving. This study was designed to quantify the impairment from hands-free and hand-held mobile phone conversations in relation to the decline in driving performance caused by alcohol impairment.

Previous research has shown that phone conversations while driving impair driving performance. However, it was difficult to quantify the risk of this impairment because the reference is usually made with regard to normal driving without using a phone. “Worse than normal driving” does not necessarily mean dangerous. We believed there was a need to benchmark driving performance while using a mobile phone against a clearly dangerous level of performance. Driving with a blood alcohol level over the legal limit is an established danger.

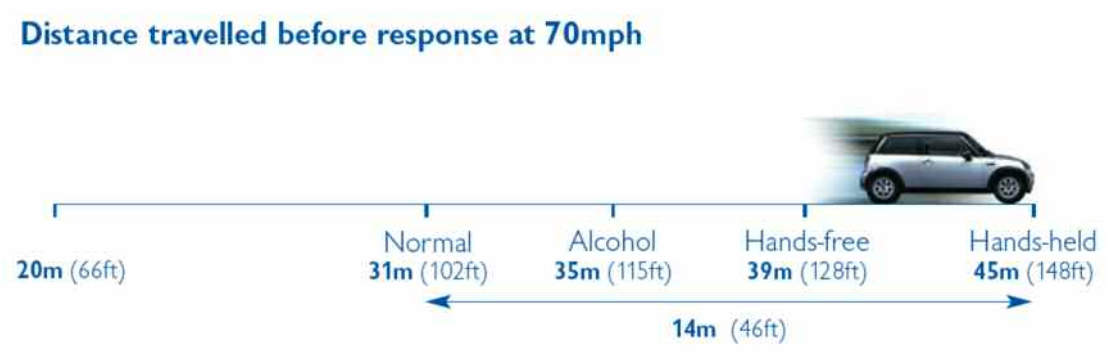
Key findings: The Direct Line research found that drivers’ reaction times were significantly slower when using a mobile phone. As reaction times slow, the risk of collision and the severity of that collision will increase. This supports a previous study that showed that drivers who are engaged in a mobile phone conversation are four times as likely to crash than other drivers (Redelmeier & Tibshirani, 1997). The Direct Line research showed a clear trend for significantly poorer driving performance (speed control, following distance and reaction times) when using a mobile phone in comparison to the other conditions.

- The best performance was by those drivers who were driving under normal conditions without the influence of alcohol or the distraction of a mobile phone.

- Driving performance under the influence of alcohol was significantly worse than normal driving, yet significantly better than driving while using a mobile phone. Furthermore, drivers reported that it was easier to drive drunk than to drive while using a phone.

- The results demonstrate that drivers’ reaction times were, on average, 30% slower when talking on a hand-held mobile phone compared to being drunk and nearly 50% slower than under normal driving conditions. According to the tests, drivers were less able to maintain a constant speed and found it more difficult to keep a safe distance from the car in front.

- Using a hand-held mobile phone had the greatest impact on driving performance. On average it took hand-held mobile phone users half a second longer to react than normal, and a third of a second longer to react compared to when they were drunk. At 70 mph, this half-second difference is equivalent to travelling an additional 46 feet (14m) before reacting to a hazard on the road.



• In addition, drivers using either a hands-free or hand-held mobile phone significantly missed more road warning signs than when drunk.

• Hands-free was safer than using hand-held mobile phones. However, the conversation itself is a major distraction, with the use of hands-free phones carrying hidden dangers. As a result of this finding, even the use of hands-free proved more dangerous than driving under the influence of alcohol.

This study demonstrates beyond doubt that using a mobile phone when driving significantly impairs the driver's attention to potentially hazardous situations, more so than having a blood alcohol level at the UK legal limit (80mg/100ml). In attempting to perform multiple tasks simultaneously, drivers subject themselves and other road-users to unacceptable dangers. This research for the first time uncovers just how great those dangers are and underlines the need for a change in the law.

4. Two seconds eyes off-road

Final report page 28:

"Consequently, in addition to a direct negative effect on road safety by increasing the risk of rear-end collisions, tailgating may also have an indirect negative effect in that tailgating can be regarded as a distraction in itself leading to an increase in the eyes off road time. This, in turn, raises the chance of missing critical external events and increases crash risk (Green, 2007; Klauer et al., 2006). According to Klauer et al. (2006), glances away from the road for more than two seconds significantly increase the risk of being involved in a crash, or near-crash."

Klauer et al. (2006): The 100-car study mentioned above also included detailed analyses of eye glance behaviour pre-crash/near crash incidents. It was shown that total eyes-off-road durations of greater than 2 seconds significantly increased individual near-crash/crash risk whereas eyeglance durations less than 2 seconds did not significantly increase risk relative to normal, baseline driving. It was estimated that 23 % of the crashes and near-crashes that occur in a metropolitan environment are attributable to eyes off the forward roadway greater than 2 seconds. As length of eyeglance from the forward roadway increases, the odds of being in a crash or near-crash also increases. Eyeglances away from the forward roadway greater than 2 seconds increase an individual's relative near-crash/crash risk by two times that of normal, baseline driving.

5. TRUCKSIM: effect of simulator training on fuel efficiency

In 2001, the Transport Research Laboratory (TRL) was commissioned by the DfT, via the Road Haulage Modernisation Fund, to investigate the feasibility of a commercially available truck driving simulator tailored to the needs of the UK road haulage industry.

TRL recruited sixty truck drivers to experience fuel efficiency training in the simulator on three occasions over a period of six months. To investigate real world driving, the participating drivers were required to submit fuel usage and distance travelled data for the working week BEFORE and the working week AFTER each of their three visits to TRL. This meant their on-road performance could be tracked in relation to their training in the simulator.

Having completed the initial drive in the simulator, the trainer gave drivers instruction on how to change their driving style in order to complete the route more efficiently. Each driver then had a second attempt at the exercise giving an opportunity to demonstrate improved fuel efficiency.

Results in the simulator showed that drivers made an 11% improvement in their fuel efficiency over the three visits to the simulator, with the biggest gain being made during the first visit. It was also clear that drivers retained what they had learned from one visit to another as fuel efficiency did not deteriorate between visits. The simulator data revealed that drivers were handling the vehicle in a much more efficient manner. Average RPM observed during periods of acceleration dropped by 22% resulting in the engine operating in a more efficient region and generating 45% higher torque. There were also 29% fewer gear changes over the course of the drives. It would be easy to assume that

drivers simply slowed down to achieve these improvements but the data show that drivers were actually around 8% faster overall. This can be attributed to the fact that fuel efficient driving required drivers to plan ahead. For example, approaching roundabouts and crossings more carefully required less sharp decelerations and subsequent accelerations resulting in a swifter drive. This also demonstrated that fuel efficient driving need not necessarily result in slower journey times.

The key question then was would this behaviour be transferred to the drivers' real world driving back in their everyday work. It was found that relative to the control group, the simulator-trained drivers showed a progressive improvement in their fuel efficiency, returning a 16% improvement in MPG after the third training session.

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Appendix F. Extended Executive Summary

Introduction

RBS Insurance commissioned the Transport Research Laboratory (TRL) to conduct a focus group and observational study to investigate typical driving behaviour. Specifically, the aim of this research was to evaluate the proposition that the majority of motorists engage in unsafe driving behaviour, on a daily basis. These behaviours include unsafe in-vehicle activities (e.g. eating, drinking, smoking, use of mobile phone, interacting with in-vehicle systems) and unsafe driving techniques (e.g. speeding, failure to check mirrors/blind-spots, tailgating).

Passing the current UK car driving test represents a watershed in the life of a driver. Thereafter, there is no requirement for drivers to have any follow-on training and driving behaviour is no longer governed by an instructor or experienced co-driver. The driving style of the newly qualified driver is therefore subject to drift over time.

Experience gained on the roads can lead to improved driver behaviour with drivers better able to predict and deal with the typical hazardous situations that arise on UK roads (Maycock, Lockwood and Lester, 1991). However, without third party guidance, drivers are also free to adopt unsafe driving behaviours, sometimes as an expression of their own personality (see Reason, 1990); sometimes in an attempt to conform to perceived norms; and sometimes in response to perceived pressure from other sources, whether from passengers or from the behaviour of other vehicles (see Sharpley, 2003).

A further aim of this study was to investigate whether these unsafe behaviours can indeed, at least partly, be attributed to social pressure. For example, strict compliance to the Highway Code (e.g. adhering to speed limits) is avoided in the belief that this may provoke frustration on behalf of other road users.

Finally, this study aimed to identify different distractions to drivers, a major contributing factor estimated to account for 22% of road accidents (Klauer et al., 2006). Overall, engaging in secondary tasks whilst driving increases the risk of having an accident by two times that of normal baseline driving for simple tasks, and three times for complex tasks (Klauer et al., 2006). The newly qualified driver is free to engage in practices that may have been forbidden as a learning driver and may cause distraction such as listening to loud music (see Brodsky, 2001) or talking on a hands free mobile phone (see Parkes, Luke, Burns and Lansdown, 2007). In addition to these internal distractors, external distractors such as other traffic and advertisements may also distract the driver from the task at hand.

In the first part of the study a focus group was held to establish the typical unsafe behaviours in which drivers frequently engage and the behaviours that motorists (and non-motorists) find annoying in other road users. The results of the focus group study were subsequently used to steer an observational study in which members of the general public were asked to complete a 30-40 minute route on public roads whilst their driving behaviour and that of other motorists' was observed.

Focus Group

Eighteen members of the public were recruited to take part in the study from a range of ages and backgrounds. Four key questions were discussed: (1) What unsafe driving behaviours do you engage in?; (2) What are your main distractions as a driver?; (3) What do other road users do that annoy you?; (4) Do you do anything in response to annoying behaviour by other road users?

Main findings:

- A large proportion of participants admitted to engage in distracting in-vehicle activities. Of these, the least safe ratings were given to reading and writing of text messages whilst driving. Participants further admitted to frequently drive whilst tired. Maycock (1995) found that driver

tiredness was implicated in around 10% of all accidents whilst Horne & Reyner (2000) suggested that fatigue was a factor in 20% of accidents on motorways.

- Large disparities existed between actions that drivers perceive as unsafe and those that are actually unsafe. The use of a handheld mobile phone whilst driving, was rated 8 out of 10 (1 = safe, 10 = very unsafe), whereas use of a hands free mobile phone whilst driving was rated at 3 out of 10. A study by Burns et al. (2002) however showed that even the use of hands-free is more dangerous than driving under the influence of alcohol. Similarly, participants tended to underestimate the dangers of excessive speed. Driving 'too fast for the road conditions' and 'driving fast through corners for pleasure' were given similar ratings as 'eating sweets'. Clearly, the contribution of excessive speed as a factor in accidents is likely to be far higher (see for example, Taylor, Lynam & Baruya, 2000).

- Indicative of individuals' recognition of the adverse effects distractions may have on their driving behaviour, a large number of distracting items was generated. The item given the highest rating of distraction was 'Children'; tending to children's needs may reduce attention to the driving task. The items given the second highest rating were 'Low sun' and 'Time pressure'. These are relatively common features of the driving experience for many motorists. Hill (2004) demonstrated that the sun's position has a significant effect on accident rate whilst time pressure influences drivers' willingness to drive aggressively resulting in raised accident risk (see Shinar & Compton, 2003).

- In line with previous research by the AA Motoring Trust (2005), 'Tail gating' and 'Cutting up/in' were rated as the most annoying behaviour on behalf of other motorists. The third item that was rated most annoying was 'Using a handheld mobile phone' (by another driver) as this would lead to increased accident risk (see also Burns et al. 2002). The final item given the maximum annoyance rating was 'Cyclists not having lights'. It was inconsiderate of cyclists to place themselves at significant risk of accident/injury through failing to use appropriate lights.

- Three broad categories of response to being annoyed by other road users were identified: (1) responses that imply direct aggression towards the aggravating party. It was of concern that drivers admitted considering actions such as confrontation and violence/vandalism towards the road user; (2) Indirect aggressive acts that may cause a hazardous driving situation. This included behaviours commonly identified as 'road rage' such as 'brake testing' (applying a vehicle's brakes unpredictably to panic/frustrate a following driver) and 'cutting in front of the aggravating party's vehicle'; (3) Aggressive acts that unlikely result in hazardous driving situations including anti-social hand gestures and moaning/swearing. Although seemingly trivial, there remains the concern that drivers in a heightened emotional state may have less control over their vehicle (Fuller, 2004).

Observational Study

The focus group study identified a large number of unsafe behaviours, distractions, annoyances, and responses to annoyance that were monitored in the subsequent observational study. In this study, 30 drivers were asked to complete two 30-40 minute routes on public roads. In the 'normal drive', participants were asked to drive as they would normally. In the 'instructed drive', participants were instructed to drive in compliance with the Highway Code.

To observe and record both driver and other road users' behaviour, a Driving Standards Agency (DSA) Approved Driving Instructor and an experimenter accompanied each participating driver. The main aspects monitored were non-adherence to Highway Code, vehicle control, driver distractions, and conflict with other road users. In addition, participants' heart rate was measured to compare the level of stress experienced between the normal and instructed drive; video footage was taken to allow for further analysis.

Normal drive – main findings

In the 'normal drive' where participants were asked to drive as they would normally it was found that:

- More than 80% of the drivers exceeded the National Speed Limit, failed to check mirrors and blind spots, and tailgated at least once on the route. For the purposes of the study, 'tailgating' was

defined as leaving a headway smaller than 2 seconds (also known as the '2-second rule') and was monitored by the qualified driving instructor.

• More than 50% of the participants displayed poor lane discipline, failed to indicate, and drove with one hand on the steering wheel at some stage during the drive (see Table 1).

Table 1. Percentage of participants displaying unsafe driving behaviour when asked to drive as they would normally.

Unsafe driving behaviour	% of participants displaying behaviour
Tailgating	90%
Failure to check mirrors or blind spots	83%
Speeding	80%
Poor lane discipline	77%
Failure to indicate	67%
Poor vehicle control	57%
Other	< 6%

These findings are particularly striking when considering that participants were being observed throughout the drive. This, in turn, is likely to have inhibited participants from displaying unsafe behaviour and, hence, the results can be considered conservative estimates of actual behaviour.

When asked to indicate 'what unsafe behaviour do you engage in', the most prevalent self-reported unsafe behaviour was 'Braking for speed cameras'. Interestingly, the high prevalence of tailgating as observed during the drives was not reflected in the self-reports; drivers tended to report that they do not engage in tailgating. Following debriefing after each drive, it became clear that drivers appeared to be unaware of their own unsafe driving practices and in particular tailgating.

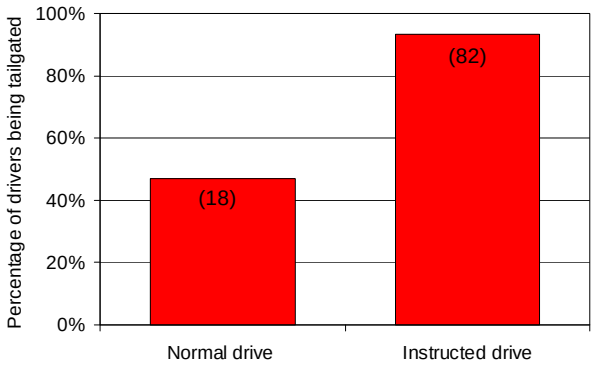

Figure 1. Percentage of drivers being tailgated during the Normal and Instructed drive. The number of incidences recorded are displayed in brackets.

Anecdotal reports further indicated that individuals were more likely to exceed speed limits in response to being tailgated. Drivers commented they were reluctant to slow down in line with the recommended speed limit and instead drove faster than they normally would have done. This provides some further support for the contention that unsafe driving behaviour is partly engaged in response to perceived pressure from behaviour of other road users.

Instructed Drive – main findings

The main aim of the 'instructed drive' was to investigate other road users' responses to those who drive according to the Highway Code. Out of the list of possible responses identified in the focus group study, only three responses were observed: 'tailgating' and 'under/overtaking', and 'cutting in'. By far the most prevalent response to participants driving according to the Highway Code was tailgating with no less than 93% of the participants being tailgated at some point on the route. A total of 82 incidences of tailgating were recorded in the 30 instructed drives. Although tailgating was also observed during the 'normal drive', with a factor 4.5, the incidence of being tailgated considerably increased when asked to drive according to the Highway Code (see Figure 1).

In the instructed drive it was further observed that 40% of the participants were under- or overtaken at some point on the route. This mainly involved aggressive overtaking manoeuvres of which the majority of instances were preceded by tailgating. Other responses were not observed.

On the basis of the heart rate data, no difference in stress levels was observed between the normal and instructed drive on average. However, being tailgated resulted in subjective and objective stress responses in some drivers.

Distractions

In line with previous research, conversation with passengers was found to be the most prevalent internal distraction. Stevens and Minton (2001) also found passengers to be the greatest single source of distraction, followed by interacting with the radio/cassette player and handling food, drink and cigarettes. In the current study, handling food, drink and cigarettes, nor use of mobile phones was observed even though participants indicated that they occasionally engage in such unsafe behaviours. Considering the presence of a driving instructor and experimenter, this may not be surprising.

In comparison to internal distractions, external distractions may play a particularly important role in accident causation. Previous research has shown that external distractions – outside persons, objects or events, are at 29.4% the most frequently reported source of distraction related accidents, followed by making adjustments to the radio/cassette/CD player (11.4%) and other occupants in the vehicle (10.9%) (Stutts et al., 2001). Furthermore, external distractions are largely independent of individual behaviour and outside the drivers' control. In the current study, the most prevalent category of external distraction was other traffic, referring to emergency and maintenance vehicles' sirens and lights, broken down vehicles, accidents, road works, and aggressive driving behaviour by others in particular tailgating.

An interesting finding was that being tailgated considerably increased the frequency with which participants checked their rear mirrors. In effect, tailgating therefore not only increases the risk of rear-end collisions due to insufficient gap distances (e.g. Mosedale et al., 2005), but may also in itself constitute an external distraction causing an increase in the time eyes off road. This, in turn, increases the risk of missing critical external events. Eyeglances away from the forward roadway greater than 2 seconds increase an individual's relative near-crash/crash risk by two times that of normal, baseline driving (Klauer et al., 2006).

Conclusions

- The majority of motorists break the rules of the Highway Code. More than 80% of the participants exceeded the national speed limit, left insufficient gap distances to the car in front (i.e. tailgating), and failed to check mirrors and blind spots.

- These traffic violations and errors may be partially attributed to the attempt to avoid frustration and aggressive driving behaviour on behalf of other motorists. This is supported by the observation of a fourfold increase in the incidence of being tailgated when asked to drive according to the Highway Code.

- Tailgating was not only rated as the most irritating driving behaviour but was also observed to be the most prevalent unsafe driving behaviour in which they engaged. This was however not

reflected in self-ratings and suggests that individuals may not always be aware of, or admit to, their own (unsafe) driving behaviours.

- A large proportion of participants admitted to engage in distracting in-vehicle activities such as mobile phone use, eating and drinking. Discrepancies between perceived and actual unsafe driving behaviour and activities indicate a general underestimation of the actual risks involved.

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Drivers' attitudes to distraction and other motorists' behaviour: a focus group and observational study

This study was designed to investigate two hypotheses about typical driving behaviours: (1) the majority of motorists engage in behaviours that could be considered unsafe, on a daily basis, and (2) that these unsafe behaviours may be, at least partly, due to social pressure, e.g., strict compliance to the Highway Code is avoided in the belief that this may provoke frustration on behalf of other road users. Following an initial focus group discussion to establish typical unsafe behaviours, an observational on-road study was conducted in which 30 drivers were asked to complete 30-40 minute routes on public roads driving 1) normally and 2) strictly compliant with the Highway Code. Results showed that in the normal drive, more than 80% of the participants exceeded the speed limit, failed to check mirrors and blind spots, and left an insufficient gap distance ("tailgating"). In the compliant drive, there was a greater than fourfold increase in the incidence of tailgating on behalf of other road users when compared to the normal drive. These findings provide support for the contention that the majority of motorists engage in unsafe driving behaviour on a daily basis, and that the high prevalence of unsafe driving behaviour may, at least partly, be the result of social pressure. That is, individuals may engage in unsafe driving behaviour (e.g. speeding) in the belief that this may prevent frustration on behalf of other road users.

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