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HGV speed limit increase evaluation: final report

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	Terry Egan

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Executive summary

The Department for Transport (DfT) commissioned the Transport Research Laboratory (TRL) to provide an evidence-base, analysis and reasoned opinion on whether or not there is likely to be any road safety risk involved in increasing the speed limit of HGVs exceeding 7.5 tonnes on single carriageway de-restricted roads from 40mph to 50mph (or possibly 45mph).

The findings are based on analyses of accident data held at TRL from the following sources: Stats19; On-The-Spot (OTS); and the Heavy Vehicle Crash Injury Study (HVCIS). Additional analysis was based on studies of the time and distance required to conduct overtaking manoeuvres.

Analysis of Stats 19 contributory factors

The characteristics of link accidents are different from those of junction accidents and the percentage of vehicles that occur on links is different for the various types of vehicle so it was decided to analyse link and junction accidents separately. Comparisons were made between heavy goods vehicle with gross vehicle weight exceeding 7.5t (HGV21) with those weighing less than 7.5t (HGV20) since the latter already have a 50mph speed limit for these roads.

On links, of the 1,188 HGV20 vehicles 8 were recorded as exceeding the speed limit (0.67 per cent) whereas among the 3,387 HGV21 vehicles 56 were recorded as exceeding the speed limit (1.65 per cent). The difference between the two proportions was found to be statistically significant, hence we can conclude that HGV21 vehicles involved in accidents are more often reported as exceeding the speed limit than are HGV20 vehicles. The difference between the proportions in which a vehicle swerved was statistically significant, insofar as the HGV21 vehicles involved in accidents were less of reported as having swerved than HGV20 vehicles.

At junctions, the differences between the speed related contributory factors for HGV20 and HGV21 vehicles were tested for statistical significance using a test comparing proportions. None of the differences were statistically significant.

An analysis of the speed related contributory factors according to severity found that the only statistically significant differences were for slight injury accidents and total injury accidents on links where more HGV21 vehicles were recorded as ‘exceeding speed limit’ than would be expected but fewer were recorded as having ‘swerved’ than would be expected.

Characteristics of heavy goods vehicle accidents

The characteristics of heavy goods vehicle accidents were evaluated to obtain a greater understanding of the types of accident and which are the more common. This can provide a better insight into what the effects of changing the speed limit for HGV21 vehicles might be. Plain language descriptions from the HVCIS fatal accident database were used for this purpose.

It was concluded that the relative frequency of accidents of various types is similar for HGV21 and HGV20 vehicles, but the severity of accidents involving HGV21 vehicles is higher than for HGV20 vehicles. This may be mainly attributable to their greater weight.

Collision data review

The review considered the broad types of accident that involved heavy goods vehicles based on information from the OTS and HVCIS fatal accident databases. A proportion of the accident records in these databases have entries for the speed of the vehicles. These were used to estimate whether these accidents would be likely to have occurred with greater or less frequency and greater or less severity had the speed of the heavy goods vehicle been greater. The estimates were scaled using Stats 19 data to provide national estimates.

Notwithstanding the limitations of the data available, it has been possible to estimate the number of accidents that could be affected by changing the speed limit. This number of accidents was estimated by applying the proportion of HGV21 vehicles that were travelling at speeds between 36 and 44mph in the HVCIS fatal accident sample to the groups of accidents identified in Stats 19. It was estimated that there were 36 fatal accidents per year where an HGV21 vehicle was travelling at a speed between 36 and 44mph on a single carriageway road with a 60mph speed limit. This estimate represents the maximum number of fatal accidents that might be affected by a change in the speed limit. However, a careful inspection of the characteristics of accidents in the HVCIS sample suggests that an increase in HGV21 speed would be likely to affect only a small proportion of these fatal accidents.

The information for fatal accidents has been applied to non-fatal accidents, however, there is some uncertainty about the appropriateness of assuming the same speed distribution for the HGVs involved in non-fatal accidents as for fatal accidents. However, given this assumption, it is estimated that the maximum numbers of serious and slight injury accidents per year that might be affected by a change in the speed limit are 95 and 304 respectively. Again, it is considered that only a small proportion of these might be affected by a change in the speed limit.

Speed and flow analysis

Raising the speed limit for HGV21 vehicles to 50mph would make legal the speeds that most of them currently adopt. They already travel on average close to the speeds of HGV20 vehicles and it seems unlikely that an increased speed limit would encourage them to travel faster than HGV20 vehicles. Thus the maximum potential increase in the average speed would be about 3mph and the actual change in average speed could well be less.

Distance and time requirements for overtaking

If the speed limit for heavy goods vehicles was increased and this led to an increase in speed of these vehicles, the distance and time required to overtake them would increase.

Three approaches were used to estimate the distance required to complete overtaking, the time required to complete overtaking and the distance gap required to allow a car driver to overtake a heavy goods vehicle safely in relation to the speed of the overtaken vehicle: an approach based on the laws of motion; a study of driver behaviour when overtaking a car on a driving simulator and on an actual road; and a study at a single site where cars overtook other cars and heavy goods vehicles.

The findings varied between the approaches especially in the estimated effect of the speed of the heavy goods vehicle. For an increase in the speed of the overtaken vehicle of 1mph the estimated increases in distance and time were as follows: 6m to 14m (distance required to complete overtaking); 0.06sec to 0.56sec (time required to complete overtaking); and 9m to 24m (distance gap required to overtake).

Heavy goods vehicle braking performance

An increase in the speed of a vehicle will lead to an increase in the distance required for that vehicle to stop. The technical performance of a braking system for heavy goods vehicles and their trailers used in Europe is outlined in EC Directive 71/320/EEC and UNECE Regulation 13. Type-approval sets a minimum standard for brake performance and there are voluntary industry standards that set out different test methods but not performance requirements.

1 Introduction

The Department for Transport (DfT) commissioned the Transport Research Laboratory (TRL) to provide an evidence-base, analysis and reasoned opinion on whether or not there is likely to be any road safety risk involved in increasing the speed limit of HGVs exceeding 7.5 tonnes on single carriageway de-restricted roads from 40mph to 50mph (or possibly 45mph).

The main part of the work involved the analysis and interpretation of historical accident data relating to accidents on single carriageway roads in the UK in order to determine the relevance of speed to different types of accident involving these HGVs. Accidents were of relevance if they involved an HGV colliding with other vehicles. Accidents were also of relevance if the HGV was not involved in the collision but nevertheless contributed to the accident, particularly accidents involving other vehicles whose drivers may have been prompted to overtake the HGV because it was not travelling as fast as they would have liked.

The findings are based on analyses of accident data held at TRL from the following sources: Stats19; On-The-Spot (OTS); and the Heavy Vehicle Crash Injury Study (HVCIS). Additional analysis was based on studies of the time and distance required to conduct overtaking manoeuvres.

Section 2 sets out the accident data sources that were used in the investigations. Section 3 presents speed distributions and vehicle proportions. Sections 4 and 5 analyse the proportion of accidents in which speed related were recorded as contributory factors in Stats 19 the Stats 19 database. Section 6 compares the accident characteristics of heavy goods vehicles with gross vehicle weights above and below 7.5 tonnes with light goods vehicles based on Stats 19 and HVCIS data. Section 7 reviews collision data based on Stats 19, HVCIS and OTS data. Section 8 considers the distance and time requirement to overtake vehicles of different lengths and travelling at different speeds. Section 9 considers heavy goods vehicle braking performance. Section 10 draws together the findings from the individual sections of the report into a single discussion section. Section 11 presents a summary and conclusions. Details of the overtaking distance and time requirements are presented in Appendix A.

2 Accident data sources

The following sections describe each of the data sources that were available for use within this research project. There were six data sources identified:

- Stats 19. The national injury accident database collected by the police.
- Fatal files archive. An archive of files relating to fatal accidents which the police have released.
- On-The-Spot (OTS). Records from expert investigators who are called out to attend accidents in the Thames Valley and Nottinghamshire. Includes damage only in addition to injury accidents.
- Heavy Vehicle Crash Injury Study (HVCIS). This includes accidents involving heavy goods vehicles and other commercial vehicles only. This has three components:
  (1) Truck Crash Injury study (TCIS).
  (2) Fatal accident database.
  (3) Press cuttings related to agricultural vehicle accidents.
- Co-operative Crash Injury Study (CCIS). However, as explained below this was not used in the project.
- VOSA Accident Database. Accidents in which the police call out VOSA inspectors and was also not included in this study for reasons given below.

The main characteristics of each data source are described below, including strengths and limitations and the relevance to the research subject covered by this report.

In addition to these six data sources, published DfT data on speed distributions and traffic flow by vehicle type on single carriageway 60mph speed limit roads and published DfT accident involvement rates by vehicle type for rural roads (Department for Transport, 2006, 2007, 2008) was also available.

2.1 Stats 19

Stats 19 is the national system for collating personal injury road accident data reported to the Police (DfT, 2009). The Accident, Vehicle and Casualty records mainly include objective details such as road type, speed limit, vehicle type and casualty severity. Contributory Factors (CFs) were introduced into the Stats 19 accident recording system for the first time at the start of 2005 (DfT, 2004). The CFs in a road accident are the key actions and failures that led directly to the actual impact. They show why the accident occurred and give clues about how it may have been prevented. The CFs are largely subjective and depend on the skill and experience of the investigating officer to reconstruct the events which led directly to the accident. The CFs reflect the Reporting Officer’s opinion at the time of reporting and are not necessarily the result of extensive investigation. It is intended that CFs should be identified on the basis of evidence rather than guesses about what may have happened. This evidence can come from various sources such as witness statements, vehicle and site inspections. In light of this, some CFs are less likely to be reported than others. The analysis is based on all accidents where a police officer attended the scene and where the CFs were recorded as either A (very likely to have contributed to the accident) or B (possibly contributed to the accident).

Stats 19 has been used for two aspects of this research. Firstly, an analysis of CFs data was carried out for relevant accidents for the period where CFs data was available (2005-2007). Secondly, the Stats 19 data has been used in conjunction with the in-depth accident data to provide estimates of the potential safety risk.

One of the main limitations with Stats19 is that there is no plain language description of the accident. The most relevant data fields of the Stats 19 Vehicle Records are:

- 2.5 Type of vehicle. In particular, code 20 distinguishes heavy goods vehicles between 3.5 tonnes and 7.5 tonnes from code 21 heavy goods vehicles which exceed 7.5 tonnes. In this report these two groups will be referred to as HGV20 and HGV21.
- 2.7 Vehicle Manoeuvres
- 2.8 Direction of vehicle travel
- 2.10 Junction location of vehicle
- 2.11 Skidding and overturning
- 2.12 Vehicle leaving carriageway
- 2.16 First point of impact on the vehicle
- 2.17 First contact between each vehicle

together with the Contributory Factors:

- 306 Exceeding speed limit
- 307 Travelling too fast for conditions
- 308 Following too close
- 408 Sudden braking
- 409 Swerved
- 410 Loss of control
- 604 Driving too slow for conditions

It may be useful at this point to clarify the distinction between contributory factor 306 'Exceeding the speed limit' and contributory factor 307 'Travelling too fast for conditions'. Instructions for the use of these codes are provided in Stats 20 (Department for Transport, 2004).

Code 306 is to be used when the driver/rider caused, or contributed to the accident, by exceeding the posted speed limit. This code should also be used in cases where the actions of another road vehicle were the immediate cause of the accident but a speeding vehicle also contributed to causing the collision. This code is also to be used where the speed of the vehicle exceeded variable speed limits (for example, on motorways) and speed limits based on vehicle type. This code is to be used (not 307) if the driver/rider was exceeding the speed limit and travelling too fast for the conditions.

Code 307 is to be used when the driver/rider was travelling within the speed limit, but their speed was not appropriate for the road conditions and/or vehicle type, and contributed to the accident.

For a single carriageway road with a posted speed limit of 60mph, the vehicle type speed limits are as follows: motorcycles (60mph), cars (60mph), vehicles towing (50mph), light goods vehicles (50mph), buses and coaches (50mph), HGV20 (50mph) and HGV21 (40mph). It is commonly thought that the speed limit for light goods vehicles on these roads is 60mph. However, this only applies to those weighing less than 2 tonnes which are also based on a car chassis.

Information for all types of vehicle (17 types and 'unknown') was obtained and divided into the groups shown in Table 2.1.

Table 2.1. Vehicle groupings.

Vehicle group	Vehicle type code	Description
Powered two wheelers	02	Motorcycle 50cc and under
	03	Motorcycle over 50cc and up to 125cc
	04	Motorcycle over 125cc and up to 500cc
	05	Motorcycle over 500cc
Cars/Taxis/Minibuses	08	Taxi/ private hire car
	09	Car
	10	Minibus (8-16 passenger seats)
Agricultural vehicles	17	Agricultural vehicles (including diggers etc)
Light goods vehicles (LGV)	19	Goods vehicle 3.5 tonnes maximum gross weight (mgw) and under
HGV20	20	Goods vehicle over 3.5 tonnes mgw and under 7.5 tonnes
HGV21	21	Goods vehicle 7.5 tonnes mgw and over
Other	01	Pedal cycle
	11	Bus or coach (17 or more passenger seats)
	14	Other motor vehicle
	15	Other non motor vehicle
	16	Ridden horse
	18	Tram/ Light rail

Although the study is primarily concerned with accidents involving HGV21s, other vehicle groups (particularly HGV20) were included for comparisons.

2.2 Fatal files archive

Each year, police forces undertake detailed investigations of all fatal road traffic accidents occurring in the GB. These fatal accident reports cost a great deal to produce both in terms of police time and in terms of the work of pathologists who carry out post mortems on fatalities from road traffic accidents. Reports are produced, even where no criminal prosecution is envisaged, for presentation in evidence at the Coroner's inquest, but in many cases no further use at all is made of them after this.

At the request of the DfT, TRL operates a system where police forces routinely send fatal road accident reports to TRL when they are no longer of use for legal processes. These files, which were due for destruction, are catalogued and stored so that they can be made readily available to researchers investigating subjects such as primary and secondary vehicle safety, road safety engineering and accident and injury causation. TRL return the reports to the police if investigations are reopened. Typically TRL receive the files around 3 years after the date of the accident when the investigations are complete.

The archive currently consists of files up to 15 years old, after which time the files are either securely destroyed or returned to the originating police force in line with their request. The files in the archive have been used to supplement the HVCIS fatal database (see section 2.3) where accidents are not routinely coded (accidents where the HGV is being overtaken).

2.3 HVCIS fatal accident database

The Heavy Vehicle Crash Injury Study Fatal Accident Database contains accidents where an HGV, light commercial vehicle (LCV, goods vehicle less than or equal to 3.5t gross vehicle weight except for those based on a car chassis), large passenger vehicle (LPV, more than 8 seats), agricultural vehicle or other motor vehicle (OMV, e.g. fire engine, military vehicles) is directly involved in an impact with another vehicle. As such, accidents where an HGV is overtaken by another vehicle and collides with an oncoming vehicle are not usually included. However, if the overtaking vehicle or the oncoming vehicle is a vehicle of interest then it will be included in the database. For example, an accident where a motorcycle overtakes an HGV and has a head-on collision with an LCV meets the criteria for inclusion in the database. However, if the motorcycle collided with a car, it would not have been included.

Accidents where the HGV is not directly involved in the accident (for example it is being overtaken) are noted in the database with a brief description, but full details are not recorded. Accidents where an HGV is being overtaken are considered to be of particular interest when discussing the speed limit for HGVs on single carriageway roads. Therefore, for the purpose of evaluating the effect of changing the HGV speed limit, the relevant accidents were identified based on the accident descriptions and retrieved from the fatal accident archive for coding. The analysis described in Section 7 is therefore based on a modified version of the HVCIS fatal accident database. As such, the conclusions from the analysis cannot be treated in the same way as the analysis of the standard HVCIS released data. Therefore, the sample used in the analysis has been compared to and analysed alongside Stats19 to allow appropriate conclusions to be made.

2.4 OTS

The On-The-Spot (OTS) accident database contains information from expert investigators who attend the scene of an accident at the same time as the emergency services, with the aim of improving the understanding of the causes and consequences of road traffic accidents.

The OTS teams are based at the TRL in Berkshire and the Vehicle Safety Research Centre (VSRC), Loughborough University. Together they investigate five hundred crashes in-depth per year. The teams are notified of the accident by the local emergency services, and attend the accident in a specially marked high visibility accident investigation vehicle.

Much of the information necessary to understand complex road safety questions can only be collected at the scene of a road traffic accident. The OTS project aims to collect these ‘perishable’ data to enable complex research questions to be answered.

The information collected at the scene includes information relating to: the speed of the vehicles prior to the impact, the dynamics of road users during impacts and the effects of new vehicle and highway safety features on the causes and consequences of accidents. The OTS investigators also interview drivers and witnesses at the scene to establish each road user’s behaviour prior to the impact.

The information collected at the scene and from additional enquiries is then collated and recorded in a relational database, to enable accident trends to be identified. The accidents are sampled within a defined geographic region, to create a representative sample of all accidents.

The OTS database was searched for accidents involving HGVs over the whole period for which OTS information is available, that is, between October 2000 and July 2008.

The OTS database contains detailed information about the accidents and therefore is relatively small in comparison to other databases. The database includes accidents involving all vehicle types and of all severities and therefore the number of accidents involving HGVs is limited.

2.5 CCIS

The Co-operative Crash Injury Study (CCIS) is concerned with the analysis of road traffic accident injury data collected from about 1,500 vehicles (and their occupants) each year. Crashes in seven separate areas are investigated, selected using criteria that are biased towards fatal and serious crashes.

The study started in 1983 and has eight sponsors, from government and the automotive industry. Each of the sponsors uses the CCIS data as part of their research and development strategies. TRL is the Project Manager for CCIS and as such is responsible for the quality of the data and the continuing production of the cases.

Once a case is selected for inclusion in CCIS, a retrospective examination of the vehicle is carried out, questionnaires are sent to the individuals involved in the accident and injury details are obtained. (Data collection is subcontracted to research units at Birmingham and Loughborough Universities and the Vehicle and Operator Services Agency (VOSA), which operates five teams. This information is then processed and the injuries are correlated against the damage to the car. After verification, the data is appended to the database, with each accident case comprised of up to 800 data items.

Browser software enables users to quickly and easily examine and print cases, perform complex queries and carry out simple data analyses. Each accident case includes photographs of the damaged vehicles and a number of sketches and diagrams, which can be browsed and viewed from within the software. The opportunity was also taken to present data in a more graphical way and to include nomenclature reminders and diagrams wherever possible.

The focus of this database is the mechanism and causes of injury to car occupants and therefore does not contain the relevant information relating to the accident causation, making it unsuitable for this study. The inclusion of HGVs is also limited to accidents that also involved a car.

2.6 VOSA accident database

The VOSA Accident Database is compiled from structured, in-depth examinations of vehicles involved in accidents of all severities, completed by VOSA examiners. The examinations include recording whether systems such as anti-lock braking systems and electronic braking systems were present on the vehicle, and whether or not these systems were functional at the time of the collision.

The database contains details of all vehicle types, but it is heavily biased towards the heavier, larger types, including HGVs (with associated trailers) and Large Passenger vehicles (LPVs) although the single largest category by volume is cars. There is also bias towards fatal accidents.

The objective of the database is to establish what patterns of defects are present on vehicles involved in road traffic accidents and to establish how these defects contribute to the cause of accidents. Data relating to the speed of the vehicle is not collected, therefore this data source was not used for this study.

2.7 Interaction between data sources used

As mentioned in the sections above, each data source has its own strengths and limitations, which affect how the data can be used. In order to estimate any potential safety risk, it is necessary to combine the information available from each data source. Figure 2.1 shows how the three data sources interact.

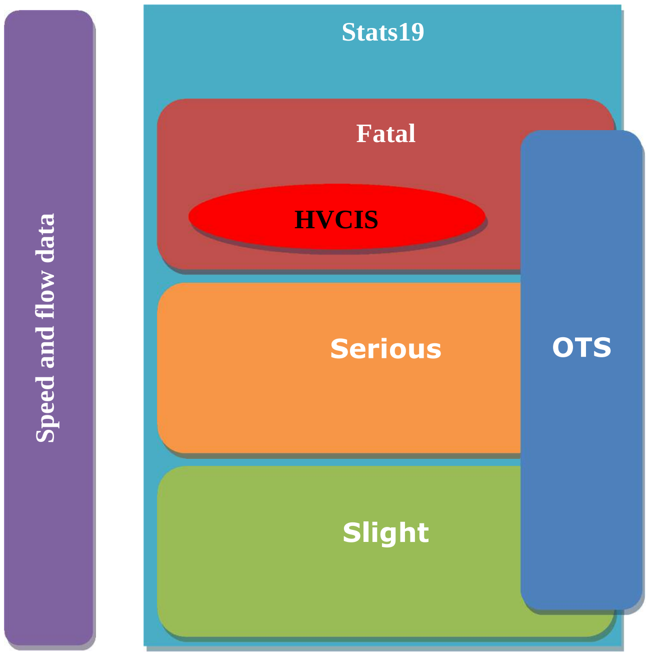

Figure 2.1. Interaction of data sources.

The Stats 19 records are the most complete set and include injury accidents throughout Great Britain. The OTS data contains only a subset of accidents within two police force areas but does include damage only accidents as well as injury accidents. The HVCIS records are a subset of the fatal accidents that involve heavy goods vehicles (and some others).

3 DfT speed and flow analysis

3.1 Available data sources

The DfT collects information from over 190 automatic traffic counter sites (ATC) on a continuous basis. The information consists of counts by vehicle type and speed. The data is used to obtain and publish vehicle speeds in free-flowing conditions and therefore the sites are located away from junctions and where congestion is relatively infrequent. The speed data published in Transport Statistics (Department for Transport, 2008) each year is based on a subset of these sites. This is because the intention is to illuminate trends over time and for this purpose it is important to include the same sites every year, and in earlier years there were fewer sites than at present.

Transport Statistics also provides information relating to traffic according to type of vehicle and class of road in terms of the number of billion kilometres travelled during the year.

3.2 Two applications

The DfT speed and flow data has been analysed for two approaches that are considered in the report. These are:

- A comparison of the percentage of vehicles exceeding the speed limit from ATC data with the percentage of vehicles involved in accidents where exceeding the speed limit or travelling too fast for the conditions was one of the recorded contributory factors in Stats 19. The results are used in Sections 4.1, 4.2 and 4.3. A judgement of whether the proportions of vehicles according to type based on the ATC site data are representative of national proportions in order to estimate relative accident involvement rates between the groups of vehicles. The results are used in Section 4.4.

3.3 Vehicle speed distributions

The DfT speed and flow data is published separately for the following types of non-built-up roads: motorways (27 sites); dual carriageways (7 sites); single carriageways (26 sites). The single carriageway sites are of the most interest and all have a 60mph speed limit. Table 3.1 presents an example of this information for the year 2007.

Table 3.1: Vehicle speeds on single carriageway roads with a 60mph speed limit by road type and vehicle type: Great Britain: 2007 (26 sites, miles per hour/per cent/number of vehicles

						Heavy goods vehicles[3]				
						Rigid			Articulated	
	Motor-cycles[1]	Cars	Cars towing	Light Goods[2]	Buses/ coaches	2 axle[4]	3 axle	4 axle	4 axles	5+ axles
Under 20 mph	*1*	*0*	*2*	*0*	*1*	*1*	*1*	*1*	*1*	*0*
20-29 mph	*3*	*2*	*7*	*3*	*3*	*3*	*6*	*6*	*5*	*2*
30-39 mph	*11*	*16*	*20*	*16*	*20*	*19*	*25*	*26*	*23*	*23*
40-49 mph	*30*	*41*	*48*	*40*	*50*	*45*	*50*	*46*	*48*	*49*
50-59 mph	*28*	*30*	*22*	*30*	*24*	*26*	*17*	*21*	*22*	*25*
60-64 mph	*9*	*6*	*2*	*6*	*2*	*3*	*0*	*0*	*1*	*1*
65-69 mph	*6*	*2*	*0*	*3*	*0*	*1*	*0*	*0*	*0*	*0*
70 mph and over	*12*	*2*	*0*	*2*	*0*	*1*	*0*	*0*	*0*	*0*
Speed limit	60	60	50	60	50	n/a	40	40	40	40
% more than 10 mile/h over the limit	*12*	*2*	*2*	*2*	*3*	*n/a*	*18*	*21*	*23*	*26*
Average speed	53	48	43	48	45	46	43	43	44	45
Number observed (thousands)	543	51,337	617	6,355	434	2,456	337	247	455	2,455

Source: National Core Census, DfT

1 Motorcycles includes mopeds and other types of powered two wheeled vehicles.
2 Goods vehicles under 3.5 tonnes gross weight
3 Goods vehicles over 3.5 tonnes gross weight
4 Speed limit depends on loading which cannot be determined
Note: Some figures have been rounded to the nearest final digit, there may be an apparent slight discrepancy between the sum of the constituent items and the total as shown.

The classification of vehicles is different to that of Stats 19 and so it is necessary to consider how to apply this data to the Stats 19 analysis. The motorcycles, cars, cars towing, light goods (less than 3.5 tonnes gross weight) and the buses and coaches types are straightforward. However, the heavy goods vehicle counts are recorded according to whether the vehicle has a rigid chassis or is articulated and by the number of axles rather than by weight.

The difficulty occurs with the rigid 2 axle heavy goods vehicles, some of which are less than 7.5 tonnes gross weight (HGV20) and others are more than 7.5 tonnes gross weight (HGV21). The mean gross weight of these vehicles is 6.9 tonnes and it is estimated that 54 per cent are HGV20 and 46 per cent are HGV21 vehicles. All of the other heavy goods vehicles are HGV21 vehicles.

Motorcycles have a speed limit of 60mph but 27 per cent exceed it and the mean speed of 53mph is the highest of all the vehicle types. Cars also have a speed limit of 60mph, 10 per cent exceed it and their mean speed is 48mph. The speed distribution of light goods vehicles is similar to that of cars. It is commonly but incorrectly thought (by drivers, possibly by the police and within some parts of DfT) that they have a speed limit of 60mph (the equivalent DfT table shows 60mph), but it is 50mph unless the vehicle is under 2 tonnes *and* based on a car chassis. There are few that are based on a car chassis. The proportion exceeding the speed limit is 41 per cent, though it would be only 11 per cent if the speed limit was 60mph and their mean speed is 48mph. Cars towing have a speed limit of 50mph, 24 per cent exceed it and their mean speed is 43mph. Buses and coaches have a speed limit of 50mph, 26 per cent exceed it and the mean speed is 45mph.

It is not possible to consider the proportion of rigid 2 axle heavy goods vehicles that exceed their speed limit because about half have a speed limit of 50mph (HGV20) and for the remainder the speed limit is 40mph (HGV21). Their mean speed is 46mph. The other heavy goods vehicles (HGV21) have a speed limit of 40mph. Between 67 and 74 per cent exceed it and the mean speed is between 43 and 45mph depending on the type of vehicle.

With the exception of motorcycles which have a mean speed 5mph in excess for cars and light goods vehicles, the mean speeds for all the other types of vehicle are within 5mph of the car and light goods mean speeds. This implies that the difference in speeds between HGV20 and HGV21 vehicles is relatively small. This increases the difficulty of comparing the effect of speed on accidents between the two groups. It also raises the issue of the likely effect of raising the speed limit for HGV21 vehicles since a high proportion of them ignore the existing limit.

At this point it is useful to consider what the effect on speed of raising the speed limit for HGV21 vehicles might be. A meta-analysis of the effect of changing a speed limit (whether by increasing it or reducing it) indicated a change in mean speed of 2.4mph for each 10mph change in the road speed limit (Finch, Kompfner, Lockwood and Maycock, 1994). This relates to a change for all types of vehicle, not for a particular group alone. However, if this assumption is applied to the HGV21 vehicles, then an increase in the speed limit to 45mph would raise the mean speed by 1.2mph and an increase to 50mph would raise the mean speed by 2.4mph.

Although the speed differences described above are relatively small, it is known that at these speeds the numbers of injury accidents on non-built-up single carriageway roads are predicted to increase by 5.5 per cent for each 1mph increase in the mean speed (Taylor, Baruya and Kennedy, 2002). Again, this figure applies to all vehicles not a particular group alone.

3.4 Vehicle proportions

Vehicle proportions can be obtained from published tables (Department for Transport, 2007) that are the equivalent of Table 3.1. However, it is not known whether these are representative of those found nationally. They are intended to provide information about vehicle speeds rather than flows. Ideally, proportions would be obtained from the published national data (Department for Transport, 2007b) for the number of billion vehicle kilometres travelled by the various types of vehicle. However, although the vehicle types in the national data are almost the same as those in Table 3.1, the road types are different. As far as non-built-up roads are concerned they are: motorways; rural trunk 'A' roads; rural principal 'A' roads; and minor rural roads. Strictly, motorways are not non-built-up roads but it is useful to include them for the purposes of comparison as this is the only type of road which can be used to directly compare ATC site data with the national statistics.

For the comparisons, the vehicle types have been condensed into the following groups: motorcycles; car and taxis; light goods vehicles; buses and coaches; HGV20; and HGV21. The separation of the 2 axle rigid chassis heavy goods vehicles into HGV20 and HGV21 was in the same proportions as in Section 3.2.

Table 3.2 presents the proportions for the year 2006. This was chosen as it is the mid year of the three years 2005, 2006 and 2007 which were used in the subsequent Stats 19 contributory factor analysis. Of particular interest is the ratio of the numbers and traffic (billion vehicle-kilometres) of HGV21 vehicles to that of HGV20 vehicles.

Table 3.2: Proportions of vehicles by group and type of road

	Great Britain M-way	Rural A Trunk	Rural A Principal	Rural Minor	ATC flows M-way	Dual c'way	Single c'way 60mph
Motorcycle	0.4%	0.7%	0.9%	1.3%	0.5%	0.7%	0.8%
Car & Taxi	74.8%	77.0%	80.7%	78.5%	74.9%	80.1%	80.8%
Buses & Coaches	0.6%	0.5%	0.7%	1.0%	0.4%	0.4%	0.5%
LGV	11.9%	12.0%	12.2%	16.3%	10.3%	8.9%	9.0%
HGV20	1.6%	1.5%	1.2%	0.9%	2.7%	2.1%	1.9%
HGV21	10.7%	8.3%	4.2%	2.0%	11.2%	7.8%	7.0%
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total (billion vehicle-km)	99.2	59.2	84.6	68.7	-	-	-
Number of Sites	-	-	-	-	27	7	26
Total (1,000 vehicles)	-	-	-	-	603,640	62,117	59,740
Ratio HGV21/HGV20	6.7	5.5	3.5	2.2	4.1	3.7	3.7

For motorways, Table 3.2 shows that HGV21 traffic was 6.7 times that of HGV20 based on the national statistics. For the ATC sites there were 4.1 times as many HGV21 vehicles counted as were HGV20 vehicles. Thus, it would seem that HGV21 vehicles are under represented at the ATC sites compared to national statistics. It is also possible that for motorways, the proportion of 2 axle rigid heavy goods vehicles that are HGV21 is different from that assumed (based on non-built-up single carriageway roads with a 60mph speed limit).

Table 3.2 also shows that for the national data, the ratio of HGV21 traffic to HGV20 traffic falls as the strategic importance of the road declines: motorway (6.7), rural trunk ‘A’ (5.5); rural principal ‘A’ (3.5); rural minor (2.2). This is less apparent in the ATC data: motorway (4.1); dual carriageway (3.7); and single carriageway (3.7).

If motorways are excluded, the weighted average ratio is almost identical for the national data (3.64) and the ATC sites (3.65). The weightings are by total traffic (national data) and total flow (ATC sites).

This provides some evidence that the ratio of HGV21 vehicles to HGV20 vehicles for ATC sites on non-built-up single carriageway roads with a 60mph speed limit is reasonably representative of the national ratio for this type of road.

Further work would clarify some of the uncertainties but this would require additional resources. For example, it would be useful to know how the existing national statistics are obtained. They are based on all (over 190) ATC sites and the rotating census which contains manual counts on one weekday in the year from a large number of sites. However, manual counts are made on only a subset of the sites in any one year.

4 Stats19 contributory factor analysis for all reported injury accidents

4.1 Link and junction accidents

Table 4.1 shows the count of vehicles involved in Stats 19 injury accidents on 60mph single carriageway roads according to vehicle type during the period from 2005 to 2007 inclusive separately for accidents occurring on links and those occurring at junctions.

A total of 162,957 vehicles were involved in injury accidents of which 1,776 were HGV20 and 4,972 were HGV21. Of the 1,776 HGV20 vehicles, 1,188 were involved in accidents on links (66.9 per cent) and 588 were at junctions (33.1 per cent). Of the 4,972 HGV21 vehicles, 3,387 (68.1 per cent) were involved in accidents on links and 1,585 were at junctions (31.9 per cent).

These results are unremarkable in themselves and show that as far as broad accident location is concerned HGV20 and HGV21 are similar. What is intriguing is a comparison with the more common lighter types of vehicle, cars (speed limit 60mph) and goods vehicles 3.5 tonnes and under (almost all of which are subject to a 50mph speed limit although it is commonly and erroneously believed that their speed limit is 60mph). Of the 128,236 cars, 79,878 were on links (62.3 per cent) and 48,356 were at junctions (37.7 per cent). Of the 8,260 goods vehicles 3.5 tonnes and under, 5,075 were on links (61.4 per cent) and 3,185 were at junctions (38.6 per cent). Thus, the percentage of vehicles involved in accidents on links was notably greater for HGV20 and HGV21 vehicles than for the lighter and higher speed limit vehicles.

Table 4.1: Number of vehicles involved in injury accidents on 60mph single carriageway roads, 2005-2007.

	Link Accident		Junction Accident		Unknown	Total	% of Accidents
Vehicle Type	**N**	**%**	**N**	**%**	**N**	**N**	**on link**
Pedal cycle	1,747	1.71%	925	1.52%	0	2,672	65.38%
Motorcycle 50cc and under	736	0.72%	428	0.70%	0	1,164	63.23%
Motorcycle over 50cc and up to 125cc	1,063	1.04%	670	1.10%	0	1,733	61.34%
Motorcycle over 125cc and up to 500cc	793	0.78%	480	0.79%	0	1,273	62.29%
Motorcycle over 500cc	4,796	4.69%	2,762	4.55%	0	7,558	63.46%
Taxi / Private hire car	473	0.46%	318	0.52%	0	791	59.80%
Car	79,878	78.17%	48,356	79.57%	2	128,236	62.29%
Minibus (8 – 16 passenger seats)	367	0.36%	207	0.34%	0	574	63.94%
Bus or coach (17 or more passenger seats)	922	0.90%	395	0.65%	0	1,317	70.01%
Other motor vehicle.	781	0.76%	320	0.53%	0	1,101	70.94%
Other non-motor vehicle.	33	0.03%	11	0.02%	0	44	75.00%
Ridden horse	196	0.19%	22	0.04%	0	218	89.91%
Agricultural vehicle (includes diggers etc.)	722	0.71%	510	0.84%	0	1,232	58.60%
Goods vehicle 3.5 tonnes maximum gross weight (mgw) and under	5,075	4.97%	3,185	5.24%	0	8,260	61.44%
Goods vehicle over 3.5 tonnes and under 7.5 tonnes mgw	1,188	1.16%	588	0.97%	0	1,776	66.89%
Goods vehicle 7.5 tonnes mgw and over	3,387	3.31%	1,585	2.61%	0	4,972	68.12%
Unknown vehicle type	30	0.03%	6	0.01%	0	36	83.33%
Overall	102,187	100.00%	60,768	100.00%	2	162,957	62.71%

Table 4.2: Number of vehicles involved in injury accidents on 60mph single carriageway roads, 2005-2007.

Vehicle Type	Link Accident N	%	Junction Accident N	%	Unknown N	Total N	% of accidents on link
Powered Two Wheeler	7,388	7.23%	4,340	7.14%	0	11,728	62.99%
Car/Taxi/Minibus	80,718	78.99%	48,881	80.44%	2	129,601	62.28%
Light Goods Vehicle	5,075	4.97%	3,185	5.24%	0	8,260	61.44%
HGV-20	1,188	1.16%	588	0.97%	0	1,776	66.89%
HGV-21	3,387	3.31%	1,585	2.61%	0	4,972	68.12%
Other Vehicle	4,401	4.31%	2,183	3.59%	0	6,584	66.84%
Unknown	30	0.03%	6	0.01%	0	36	83.33%
Overall	102,187	100.00%	60,768	100.00%	2	162,957	62.71%

Note:
HGV-20=Goods vehicle over 3.5 tonnes and under 7.5 tonnes mgw
HGV-21=Goods vehicle 7.5 tonnes mgw and over

Table 4.2 shows the same effect where powered two wheelers are combined into a group and car/taxi/minibus form a group.

It is desirable to consider more possible differences of this kind especially between HGV20 and HGV21. However, the real difficulty is in judging whether they are attributable to a different speed limit or to other factors.

The characteristics of link accidents are different from those of junction accidents and therefore it is desirable to treat them separately.

4.2 Analysis based on contributory factors: link accidents

The majority of link accidents involve at least one vehicle where a contributory factor was recorded. Table 4.3 shows that the percentage of vehicles in accidents with one or more contributory factors is relatively high for all types of vehicle although the percentage of vehicles with contributory factors attached varies between vehicle types.

Table 4.3: Count of vehicles involved in injury accidents on 60mph single carriageway roads (link accidents only), 2005-2007.

	PTW	Car/Taxi/Minibus	LGV	HGV20	HGV21	Other	Unknown	Total
All vehicles in accidents with no CFs reported in accident	1,001	12,018	685	213	396	1,230	9	15,552
All vehicles in accidents with CFs reported in accident	6,387	68,700	4,390	975	2,991	3,171	21	86,635
CF reported for vehicle	5,340	45,588	2,627	500	1,288	1,432	13	56,788
Total number of vehicles	7,388	80,718	5,075	1,188	3,387	4,401	30	102,187
% of vehicles in accident with CF reported	86.5%	85.1%	86.5%	82.1%	88.3%	72.1%	70.0%	84.8%
% with a CF reported for vehicle in accidents with a CF	83.6%	66.4%	59.8%	51.3%	43.1%	45.2%	61.9%	65.5%

Table 4.4 shows full details of the count of vehicles involved in injury accidents on links on 60mph single carriageway roads by group and by single speed related factors and combinations of factors from 2005 to 2007. (See section 2.1 for explanation of the CF codes.). Contributory factor 410 ‘loss of control’ was the most common for all types of vehicle, followed by contributory factor 307 ‘travelling too fast for conditions’ and 408 ‘sudden braking’.

Table 4.4: Count of vehicles involved in injury accidents on 60mph single carriageway roads (link accidents only) by speed related contributory factors, 2005-2007.

The number of vehicles possessing certain speed factors	PTW	Car/Taxi/Minibus	LGV	HGV20	HGV21	Other	Unknown	Total
306 only	133	721	32	2	21	1	1	911
307 only	344	4,289	239	39	84	74	1	5,070
308 only	135	1,216	127	30	64	27	0	1,599
408 only	217	1,896	135	25	74	51	2	2,400
409 only	71	1,081	64	19	34	47	0	1,316
410 only	1,338	8,202	326	45	132	161	0	10,204
604 only	2	34	4	1	2	10	0	53
306 & 307 only	25	273	7	1	5	1	0	312
306 & 308 only	9	35	4	1	6	0	0	55
306 & 408 only	6	37	1	0	1	0	0	45
306 & 409 only	3	51	1	0	1	0	0	56
306 & 410 only	121	682	11	0	14	5	0	833
307 & 308 only	24	200	18	2	18	3	0	265
307 & 408 only	32	404	39	3	7	14	0	499
307 & 409 only	9	156	10	2	2	3	0	182
307 & 410 only	300	3,447	126	8	37	48	0	3,966
308 & 408 only	12	155	17	6	7	4	0	201
308 & 409 only	2	26	2	0	0	0	0	30
308 & 410 only	7	36	2	1	0	2	0	48
408 & 409 only	7	160	10	2	3	3	0	185
408 & 410 only	158	663	36	8	13	7	0	885
408 & 604 only	0	3	1	0	0	0	0	4
409 & 410 only	62	1,058	44	5	12	12	0	1,193
409 & 604 only	0	1	0	0	0	0	0	1
410 & 604 only	1	4	0	0	0	0	0	5
306 & 307 & 308 only	2	9	0	0	0	0	0	11
306 & 307 & 408 only	5	26	2	0	1	0	0	34
306 & 307 & 409 only	0	10	2	1	0	0	0	13
306 & 307 & 410 only	41	350	4	1	4	0	0	400
306 & 308 & 408 only	1	7	0	0	0	0	0	8
306 & 308 & 409 only	0	2	0	0	0	0	0	2
306 & 308 & 410 only	1	5	0	0	1	0	0	7
306 & 308 & 604 only	0	1	0	0	0	0	0	1
306 & 408 & 409 only	0	3	1	0	1	0	0	5
306 & 408 & 410 only	20	56	3	1	1	0	0	81
306 & 409 & 410 only	8	74	3	0	0	0	0	85
307 & 308 & 408 only	2	43	2	0	1	0	0	48
307 & 308 & 409 only	0	9	0	1	0	1	0	11
307 & 308 & 410 only	3	11	0	0	1	0	0	15
307 & 408 & 409 only	4	33	4	1	1	0	0	43
307 & 408 & 410 only	35	320	13	1	2	6	0	377
307 & 409 & 410 only	10	223	13	1	1	2	0	250
307 & 410 & 604 only	0	1	0	0	0	0	0	1
308 & 408 & 409 only	1	9	1	1	0	0	0	12
308 & 408 & 410 only	6	15	1	1	1	0	0	24
308 & 409 & 410 only	2	5	0	1	0	0	0	8
408 & 409 & 410 only	20	242	8	0	2	0	0	272
408 & 410 & 604 only	0	2	0	0	0	0	0	2
306 & 307 & 308 & 408 only	0	0	0	0	0	0	0	0
306 & 307 & 308 & 409 only	0	2	0	0	0	0	0	2
306 & 307 & 308 & 410 only	3	1	0	0	0	0	0	4
306 & 307 & 408 & 409 only	0	5	0	0	0	0	0	5
306 & 307 & 408 & 410 only	3	44	0	1	0	0	0	48

306 & 307 & 409 & 410 only	1	33	1	0	0	1	0	36
306 & 308 & 408 & 410 only	1	2	0	0	0	0	0	3
306 & 308 & 409 & 410 only	1	1	0	0	0	1	0	3
306 & 408 & 409 & 410 only	3	24	1	0	0	1	0	29
307 & 308 & 408 & 409 only	0	4	0	0	0	0	0	4
307 & 308 & 408 & 410 only	1	2	0	0	1	0	0	4
307 & 308 & 409 & 410 only	0	1	0	0	0	0	0	1
307 & 408 & 409 & 410 only	5	66	5	0	0	0	0	76
308 & 408 & 409 & 410 only	2	3	1	0	0	0	0	6
306 & 307 & 408 & 409 & 410 only	0	10	0	0	0	0	0	10
306 & 308 & 408 & 409 & 410 only	0	1	0	0	0	0	0	1
307 & 308 & 408 & 409 & 410 only	0	1	0	0	0	0	0	1
306 & 307 & 308 & 408 & 409 & 410 only	0	1	0	0	0	0	0	1
Total with at least one of these CFs	3,199	26,487	1,321	211	555	485	4	32,262
Other CFs	2,141	19,101	1,306	289	733	947	9	24,526
No CF reported for vehicle in a CF accident	1,047	23,112	1,763	475	1,703	1,739	8	29,847
All vehicles in accidents with CFs reported in accident	6,387	68,700	4,390	975	2,991	3,171	21	86,635
All vehicles in accidents with no CFs reported in accident	1,001	12,018	685	213	396	1,230	9	15,552
Total number of vehicles	7,388	80,718	5,075	1,188	3,387	4,401	30	102,187

Table 4.5 compares the count and percentage of speed related CFs for the various groups of vehicles. The percentage of vehicles (in accidents where contributory factors were present) with one or more speed related CFs is highest for powered two wheelers (50 per cent), followed by car/taxi/minibus (39 per cent), light goods vehicles (30 per cent), HGV20 (22 per cent) and HGV21 (19 per cent). Thus, the smaller and lighter vehicles are more likely to have speed related CFs recorded than heavy goods vehicles. It is notable that the percentages for HGV20 and HGV21 vehicles are similar.

Table 4.5: Count of vehicles involved in injury accidents on 60mph single carriageway roads (link accidents only) according to whether one or more speed related CFs were recorded, 2005-2007.

	PTW	Car/Taxi/Minibus	LGV	HGV20	HGV21	Other	Unknown	Total
Total with at least one speed related CF	3,199	26,487	1,321	211	555	485	4	32,262
No speed related CF	3,188	42,213	3,069	764	2,436	2,686	17	54,373
All vehicles in accidents with CFs reported in accident	6,387	68,700	4,390	975	2,991	3,171	21	86,635
% with one of these CFs	50.1%	38.6%	30.1%	21.6%	18.6%	15.3%	19.0%	37.2%
All vehicles in accidents with no CFs reported in accident	1,001	12,018	685	213	396	1,230	9	15,552
Total number of vehicles	7,388	80,718	5,075	1,188	3,387	4,401	30	102,187

Table 4.6 presents the count of vehicles and the percentages involved in injury accidents by specific vehicle speed related factor for the various groups of vehicle. Although included, the results for the categories ‘other’ and ‘unknown’ are not discussed below as there are few of the latter and the former involves unpowered vehicles.

It is worth noting that vehicles for which there was recorded more than one speed related contributory factor appear more than once in Table 4.6. The percentages in Table 4.6 were calculated by dividing the number of vehicles possessing certain contributory factors by the total number of vehicles in accidents where contributory factors were present. For example, the percentage of HGV21 vehicles recorded as exceeding the speed limit (1.9 per cent) was obtained by dividing the relevant number of vehicles (56) by the total number of HGV21 vehicles (2,991) multiplied by 100.

The percentage exceeding the speed limit is highest (6.1 per cent) for powered two wheelers, followed by car/taxi/minibus (3.6 per cent), HGV21 (1.9 per cent), light goods vehicle (1.7 per cent) and HGV20 (0.8 per cent). These results will be considered within the context of vehicle type speed limits, mean speeds and the proportion exceeding the speed limit later in this section.

The percentage travelling too fast for the conditions is highest (14.5 per cent) for the car/taxi/minibus group, followed by powered two wheelers (13.3 per cent) and light goods vehicles (11.0 per cent). The percentages for HGV20 (6.4 per cent) and HGV21 (5.5 per cent) were again the lowest. These results also will be considered within the context of vehicle type speed limits, mean speeds and the proportion exceeding the speed limit later in this section.

The percentage of vehicles following too close was lowest (2.6 per cent) for the car/taxi/minibus group, but varied little between the other groups (between 3.3 and 4.5 per cent).

The percentage involving sudden braking was highest (8.5 per cent) for powered two wheelers, followed by light goods vehicles (6.4 per cent) and car/taxi/minibus (6.2 per cent). The percentages for HGV20 (5.1 per cent) and HGV21 (3.9 per cent) were the lowest.

The percentage involving swerving was highest for the car/taxi/minibus group (4.8 per cent), followed by light goods vehicles (3.9 per cent) and powered two wheelers (3.3 per cent). The percentages for HGV20 (3.5 per cent) and HGV21 (1.9 per cent) were low.

The percentage involving loss of control was highest for powered two wheelers (33.7 per cent), followed by the car/taxi/minibus group (22.7 per cent) and light goods vehicles (13.6 per cent). The percentages for HGV20 (7.6 per cent) and HGV21 (7.4 per cent) were much lower.

The percentages involving driving too slow for the conditions or a slow vehicle were very small (less than 0.2 per cent) in all cases.

Table 4.6: Count of vehicles and percentages involved in injury accidents on 60mph single carriageway roads (link accidents only) by specific vehicle speed related contributory factor, 2005-2007.

The number of vehicles possessing certain contributory factors	**PTW**	**Car/Taxi/Minibus**	**LGV**	**HGV20**	**HGV21**	**Other**	**Unknown**	**Total**
306 Exceeding speed limit	387	2,466	73	8	56	10	1	3,001
307 Travelling too fast for conditions	849	9,974	485	62	165	153	1	11,689
308 Following too close	215	1,803	175	44	100	38	0	2,375
408 Sudden braking	541	4,237	281	50	116	86	2	5,313
409 Swerved	211	3,295	171	34	57	71	0	3,839
410 Loss of control	2,153	15,586	598	74	222	246	0	18,879
604 Driving too slow for conditions or slow vehicle (e.g. tractor)	3	46	5	1	2	10	0	67
Total number of vehicles	6,387	68,700	4,390	975	2,991	3,171	21	86,635
The percentage of vehicles possessing certain contributory factors	**PTW**	**Car/Taxi/Minibus**	**LGV**	**HGV20**	**HGV21**	**Other**	**Unknown**	**Total**
306 Exceeding speed limit	6.1%	3.6%	1.7%	0.8%	1.9%	0.3%	4.8%	3.5%
307 Travelling too fast for conditions	13.3%	14.5%	11.1%	6.4%	5.5%	4.8%	4.8%	13.5%
308 Following too close	3.4%	2.6%	4.0%	4.5%	3.3%	1.2%	0.0%	2.7%
408 Sudden braking	8.5%	6.2%	6.4%	5.1%	3.9%	2.7%	9.5%	6.1%
409 Swerved	3.3%	4.8%	3.9%	3.5%	1.9%	2.2%	0.0%	4.4%
410 Loss of control	33.7%	22.7%	13.6%	7.6%	7.4%	7.8%	0.0%	21.8%
604 Driving too slow for conditions or slow vehicle (e.g. tractor)	0.1%	0.1%	0.1%	0.1%	0.1%	0.3%	0.0%	0.1%

The percentage of vehicles possessing the contributory factors 306 'Exceeding speed limit' and 307 'Travelling too fast for conditions' are considered in relation to published figures for mean vehicle speed and the proportion of vehicles exceeding the speed limit obtained from Department for Transport ATC sites (Department for Transport, 2008).

The vehicle speeds are based on data obtained throughout the year (2007) from 26 sites on non-built-up single carriageway roads with a 60 mph posted speed limit.

Table 4.7 presents the comparisons for each group of vehicles.

Table 4.7: Comparison of speed related contributory factors 306 (exceeding speed limit) and 307 (travelling too fast for conditions) with speeds by vehicle group

	CF306	CF307	Speed Limit (mph)	Mean Speed (mph)	Percentage exceeding speed limit for vehicle type
Motorcycle	6.1%	13.3%	60	53	27%
Car & Taxi	3.6%	14.5%	60	48	10%
LGV	1.7%	11.0%	50	48	41%
HGV20	0.8%	6.4%	50	n/k	n/k
HGV21	1.9%	5.5%	40	43-45	67%-74%

The requirement for recording contributory factor 306 relates to the speed limit *for that type of vehicle* and not for the road. There is evidence, though, that this requirement is being ignored. Table 4.7 shows that the ratio of the percentage exceeding the speed limit for the type of vehicle compared with the percentage recorded with contributory factor 306 is as follows: powered two wheeler (4.5); car/taxi/minibus (2.8); light goods vehicle (25); and HGV21 (38). It is clear from this that the ratio is considerably higher for those vehicles with lower speed limits. However, if the percentage of light goods vehicles that exceed the speed limit for the road (60mph) is considered, then 11 per cent exceed the limit (from Table 3.1), giving a ratio of 6.5. While if the percentage of HGV21 vehicles that exceed the speed limit for the road (60mph) is considered, then only 1 per cent exceed the limit (from Table 3.1), giving a ratio of 0.5.

The percentage of vehicles in each group for which contributory factor 307 'Travelling too fast for conditions' was recorded follows a broadly similar pattern to the use of contributory factor 306 with the exception of powered two wheelers, where contributory factor 307 is recorded less frequently than might be expected. This may be related to the requirement that if both factors are judged to have contributed to the accident then only contributory factor 306 should be recorded (not 307 or both).

Table 4.8 compares the number of vehicles with each contributory factor between the HGV20 and HGV21 groups. For each factor, the number of observed involvements for the HGV21 group is compared with the number expected with the assumption that the HGV21 group has the same accident characteristics as the HGV20 group. For example, of the 975 HGV20 vehicles, 8 exceeded the speed limit (0.82 per cent). If this proportion applied to HGV21 vehicles, 25 HGV21 vehicles would be expected to have been reported as exceeding the speed limit. This can then be compared with the 56 observed cases.

The differences between the speed related contributory factors for HGV20 and HGV21 vehicles were tested for statistical significance using a test comparing proportions.

In the above example, of the 975 HGV20 vehicles 8 exceeded the speed limit (0.82 per cent) whereas among the 2,991 HGV21 vehicles 56 exceeded the speed limit (1.87 per cent). The difference between the two proportions was found to be statistically significant, that is, the probability of the two percentages coming from the same population is less than 0.05, so we can be 95 per cent sure that they are different (hence we can conclude that HGV21 vehicles involved in accidents are more often reported as exceeding the speed limit than are HGV20 vehicles). The difference between the proportions in which a vehicle swerved was statistically significant, insofar as fewer of the HGV21 involved in accidents were reported as having swerved than were HGV20 vehicles.

Overall it seems that the speed related contributory factors on links are in general similar for HGV21 and HGV20 vehicles.

Table 4.8: Count of Heavy Goods Vehicles (HGVs) involved in injury accidents on 60mph single carriageway roads (link accidents only) by specific vehicle speed feature, 2005-2007.

		HGV20		**HGV21**	
	The number of vehicles possessing certain contributory factors	**number**	**percentage**	**expected**	**observed**
*	306 Exceeding speed limit	8	0.82%	24.5	56
	307 Travelling too fast for conditions	62	6.36%	190.2	165
	308 Following too close	44	4.51%	135.0	100
	408 Sudden braking	50	5.13%	153.4	116
*	409 Swerved	34	3.49%	104.3	57
	410 Loss of control	74	7.59%	227.0	222
	604 Driving too slow for conditions or slow vehicle	1	0.10%	3.1	2
	Total number of vehicles	975	100.00%	2,991.0	2,991

*Note: * indicates statistical significance*

4.3 Analysis based on contributory factors: junction accidents

The majority of junction accidents involve at least one vehicle where a contributory factor was recorded. Table 4.10 shows that the percentage of vehicles in accidents with one or more contributory factors is relatively high for all types of vehicle.

Table 4.10: Count of vehicles involved in injury accidents on 60mph single carriageway roads (junction accidents only), 2005-2007.

	PTW	Car/Taxi/Minibus	LGV	HGV20	HGV21	Other	Unknown	Total
All vehicles in accidents with no CFs reported in accident	540	7,358	370	80	164	488	2	9,002
All vehicles in accidents with CFs reported in accident	3,800	41,523	2,815	508	1,421	1,695	4	51,766
CF reported for vehicle	2,393	23,514	1,673	296	768	896	3	29,543
Total number of vehicles	4,340	48,881	3,185	588	1,585	2,183	6	60,768
% of vehicles in accident with CF reported	87.56%	84.95%	88.38%	86.39%	89.65%	77.65%	66.67%	85.19%
% with a CF reported for vehicle in accidents with a CF	62.97%	56.63%	59.43%	58.27%	54.05%	52.86%	75.00%	57.07%

Table 4.11 shows full details of the count of vehicles involved in injury accidents on junctions on 60mph single carriageway roads by group and by relevant contributory factors for the period from 2005 to 2007. (See section 2.1 for an explanation of the CF codes.)

It shows all combinations of speed related contributory factors which differ from those found for the link accidents. Contributory factor 307 'travelling too fast for conditions' was the most common for all types of vehicle, followed by contributory factor' 410 'loss of control' and there were similar numbers of vehicles where the contributory factors 308 'following too close' and 408 'sudden braking' were assigned.

Table 4.11: Count of vehicles involved in injury accidents on 60mph single carriageway roads (junction accidents only) by speed related contributory factors, 2005-2007.

The number of vehicles possessing certain speed factors	PTW	Car/Taxi/Minibus	LGV	HGV20	HGV21	Other	Unknown	Total
306 only	152	418	19	3	19	2	0	613
307 only	210	1,249	97	16	34	25	0	1,631
308 only	91	923	97	22	53	25	0	1,211
408 only	105	957	79	10	27	27	0	1,205
409 only	19	248	19	1	6	19	0	312
410 only	274	1,150	47	8	28	33	0	1,540
604 only	0	34	2	0	1	20	0	57
306 & 307 only	18	101	7	2	5	2	0	135
306 & 308 only	5	32	6	0	0	0	0	43
306 & 408 only	9	22	2	1	0	0	0	34
306 & 409 only	2	19	0	0	0	0	0	21
306 & 410 only	23	85	2	0	2	0	0	112
307 & 308 only	11	149	24	7	11	3	0	205
307 & 408 only	10	124	19	2	2	1	0	158
307 & 409 only	1	27	4	0	1	1	0	34
307 & 410 only	55	461	24	3	7	3	0	553
308 & 408 only	13	107	12	5	13	1	0	151
308 & 409 only	0	22	1	1	0	0	0	24
308 & 410 only	6	16	1	0	0	3	0	26
408 & 409 only	6	44	2	1	4	2	0	59
408 & 410 only	63	139	11	1	6	3	0	223
408 & 604 only	0	1	1	0	0	0	0	2
409 & 410 only	14	143	3	1	0	3	0	164
409 & 604 only	0	0	0	0	0	0	0	0
410 & 604 only	0	0	0	0	0	0	0	0
306 & 307 & 308 only	0	10	0	0	3	0	0	13
306 & 307 & 408 only	0	14	0	0	1	0	0	15
306 & 307 & 409 only	0	0	0	0	0	0	0	0
306 & 307 & 410 only	8	53	1	0	0	0	0	62
306 & 308 & 408 only	0	4	0	0	0	0	0	4
306 & 308 & 409 only	0	0	0	0	0	0	0	0
306 & 308 & 410 only	0	1	0	0	0	0	0	1
306 & 308 & 604 only	0	0	0	0	0	0	0	0
306 & 408 & 409 only	0	2	0	0	0	0	0	2
306 & 408 & 410 only	6	9	1	0	1	0	0	17
306 & 409 & 410 only	1	11	0	0	0	0	0	12
307 & 308 & 408 only	5	17	2	0	1	1	0	26
307 & 308 & 409 only	0	3	1	0	0	0	0	4
307 & 308 & 410 only	1	2	1	0	0	0	0	4
307 & 408 & 409 only	2	4	0	0	0	0	0	6
307 & 408 & 410 only	15	55	4	1	2	1	0	78
307 & 409 & 410 only	1	24	2	1	0	0	0	28
307 & 410 & 604 only	0	0	0	0	0	0	0	0
308 & 408 & 409 only	0	3	0	0	0	0	0	3
308 & 408 & 410 only	7	7	0	0	0	0	0	14
308 & 409 & 410 only	0	1	0	0	0	0	0	1
408 & 409 & 410 only	9	47	1	0	4	0	0	61
408 & 410 & 604 only	0	0	0	0	0	0	0	0
306 & 307 & 308 & 408 only	0	1	0	0	0	0	0	1
306 & 307 & 308 & 409 only	0	0	0	0	1	0	0	1
306 & 307 & 308 & 410 only	0	0	0	0	0	0	0	0
306 & 307 & 408 & 409 only	0	2	0	0	0	0	0	2
306 & 307 & 408 & 410 only	2	5	0	0	0	0	0	7

306 & 307 & 409 & 410 only	1	2	0	0	0	0	0	3
306 & 308 & 408 & 410 only	0	0	0	0	0	0	0	0
306 & 308 & 409 & 410 only	0	0	0	0	0	0	0	0
306 & 408 & 409 & 410 only	2	4	0	0	0	0	0	6
307 & 308 & 408 & 409 only	0	0	0	0	0	0	0	0
307 & 308 & 408 & 410 only	1	2	0	1	0	0	0	4
307 & 308 & 409 & 410 only	0	2	0	0	0	0	0	2
307 & 408 & 409 & 410 only	0	13	0	0	0	0	0	13
308 & 408 & 409 & 410 only	1	1	1	0	0	0	0	3
306 & 307 & 408 & 409 & 410 only	0	4	0	0	0	0	0	4
306 & 308 & 408 & 409 & 410 only	0	0	0	0	0	0	0	0
307 & 308 & 408 & 409 & 410 only	0	1	0	0	0	0	0	1
306 & 307 & 308 & 408 & 409 & 410 only	0	0	0	0	0	0	0	0
Total with at least one of these CFs	1,149	6,775	493	87	232	175	0	8,911
Other CFs	1,244	16,739	1,180	209	536	721	3	20,632
No CF reported for vehicle in a CF accident	1,407	18,009	1,142	212	653	799	1	22,223
All vehicles in accidents with CFs reported in accident	3,800	41,523	2,815	508	1,421	1,695	4	51,766
All vehicles in accidents with no CFs reported in accident	540	7,358	370	80	164	488	2	9,002
Total number of vehicles	4,340	48,881	3,185	588	1,585	2,183	6	60,768

Table 4.12 compares the count and percentage of speed related contributory factors for the various groups of vehicles. The percentage of vehicles with one or more speed related contributory factors is highest for powered two wheelers (30 per cent). The percentages for the other main groups were similar (with the range from 16 per cent to 18 per cent).

Table 4.12: Count of vehicles involved in injury accidents on 60mph single carriageway roads (junction accidents only) according to whether one or more speed related CFs were recorded, 2005-2007.

	PTW	Car/Taxi/Minibus	LGV	HGV20	HGV21	Other	Unknown	Total
Total with at least one speed related CF	1,149	6,775	493	87	232	175	0	8,911
No speed related CF	2,651	34,748	2,322	421	1,189	1,520	4	42,855
All vehicles in accidents with CFs reported in accident	3,800	41,523	2,815	508	1,421	1,695	4	51,766
% with one of these CFs	30.2%	16.3%	17.5%	17.1%	16.3%	10.3%	0.0%	17.2%
All vehicles in accidents with no CFs reported in accident	540	7,358	370	80	164	488	2	9,002
Total number of vehicles	4,340	48,881	3,185	588	1,585	2,183	6	60,768

Table 4.13 presents the count of vehicles and the percentages involved in injury accidents by specific vehicle speed related factor for the various groups of vehicle. Although included, the results for the categories 'other' and 'unknown' are not discussed below as there are few of the latter and the former involves unpowered vehicles.

It is worth noting that vehicles for which there was recorded more than one speed related contributory factor appear more than once in Table 4.13. The percentages in Table 4.13 were calculated by dividing the number of vehicles possessing certain contributory factors by the total number of vehicles. For example, the percentage of HGV21 vehicles recorded as exceeding the speed limit (2.3 per cent) was obtained by dividing the relevant number of vehicles (32) by the total number of HGV21 vehicles (1,421) multiplied by 100.

The percentage exceeding the speed limit is highest (6.0 per cent) for powered two wheelers, followed by car/taxi/minibus (1.9 per cent), HGV21 (2.3 per cent), light goods vehicle (1.3 per cent) and HGV20 (1.2 per cent). These results will be considered within the context of vehicle type speed limits, mean speeds and the proportion exceeding the speed limit later in this section.

The percentage travelling too fast for the conditions is highest (9.0 per cent) for powered two wheelers, followed by light goods vehicle (6.6 per cent), HGV20 (6.5 per cent), the car/taxi/minibus group (5.6 per cent) and HGV21 (4.8 per cent). These results also will be considered within the context of vehicle type speed limits, mean speeds and the proportion exceeding the speed limit later in this section.

The percentage of vehicles following too close was highest for the HGV20 group (7.1 per cent), followed by HGV21 (5.8 per cent), light goods vehicle (5.2 per cent), powered two wheeler (3.7 per cent) and the car/taxi/minibus group (3.1 per cent) for the car/taxi/minibus group.

The percentage involving sudden braking was highest (6.7 per cent) for powered two wheelers, followed by light goods vehicle (4.8 per cent), HGV20 (4.3 per cent), HGV21 (4.3 per cent) and car/taxi/minibus (3.8 per cent).

The percentage involving swerving was similar and low for all the vehicle groups.

The percentage involving loss of control was highest for powered two wheelers (12.9 per cent), followed by the car/taxi/minibus group (5.4 per cent), HGV21 (3.5 per cent), light goods vehicle (3.5 per cent) and HGV20 (3.1 per cent).

The percentages involving driving too slow for the conditions or a slow vehicle were very small (less than 0.2 per cent) in all cases.

Table 4.13: Count of vehicles and percentages involved in injury accidents on 60mph single carriageway roads (junction accidents only) by specific vehicle speed related contributory factors, 2005-2007.

The number of vehicles possessing certain contributory factors	**PTW**	**Car/Taxi/Minibus**	**LGV**	**HGV20**	**HGV21**	**Other**	**Unknown**	**Total**
306 Exceeding speed limit	229	799	38	6	32	4	0	1,108
307 Travelling too fast for conditions	341	2,325	186	33	68	37	0	2,990
308 Following too close	141	1,304	146	36	82	33	0	1,742
408 Sudden braking	256	1,589	135	22	61	36	0	2,099
409 Swerved	59	627	34	5	16	25	0	766
410 Loss of control	490	2,238	99	16	50	46	0	2,939
604 Driving too slow for conditions or slow vehicle (e.g. tractor)	0	35	3	0	1	20	0	59
Total number of vehicles	3,800	41,523	2,815	508	1,421	1,695	4	51,766

The percentage of vehicles possessing certain contributory factors	**PTW**	**Car/Taxi/Minibus**	**LGV**	**HGV20**	**HGV21**	**Other**	**Unknown**	**Total**
306 Exceeding speed limit	6.03%	1.92%	1.35%	1.18%	2.25%	0.24%	0.00%	2.14%
307 Travelling too fast for conditions	8.97%	5.60%	6.61%	6.50%	4.79%	2.18%	0.00%	5.78%
308 Following too close	3.71%	3.14%	5.19%	7.09%	5.77%	1.95%	0.00%	3.37%
408 Sudden braking	6.74%	3.83%	4.80%	4.33%	4.29%	2.12%	0.00%	4.05%
409 Swerved	1.55%	1.51%	1.21%	0.98%	1.13%	1.47%	0.00%	1.48%
410 Loss of control	12.89%	5.39%	3.52%	3.15%	3.52%	2.71%	0.00%	5.68%
604 Driving too slow for conditions or slow vehicle (e.g. tractor)	0.00%	0.08%	0.11%	0.00%	0.07%	1.18%	0.00%	0.11%

Table 4.14 compares the number of vehicles with each contributory factor between the HGV20 and HGV21 groups. For each factor, the number of observed involvements for the HGV21 group is compared with the number expected with the assumption that the

HGV21 group has the same accident characteristics as the HGV20 group. For example, of the 508 HGV20 vehicles, 6 exceeded the speed limit (1.18 per cent). If this proportion applied to HGV21 vehicles, 17 HGV21 vehicles would be expected to have been reported as exceeding the speed limit. This can then be compared with the 32 observed cases.

The differences between the speed related contributory factors for HGV20 and HGV21 vehicles were tested for statistical significance using a test comparing proportions. None of the differences were statistically significant.

Thus, it seems that the speed related contributory factors at junctions are in general similar for HGV21 and HGV20 vehicles.

Table 4.14: Count of Heavy Goods Vehicles (HGVs) involved in injury accidents on 60mph single carriageway roads (junction accidents only) by specific vehicle speed feature, 2005-2007.

	HGV20		**HGV21**	
The number of vehicles possessing certain contributory factors	**number**	**percentage**	**expected**	**observed**
306 Exceeding speed limit	6	1.18%	16.8	32
307 Travelling too fast for conditions	33	6.50%	92.3	68
308 Following too close	36	7.09%	100.7	82
408 Sudden braking	22	4.33%	61.5	61
409 Swerved	5	0.98%	14.0	16
410 Loss of control	16	3.15%	44.8	50
604 Driving too slow for conditions or slow vehicle	0	0.00%	0.0	1
Total number of vehicles	508	100.00%	1,421.0	1,421

4.4 Vehicle involvements

4.4.1 Based on 26 DfT ATC sites

It is revealing to consider the extent to which the numbers of vehicles involved in accidents on single carriageway roads with 60mph speed limits is related to the numbers counted at the 26 ATC sites for each group of vehicles.

Table 4.15 sets out the number of involvements for each group of vehicles over the three year period separately for link and junction accidents and for both combined. It also sets out the numbers of vehicles in each group as obtained or estimated from the ATC sites using the approach explained in Section 3.4. The numbers of vehicles are the numbers recorded in 2006 at the 26 ATC sites (the mid-year during the three year period for which CF information was available) multiplied by three. The number of involvements was then divided by the number of vehicles in each group to form a ratio. Finally, the ratio for each group was divided by the ratio for the car/taxi/minibus group. The latter values show the relative involvement of vehicles for the different groups.

Table 4.15: Accident involvements by vehicle group based on Stats 19: Great Britain: 2005-2007

	Number of vehicles (26 ATC sites 3 years)	Number of involvements (Stats 19 GB 3 years)	Ratio	Ratio (relative to car/taxi/ minibus)
Links				
PTW	1,540	7,388	4.80	8.77
Car/Taxi/Minibus	147,494	80,718	0.55	1.00
LGV	16,837	5,075	0.30	0.55
HGV20	3,362	1,188	0.35	0.65
HGV21	13,244	3,387	0.26	0.47
Junctions				
PTW	1,540	4,340	2.82	8.50
Car/Taxi/Minibus	147,494	48,881	0.33	1.00
LGV	16,837	3,185	0.19	0.57
HGV20	3,362	588	0.17	0.53
HGV21	13,244	1,585	0.12	0.36
Links and junctions combined				
PTW	1,540	11,728	7.62	8.67
Car/Taxi/Minibus	147,494	129,601	0.88	1.00
LGV	16,837	8,260	0.49	0.56
HGV20	3,362	1,776	0.53	0.60
HGV21	13,244	4,972	0.38	0.43

For both links and junctions, the relative involvements were much higher for the powered two wheeler group (8.77 for links and 8.55 for junctions). The relative involvements for the light goods vehicle group were considerably lower than for the car/taxi/minibus group (0.55 for links and 0.58 for junctions). The relative involvements for the HGV20 group were similar (0.64 for links and 0.58 for junctions) to those for light goods vehicles.

The most interesting comparison, in the context of this study, is between the HGV21 group and the HGV20 group. The relative involvement for the HGV21 group is lower than for the HGV20 on links and at junctions. On links the relative involvement was 0.47 for HGV21 compared with 0.55 for HGV20 (15 per cent less). At junctions the relative involvement was 0.36 for HGV21 compared with 0.52 for HGV20 (23 per cent less).

On the basis of the assumptions made this indicates that goods vehicles have a lower risk of being involved in injury accidents than the large group of car/taxi/minibus and by a large margin, also that HGV21s have a 15-23 per cent lower risk than HGV20s.

4.4.2 Based on published DfT statistics

Published information on vehicle involvement rates for 2007 (Department for Transport, 2008) does not support the above findings, though separate results for single carriageway roads with a 60mph speed limit are not available and not separated into HGV20 and HGV21 groups.

The involvement rates in injury accidents per 100 million vehicle-kilometres on rural 'A' roads (includes both single and dual carriageways) were as follows: motorcycles (383); cars (45); buses or coaches (51); light goods vehicles (18); heavy goods vehicles (44).

The involvement rates in injury accidents per 100 million vehicle-kilometres on rural 'B, C and unclassified' roads were as follows: motorcycles (440); cars (69); buses or coaches (83); light goods vehicles (19); heavy goods vehicles (67).

The involvement rates in fatal or serious accidents per 100 million vehicle-kilometres on rural 'A' roads (includes both single and dual carriageways) were as follows: motorcycles (156); cars (7.0); buses or coaches (10); light goods vehicles (3.1); heavy goods vehicles (7.7).

The involvement rates in fatal or serious accidents per 100 million vehicle-kilometres on rural 'B, C and unclassified' roads were as follows: motorcycles (162); cars (10); buses or coaches (13); light goods vehicles (3.6); heavy goods vehicles (13).

It is notable that involvement rates for light goods vehicles are markedly lower for light goods vehicles than for the other groups and that HGVs are very similar to cars.

4.4.3 Reasons for the differences in accident involvements

The reasons for the differences in the findings based on the 26 DfT sites compared with the published statistics are unclear.

One possible explanation already mentioned is that the accident involvements from the two sources refer to different types of road. The 26 DfT ATC sites are all on roads with a 60mph speed limit whereas the published statistics do not apply specifically to this type of road.

Another possible explanation is that the way accident involvement rates are calculated is different (Department for Transport, 2007).

The ATC sites operate continuously and recognise 22 different types of vehicle at sites outside London but only distinguish between short (<5.2m) and long (>5.2m) at sites within London. The 22 types are combined to provide estimates for 11 vehicle classes (pedal cycle, two-wheeled motor vehicle, car, light goods van, bus, rigid 2 axle lorry, rigid 3 axle lorry, rigid 4 or more axle lorry, 3 or 4 axle articulated, 5 axle articulated and 6 axle or more articulated).

The published DfT statistics are based on data from both ATC sites (previously referred to as the core census) and manual counts (previously referred to as the rotating census and the biennial counts).

The manual counts operate differently for major and minor roads. The major roads are split into five road classes: motorways; trunk roads (urban and rural 'A'); and principal roads (urban and rural 'A'). The minor roads are divided into six classes: 'B' class (urban and rural); 'C' class (urban and rural); and unclassified 'U' class (urban and rural).

For major roads every link is counted between every year and every eight years depending on the traffic flow and its variability. Enumerators count vehicles according to the 11 vehicle classes mentioned above for 12 hours from 07:00 to 19:00 for one weekday not or near to public holidays or during school holidays in 'neutral weeks' (most weeks in March, April, May, June, September and October). There are about 16,000 links overall of which a random sample of about 4,500 are manually counted each year.

It seems likely that the only way that might resolve the issue would be to calculate relative involvement rates from what would in essence be a new statistic which was based only on data from roads with a 60mph speed limit which would include data from both automatic and manual counter sites. Unfortunately, this would seem to be a major undertaking.

4.5 Discussion

If the speed limit for HGV21 vehicles was raised to 50mph it could be argued that these vehicles might be expected to have a similar involvement in accidents to HGV20 which have a speed limit of 50mph. The counter argument might be that HGV21 vehicles are heavier and many are articulated.

The CF analysis for link accidents indicates that a greater percentage (1.9 per cent) of HGV21 vehicles are recorded as ‘exceeding the speed limit’ compared with HGV20 vehicles (0.8 per cent). It may be that this is simply a recognition of the fact that the speed limit for HGV21 vehicles is lower than for HGV20 vehicles whilst the average travel speeds for these classes of vehicle are similar.

There was no material difference between the percentage of HGV21 (5.5 per cent) and HGV20 (6.4 per cent) recorded as ‘travelling too fast for conditions’. This suggests that the influence of speed in accident involvement is similar for HGV21 and HGV20 vehicles. This is not surprising given that their average speeds are similar.

A lower percentage (1.9 per cent) of HGV21 vehicles were recorded as having ‘swerved’ than HGV20 vehicles (3.5 per cent). A possible explanation may be that swerving is a behaviour which is avoided, wherever possible, by the drivers of HGV21 vehicles many of which are articulated.

The CF analysis for junction accidents revealed no material difference for speed related CFs between HGV21 and HGV20 vehicle involvements.

Raising the speed limit for HGV21 vehicles to 50mph would make legal the speeds that most of them currently adopt. They already travel on average close to the speeds of HGV20 vehicles and it seems unlikely that an increased speed limit would encourage them to travel faster than HGV20 vehicles. Thus the maximum potential increase in the average speed would be about 3mph and the actual change in average speed could well be less. However, any increase in speed is likely to increase the numbers of accidents, except perhaps those involving the overtaking of HGVs by other vehicles.

5 Stats 19 contributory factor analysis by accident severity

Section 4 was concerned with information about the numbers of Stats 19 injury accidents in which speed related CFs were recorded. In particular, accidents in which HGV21 vehicles were involved were compared with the numbers expected from equivalent records for HGV20 vehicles.

This section refines the analysis by considering fatal, serious, fatal and serious combined and slight injury accidents according to whether the accidents occurred on links or at junctions. Tabulations equivalent to those presented in Section 4 were produced for each of the four groups of accidents. These are not presented in the report as they are numerous and in the event added little additional understanding.

As before the speed related contributory factors were as follows:

- 306 Exceeding speed limit
- 307 Travelling too fast for conditions
- 308 Following too close
- 408 Sudden braking
- 409 Swerved
- 410 Loss of control
- 604 Driving too slow for conditions or slow vehicle

Tables 4.8 and 4.14 compared the observed numbers of speed related CFs for total injury accidents involving HGV21 vehicles with the numbers that would be expected if the behaviour of HGV21 vehicles was the same as HGV20 vehicles. Separate analyses were conducted for links and junctions.

The same approach is used in this section. Table 5.1 summarises the findings. In each case the differences between the observed and the expected numbers were tested for statistical significance. In many cases a straightforward test could not be applied because the numbers are too small (less than five vehicles).

Although it was possible that analysing the speed related CFs according to severity would provide useful further insights, the results have proved to be disappointing. The only statistically significant differences are for slight injury accidents and total injury accidents on links where more HGV21 vehicles were recorded with code 306 (exceeding speed limit) than would be expected but fewer with code 409 (swerved) than would be expected.

Table 5.1: Summary of results of statistical tests comparing the speed related CFs between HGV21 and HGV20 vehicles involved in accidents according to severity

Accident severity	Link accidents	Junction accidents
Fatal	Test not applicable for any CFs	Test not applicable for any CFs
Serious	Test not applicable for CFs 306, 308 and 604 Not stat. sig. for other CFs	Test not applicable for any CFs
Fatal & serious	Test not applicable for CFs 306, 308 and 604 Not stat. sig. for other CFs	Test not applicable for any CFs
Slight	Test not applicable for CF 604 Stat. sig. for CFs 306 and 409	Test not applicable for CFs 409 and 604 Not stat. sig. for other CFs

6 Characteristics of heavy goods vehicle accidents

6.1 Introduction

It is useful to consider in some detail the characteristics of heavy goods vehicle accidents. There are two reasons for this:

- To obtain a greater understanding of the types of accident and which are the more common. This may provide a better insight into what the effects of changing the speed limit for HGV21 vehicles might be.
- To compare the characteristics of accidents involving HGV21 vehicles with those involving HGV20 and LGV vehicles which already have a 50mph speed limit.

Ideally, the characteristics of Stats 19 accidents would have been considered since the possibly different characteristics of accident involving fatal, serious and slight injury could be evaluated. However, an in depth knowledge of what exactly happened when an accident occurred is extremely difficult in the absence of a plain language description of the events that occurred and in particular the time sequence of the events. Stats 19 does not include plain language descriptions.

Plain language descriptions are readily available in the HVCIS fatal accident database and hence these were used to identify the accident characteristics. Clearly, only the characteristics of fatal accidents involving heavy goods vehicles can be obtained in this way.

6.2 Method of analysis

Records of fatal accidents involving heavy goods vehicles travelling on single carriageway roads with a 60mph speed limit were identified that were contained in the HVCIS fatal accident database over the period from 1997 to 2006 inclusive. The database contains some records of accidents involving light goods vehicles and other large vehicles (such as fire engines, buses and minibuses) and these were removed for the purpose of the analysis. The HVCIS fatal accident database contains a sample of on average 23 per cent of fatal goods vehicle accidents. For some years up to 53 per cent of the accidents are included in the database, however, the proportion of accidents for the most recent years is lower, in part because some of these accidents remain subject to legal proceedings. The distribution of fatalities in terms of the types of other road users involved in the accidents is representative of Stats 19. The extent to which the accidents are representative of the split between HGV21 and HGV20 vehicles has not been checked.

In order to compare the characteristics of accidents involving HGV20 and HGV21 vehicles it was necessary to identify which vehicles were in these categories. Although the plain language descriptions often identify the manufacturer of the vehicle, they do not indicate whether they are HGV20 or HGV21 or even light goods. The gross vehicle weights of the vehicles are often available but by no means always so. For this reason it was decided to use the related Stats 19 records to determine the type of heavy goods vehicle (as recorded by the police). This was possible because the Stats 19 reference codes and the HVCIS accident references are linked. However, Stats 19 did not require these two categories of heavy goods vehicle to be separately identified prior to 1999. The analysis is therefore based on the period from 1999 to 2006 inclusive.

There is no means of analysing the plain language descriptions using automatic processing and therefore each record was analysed manually.

It was necessary to decide which characteristics to use in the analysis. The main division was between link (non-junction) and junction/access accidents since the nature of these accidents is different. The allocation of each accident to these categories was determined by the information in the plain language description. It will not necessarily match the link/junction coding in the Stats 19 record.

The next level of division was to separate single vehicle accidents from multiple vehicle accidents.

On links, the single vehicle accidents were further divided into pedestrian, hit debris and other single vehicle accidents. Other single vehicle accidents were divided according to whether the accident occurred on a left hand bend, on a straight or on a right hand bend and whether the vehicle left the carriageway on the nearside, on the offside, or did not leave the carriageway.

On links, the multiple vehicle accidents were divided into overtaking accidents, accidents involving collision with a parked vehicle and non-overtaking accidents.

The overtaking accidents were divided into those where the overtaking vehicle collided a vehicle travelling in the same direction (usually the overtaken vehicle), those involving overtaking in which the overtaking vehicle collided with a vehicle travelling in the opposite direction, and those where the overtaking vehicle lost control but did not hit another vehicle. The latter could be classed as a single vehicle accident, but since overtaking is an issue with respect to this study, it was convenient to class this as an overtaking accident. The location of the accident, whether on a left hand bend, on a straight or on a right hand bend was recorded where this was known.

Non-overtaking accidents were treated in a similar way. They were divided into those involving a collision involving vehicles travelling in the same direction (essentially shunt accidents), accidents involving U-turns, and those involving vehicles travelling in the opposite direction. Some of the latter are collisions with an oncoming vehicle where a vehicle had either lost control or in seeking to avoid a collision with a vehicle braking ahead had swerved into the opposing lane. The bulk, however, were collisions involving vehicles drifting into the opposing lane (especially on left hand bends) or losing control and entering the opposing lane. As before, the location of the accident, whether on a left hand bend, on a straight or on a right hand bend was recorded where this was known.

At junctions and accesses single vehicle accidents were also divided into pedestrian, hit debris and other single vehicle accidents.

Multiple vehicle accidents were divided into overtaking accidents where a vehicle travelling from the minor arm was not involved, parked vehicle accidents, accidents not involving overtaking where a vehicle travelling from the minor arm was not involved, accidents not involving overtaking where a vehicle travelling from the minor arm was involved, and accidents involving a vehicle reversing.

Junction/access accidents which did not involve overtaking and in which a minor arm vehicle was not involved were further divided according to whether a vehicle was turning left from the major road, going ahead or turning right and according to whether the collision was with a vehicle travelling in the same direction or in the opposite direction.

Junction/access accidents which did not involve overtaking but in which a minor arm vehicle was involved were divided according to whether the minor arm vehicle was turning left, going ahead or turning right and according to whether the collision was with a vehicle on the major road travelling from the left or the right, to the extent that this information was recorded.

This framework was used to provide a consistent approach to the analysis of the various types of accident. Inevitably, though, there were no examples of some of these types.

For all accidents the class of each vehicle involved in the collision was recorded by: pedal cycle; powered two wheel vehicle; car; light goods vehicle; HGV20; HGV21; other.

The type of accident was determined by the role of the heavy goods vehicle. There were some accidents which were difficult to classify and these were placed in an ‘other’ category. The latter included those accidents where the events were uncertain, unusual, or complex. Some of these accidents involved more than three vehicles.

6.3 Overall findings

The numbers of each of these types of accident are presented in Table 6.1 and 6.2. Table 6.1 refers to link accidents and Table 6.2 to junction/access accidents. The numbers of accidents involving HGV20, HGV21 or both are recorded separately.

Table 6.1: Number of fatal link accidents by accident type and by type of heavy goods vehicle (HVCIS data)

		Number of fatal link accidents			
Accident type		**HGV20**	**HGV20 & HGV21**	**HGV21**	**All HGV**
Single vehicle accidents					
Pedestrian		2	-	25	27
Hit debris		2	-	1	3
Other single vehicle	LH bend - left c'way nearside	-	-	-	-
	LH bend - on c'way	-	-	1	1
	LH bend - left c'way offside	-	-	2	2
	Straight - left c'way nearside	1	-	2	3
	Straight - on c'way	-	-	1	1
	Straight - left c'way offside	-	-	2	2
	RH bend - left c'way nearside	-	-	-	-
	RH bend on c'way	-	-	-	-
	RH bend - left c'way offside	-	-	-	-
Multiple vehicle accidents					
Overtaking: hit same direction	LH bend	-	-	-	-
	Straight	1	-	12	13
	RH bend	-	-	-	-
	Bend N/K	-	-	-	-
Overtaking: hit opposite direction	LH bend	3	1	9	13
	Straight	5	2	49	56
	RH bend	-	-	2	2
	Bend N/K	-	-	3	3
	Alignment N/K	1	-	12	13
Overtaking: lost control		-	-	1	1
Parked vehicle	hit parked vehicle	1	-	7	8
	hit opposite direction	-	-	1	1
Not overtaking: hit same direction	LH bend	-	-	-	-
	straight – slowing vehicles	-	-	1	1
	straight - queue	2	1	8	11
	RH bend	-	-	-	-
	Bend N/K	-	-	-	-
Not overtaking: hit opposite direction	LH bend	13	1	86	100
	straight - slowing vehicle	2	-	21	23
	straight - queue	-	-	4	4
	straight - other	13	3	116	132
	RH bend	2	-	16	18

	Bend N/K	-	-	6	6
Not overtaking	U - turn	-	1	10	11
Uncertain/unusual/complex		5	3	27	35
All fatal link accidents		53	12	425	490

Table 6.2: Fatal junction/access accidents by accident type and by type of heavy goods vehicle (HVCIS data)

		Number of fatal junction/access accidents			
Accident type		**HGV20**	**HGV20 & HGV21**	**HGV21**	**All HGV**
Single vehicle accidents					
Pedestrian		-	-	-	-
Hit debris		-	-	-	-
Other single vehicle		-	-	-	-
Multiple vehicle accidents					
Overtaking: minor arm vehicle not involved	L turn from major – hit same direction	-	-	-	-
	L turn from major - hit opposite direction	-	-	-	-
	Ahead from major – hit same direction	-	-	1	1
	Ahead from major - hit opposite direction	-	1	-	1
	R turn from major – hit same direction	-	-	-	-
	R turn from major - hit opposite direction	-	-	-	-
Parked vehicle		-	-	-	-
Not overtaking: minor arm vehicle not involved	L turn from major – hit same direction	-	-	1	1
	L turn from major - hit opposite direction	-	-	1	1
	Ahead from major – hit same direction	-	-	-	-
	Ahead from major - hit opposite direction	-	-	-	-
	R turn from major – hit same direction	1	-	6	7
	R turn from major - hit opposite direction	1	-	9	10
	R turn from major – did not hit	-	-	5	5
Not overtaking: minor arm vehicle involved	L turn from minor – hit major from L	-	-	1	1
	L turn from minor – hit major from R	1	-	5	6
	L turn from minor – hit major N/K	-	-	-	-
	Ahead from minor – hit major from L	-	-	4	4
	Ahead from major – hit major from R	3	-	10	13
	Ahead from minor – hit major N/K	-	-	1	1
	R turn from minor – hit major from L	1	-	5	6
	R turn from minor – hit major from R	4	-	30	34
	R turn from minor – hit major N/K	-	-	-	-

	R turn from minor – hit other minor R turn	-	-	1	1
	Overshot from minor – hit major from L	-	-	2	2
	Overshot from minor – hit major from R	-	-	4	4
	Overshot from major – hit major N/K	-	-	-	-
Reversing		-	1	6	7
Uncertain/unusual/complex		-	-	3	3
All fatal junction/access accidents		11	2	95	108

Table 6.3 sets out the main types of link and junction fatal heavy goods vehicle accidents in order of their frequency of occurrence. Of the 595 accidents studied the most common were: link accidents not involving overtaking where the collision was between vehicles travelling in the opposite direction (47 per cent); link accidents involving overtaking where the collision was between vehicles travelling in the opposite direction (15 per cent); non-overtaking junction/access accidents where a minor arm vehicle was involved (12 per cent); and pedestrian accidents (5 per cent). All the other types were represented by less than 5 per cent of the accident total.

Table 6.3: Main link and junction/access accidents by accident type (HVCIS data)

Accident type	Link or junction/access	Number of fatal HGV accidents
Not overtaking: hit opposite direction	Link	283 (47%)
Overtaking: hit opposite direction	Link	87 (15%)
Not overtaking: minor arm vehicle involved	Junction/access	72 (12%)
Pedestrian	Link	27(5%)
Not overtaking: minor arm vehicle not involved	Junction/access	24 (4%)
Overtaking: hit same direction	Link	13 (2%)
Not overtaking: hit same direction	Link	12 (2%)
U-turn	Link	11 (2%)
Other single vehicle	Link	9 (1%)
Parked vehicle	Link	9 (1%)
Reversing	Junction/access	7 (1%)
Other	Link	39 (7%)
Other	Junction/access	5 (1%)
All fatal accidents	Link and junction/access	598 (100%)

6.4 Comparing HGV21 with HGV20 fatal accidents based on HVCIS

Table 6.4 compares the numbers and percentages of fatal injury accidents on links from the HVCIS plain language descriptions according to whether the accident involved HGV20, HGV21 or both classes of vehicle.

For link accidents, the most common fatal accidents were: not overtaking and collision with a vehicle travelling in the opposite direction (58 per cent); overtaking and collision with a vehicle travelling in the opposite direction (18 per cent); and accidents involving a pedestrian (6 per cent). Unfortunately, the numbers of accidents involving HGV20 vehicles are relatively few (13 per cent) so comparisons are uncertain. However, there is no clear evidence that the fatal accident characteristics of HGV21 accidents are different from the characteristics of HGV20 accidents.

Table 6.4: Summary of fatal link accidents by accident type and type of heavy goods vehicle (HVCIS data)

Accident type	Number and percentage of fatal accidents			
	HGV20	HGV20& HGV21	HGV21	All known HGV types
Single vehicle accidents				
Pedestrian	2 (4%)	-	25 (6%)	27 (69%)
Hit debris	2 (4%)	-	1 (<1%)	3 (<1%)
Other single vehicle	1 (2%)	-	8 (2%)	9 (2 %)
Multiple vehicle accidents				
Overtaking: hit same direction	1 (2%)	-	12 (3%)	13 (3%)
Overtaking: hit opposite direction	9 (17%)	3 (25%)	75 (18%)	87 (18%)
Overtaking: lost control	-	-	1 (<1%)	1 (<1%)
Parked vehicle	1 (2%)	-	8 (2%)	9 (2%)
Not overtaking: hit same direction	2 (4%)	1 (8%)	9 (2%)	12 (2%)
Not overtaking: hit opposite direction	30 (56%)	4 (34%)	249 (59%)	283 (58%)
U turn	-	1(8%)	10 (2%)	11 (2%)
Uncertain/unusual/complex	5 (9%)	3 (25%)	27 (6%)	35 (7%)
All link accidents	53 (100%)	12 (100%)	425 100%)	490 (100%)

Table 6.5 compares the numbers and percentages of fatal injury accidents at junctions/accesses from the plain language descriptions according to whether the accident involved HGV20, HGV21 or both classes of vehicle.

For junction/link accidents, the most common fatal accidents were: not overtaking and collision with a minor arm vehicle (68 per cent); not overtaking in which collision with a minor arm vehicle was not involved (20 per cent); and accidents involving a vehicle reversing (7 per cent). Again, the numbers of accidents involving HGV20 vehicles are relatively few (12 per cent) so comparisons are uncertain. There is no clear evidence that the fatal accident characteristics of HGV21 accidents are different from the characteristics of HGV20 accidents.

Table 6.5: Summary of fatal junction/access accidents by accident type and type of heavy goods vehicle (HVCIS data)

Accident type	Number and percentage of fatal accidents			
	HGV20	HGV20 & HGV21	HGV21	All known HGV type
Single vehicle accidents				
Pedestrian	-	-	-	-
Hit debris	-	-	-	-
Other single vehicle	-	-	-	-
Multiple vehicle accidents				
Overtaking: minor arm vehicle not involved	-	1 (50%)	1 (1%)	2 (2%)
Parked vehicle	-	-	-	-
Not overtaking: minor arm vehicle not involved	2 (18%)	-	22 (22%)	24 (20%)
Not overtaking minor arm vehicle involved	9 (82%)	-	63 (68%)	72 (68%)
Reversing	-	1 (50%)	6 (6%)	7 (7%)
Uncertain/unusual/complex	-	-	3 (3%)	3 (3%)
All junction/access accidents	11 (100%)	2 (100%)	95 (100%)	108 (100%)

6.5 Comparing HGV21 with HGV20 injury accidents based on Stats 19

The fatal injury accidents within the HVCIS database are only a subset of those that occurred. Stats 19 has a more complete record. For example, for the same period of years 1999 to 2008, Stats 19 recorded 281 fatal accidents involving at least one HGV20 vehicle on 60mph single carriageway roads whilst HVCIS contains 78 HGV20 fatal accidents. Similarly, Stats 19 recorded 1,434 fatal accidents involving at least one HGV21 vehicle whilst HVCIS contains 531 HGV21 fatal accidents.

For these reasons, comparisons between the characteristics of HGV21 accidents and HGV20 accidents were obtained from Stats19 records.

It was not feasible to analyse the Stats19 accidents in the level of detail available from the plain language descriptions available in HVCIS.

The Stats19 comparisons did not consider link and junction accidents separately. The types considered were: single vehicle; overtaking; and other multiple vehicle accidents separately according to whether the heavy goods vehicle was involved in a frontal impact, a rear impact, a side impact or another impact. In each case, the class of vehicle involved in the impact was recorded. The comparisons were not restricted to fatal accidents; serious and slight injury accidents were analysed as well.

6.5.1 Accident frequency

Table 6.6 compares the percentage of accidents by type for accidents involving HGV20 or HGV21 vehicles. Those accidents which involve both an HGV20 vehicle and an HGV21 vehicle appear twice.

For other multiple vehicle accidents taken as a whole, the percentages involving HGV20 and HGV21 vehicles are similar. Other multiple vehicle accidents which involve only slight injury are slightly more common than those involving fatal or serious injury.

Multiple vehicle HGV frontal impact accidents are by far the most common type of accident involving HGVs. The percentages are greatest for fatal accidents (about 50 per cent), less for serious injury accidents (slightly more than 40 per cent) and least for slight injury accidents (slightly less than 40 per cent). The percentage of HGV21 vehicles involved in these fatal accidents is only slightly greater than for HGV20 vehicles, and is less for serious and slight injury accidents.

Multiple vehicle HGV rear impact accidents form about 4 per cent of fatal accidents, 7 per cent of serious injury accidents and about 9 per cent of slight injury accidents.

Multiple vehicle side impact accidents form about 12 per cent of fatal accidents, 19 per cent of serious injury accidents and slightly more than 20 per cent of slight injury accidents.

Given that about three quarters of accidents involving heavy goods vehicles and that the percentages are similar for HGV21 and HGV20 vehicles, any differences that there may be must appear in the remainder which are single vehicle accidents and those involving overtaking.

The percentages of single vehicle accidents are marginally lower for HGV21 than for HGV20 accidents for all severities. The percentages of overtaking accidents is somewhat higher for HGV21 accidents than for HGV20 accidents and this shows up more strongly for severe and slight injury accidents than for fatal accidents.

This leads to the further issue of whether this greater percentage of overtaking accidents is related to HGVs overtaking other vehicles, other vehicles overtaking HGVs or other vehicles overtaking other HGVs and colliding with HGVs travelling in the opposite direction. This issue will be put aside for the moment whilst the Stats 19 accident records are considered from the point of view of accident severity.

6.5.2 Accident severity

The findings presented so far relate to comparisons of accident frequency. However accident severity is also important.

Table 6.7 compares the severity of accidents involving HGV21 with those involving HGV20 vehicles for the various types of accident.

The percentage of fatal accidents involving HGV21 vehicles (7.2 per cent) is greater than for HGV20 vehicles (4.7 per cent) and so is the percentage of serious injury accident (21.4 per cent for HGV21 and 18.2 per cent for HGV20). Both of these differences are statistically significant.

Furthermore, the percentage of fatal accidents involving HGV21 vehicles is greater than for HGV20 vehicles for all major types of accident and in particular multiple vehicle accidents where there was a full frontal impact with the heavy goods vehicle (10.2 per cent for HGV21 and 5.9 per cent for HGV20)

The percentage of serious injury accidents involving HGV21 vehicles is also greater than for HGV20 vehicles for all the types of accident.

Table 6.6: Percentage of accidents by severity, by type of accident, by HGV impact and by vehicle hit (Stats 19 data)

			Percentage of accidents					
			Fatal		Serious		Slight	
Accident type			**HGV20**	**HGV21**	**HGV20**	**HGV21**	**HGV20**	**HGV21**
Overtaking			18.9%	19.5%	15.1%	19.0%	11.9%	14.6%
Single vehicle			7.5%	6.5%	10.5%	8.3%	9.5%	9.0%
Multiple vehicle			73.7%	74.0%	74.4%	72.6%	78.5%	76.4%
	HGV frontal impact		50.5%	54.9%	43.0%	41.1%	39.4%	36.9%
		cyclist /PTW	7.5%	5.3%	3.0%	2.3%	1.1%	0.7%
		car	28.5%	37.0%	26.9%	25.8%	24.9%	23.9%
		LGV	2.1%	4.2%	2.2%	3.6%	2.9%	2.5%
		HGV20	0.4%	0.3%	0.3%	0.7%	0.6%	0.7%
		HGV21	2.1%	1.6%	2.9%	2.0%	2.3%	1.7%
		Other/N/K	10.0%	6.6%	7.8%	6.7%	7.7%	7.4%
	HGV rear impact		4.3%	3.2%	6.8%	6.9%	9.9%	8.2%
		cyclist/PTW	1.8%	0.6%	1.8%	1.1%	0.6%	0.4%
		car	2.1%	2.1%	3.5%	4.0%	5.5%	4.7%
		LGV	-	0.1%	0.1%	0.7%	0.9%	0.8%
		HGV20	-	0.1%	0.1%	0.2%	0.0%	0.2%
		HGV21	-	-	0.4%	0.1%	0.8%	0.3%
		Other/ N/K	0.4%	0.3%	0.9%	0.8%	2.0%	1.7%
	HGV side impact		12.5%	12.1%	18.4%	19.7%	21.2%	23.4%
		cyclist/PTW	4.6%	3.1%	3.5%	3.3%	1.0%	0.8%
		car	5.0%	5.9%	8.6%	11.0%	11.8%	14.3%
		LGV	-	0.8%	1.6%	1.1%	1.2%	1.6%
		HGV20	-	-	0.4%	0.3%	0.7%	0.7%
		HGV21	-	0.6%	1.3%	0.9%	1.9%	1.9%
		Other/ N/K	2.8%	1.8%	3.0%	3.0%	4.6%	4.1%
	HGV other impact		6.4%	3.8%	6.3%	4.9%	8.0%	7.9%
		cyclist/PTW	-	-	0.1%	0.1%	-	0.1%
		car	0.7%	0.1%	0.3%	0.1%	0.2%	0.5%
		LGV	-	-	-	0.0%	0.0%	0.0%
		HGV20	-	-	-	-	0.0%	-
		HGV21	-	-	-	0.0%	0.0%	0.0%
		Other/ N/K	5.7%	3.7%	5.9%	4.5%	7.7%	7.4%
Total			100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 6.7: Accident severity by type of accident and by HGV involvement (Stats 19 data)

		Number and percentage severity of accidents							
		Fatal		Serious		Slight		PIA	
Accident type		**HGV20**	**HGV21**	**HGV20**	**HGV21**	**HGV20**	**HGV21**	**HGV20**	**HGV21**
Overtaking	Number	53	280	163	809	543	2,064	759	3,153
	% severity	7.0%	8.9%	21.5%	25.7%	71.5%	65.5%	100.0%	100.0%
Single vehicle	Number	21	93	113	354	435	1,274	569	1,721
	% severity	3.7%	5.4%	19.9%	20.6%	76.4%	74.0%	100.0%	100.0%
Multiple vehicle	Number	207	1,061	803	3,084	3580	10,792	4590	14,937
	% severity	4.5%	7.1%	17.5%	20.6%	78.0%	72.3%	100.0%	100.0%
Multiple vehicle: HGV frontal impact	Number	142	787	464	1,746	1798	5,217	2404	7,750
	% severity	5.9%	10.2%	19.3%	22.5%	74.8%	67.3%	100.0%	100.0%
Multiple vehicle: HGV rear impact	Number	12	46	73	295	452	1,153	537	1,494
	% severity	2.2%	3.1%	13.6%	19.7%	84.2%	77.2%	100.0%	100.0%
Multiple vehicle HGV side impact	Number	35	174	198	836	965	3,302	1198	4,312
	% severity	2.9%	4.0%	16.5%	19.4%	80.6%	76.6%	100.0%	100.0%
Multiple vehicle: HGV other impact	Number	18	54	68	207	365	1,120	451	1,381
	% severity	4.0%	3.9%	15.1%	15.0%	80.9%	81.1%	100.0%	100.0%
Total accidents	Number	281	1,434	1079	4,247	4558	14,130	5918	19,811
	% severity	4.7%	7.2%	18.2%	21.4%	77.0%	71.3%	100.0%	100.0%

6.6 Comparing HGV21 with HGV20 and LGV injury accidents based on Stats 19

Extending the analysis based on Stats19 to include comparisons with accidents involving light goods vehicles.

6.6.1 *Accident frequency*

Table 6.8 presents the percentage of accidents of various types separately for fatal and serious injury accidents combined (KSI) and for all personal injury accidents (PIA) according to whether an HGV21, HGV20 or LGV was involved.

For multiple vehicle fatal and serious accidents the percentages were similar for HGV21, HGV20 and LGV involved accidents and were 72.9 per cent, 74.2 per cent and 70.8 per cent respectively. For all multiple vehicle injury accidents the percentages were also similar and were 75.4 per cent, 77.6 per cent and 75.1 per cent respectively.

For single vehicle fatal and serious accidents the percentages were lowest for HGV21 (7.9 per cent), greater for HGV20 (9.9 per cent) and highest (12.5 per cent) for LGV involved accidents. For all single vehicle injury accidents the percentages were also lowest for HGV21 (8.7 per cent), greater for HGV20 (9.6 per cent) and highest (12.3 per cent) for LGV involved accidents.

For fatal and serious overtaking accidents the percentages were similar for HGV20 and LGV involved accidents and were 15.9 per cent and 16.7 per cent respectively but the percentage was higher (19.2 per cent) for HGV21 involved accidents. For all overtaking accidents the percentages were also similar for HGV20 and LGV involved accidents and were 12.8 per cent and 12.6 per cent respectively but the percentage was higher (15.9 per cent) for HGV21 involved accidents.

Table 6.8: Percentage of accidents by severity, by type of accident and by LGV and HGV impact (Stats 19 data)

	Percentage of accidents					
	KSI			PIA		
Accident type	**LGV**	**HGV20**	**HGV21**	**LGV**	**HGV20**	**HGV21**
Overtaking	16.7%	15.9%	19.2%	12.6%	12.8%	15.9%
Single vehicle	12.5%	9.9%	7.9%	12.3%	9.6%	8.7%
Multiple vehicle	70.8%	74.2%	72.9%	75.1%	77.6%	75.4%
Multiple vehicle: frontal impact	45.9%	44.5%	44.5%	43.9%	40.7%	39.1%
Multiple vehicle: rear impact	6.1%	6.3%	6.0%	10.8%	9.1%	7.5%
Multiple vehicle: side impact	14.9%	17.1%	17.8%	15.8%	20.2%	21.8%
Multiple vehicle: other impact	3.9%	6.3%	4.6%	4.6%	7.6%	7.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

6.6.2 *Accident severity*

Table 6.9 presents the severity of accidents of various types separately for fatal and serious injury accidents combined and for all injury accidents according to whether an HGV21, HGV20 or LGV was involved.

The percentages of fatal and serious injury accidents involving HGV21 vehicles was higher (28.7 per cent) than for HGV20 and LGV vehicles which were similar (23.0 per cent and 22.5 per cent respectively). The higher percentages for HGV21 vehicles were statistically significant.

Furthermore, the percentage of fatal and serious accidents involving HGV21 vehicles was greater than for HGV20 and LGV vehicles which were for all major types of accident.

Table 6.9: Accident severity by type of accident and by LGV and HGV involvement (Stats 19 data)

		Number and percentage severity of accidents						
		KSI				PIA		
Accident type		**LGV**	**HGV20**	**HGV21**		**LGV**	**HGV20**	**HGV21**
Overtaking	Number	989	216	1,089	3,335	759	3,153	989
	% severity	29.7%	28.5%	34.5%	100.0%	100.0%	100.0%	29.7%
Single vehicle	Number	741	134	447	3,241	569	1,721	741
	% severity	22.9%	23.6%	26.0%	100.0%	100.0%	100.0%	22.9%
Multiple vehicle	Number	4,207	1,010	4,145	19,820	4,590	14,937	4,207
	% severity	21.2%	22.0%	27.7%	100.0%	100.0%	100.0%	21.2%
Multiple vehicle: HGV frontal impact	Number	2,727	606	2,533	11,585	2,404	7,750	2,727
	% severity	23.5%	25.2%	32.7%	100.0%	100.0%	100.0%	23.5%
Multiple vehicle: HGV rear impact	Number	363	85	341	2,843	537	1,494	363
	% severity	12.8%	15.8%	22.8%	100.0%	100.0%	100.0%	12.8%
Multiple vehicle: HGV side impact	Number	885	233	1,010	4,172	1,198	4,312	885
	% severity	21.2%	19.4%	23.4%	100.0%	100.0%	100.0%	21.2%
Multiple vehicle: HGV other impact	Number	232	86	261	1,220	451	1,381	232
	% severity	19.0%	19.1%	18.9%	100.0%	100.0%	100.0%	19.0%
Total accidents	Number	5,937	1,360	5,681	26,396	5,918	19,811	5,937
	% severity	22.5%	23.0%	28.7%	100.0%	100.0%	100.0%	22.5%

6.7 The role of heavy goods vehicles in fatal overtaking accidents

Given that the severity of accidents involving HGV21 is greater than of either HGV20 or LGV vehicles for all types of accident it would be informative to know what their role in the various types of accident might be.

Project resources have not permitted a full investigation of this issue. However, the role of HGV21 and HGV20 vehicles in fatal overtaking accidents has been investigated based on analysis of the plain language descriptions in the HVCIS database. Overtaking accidents involving HGV21 vehicles are of particular interest since not only do have a greater severity than HGV20 and LGV overtaking accidents but they form a higher percentage of accidents as well.

Three types of overtaking accidents might be considered:

- The collision is with a vehicle travelling in the opposite direction
- The collision is with the vehicle being overtaken
- The overtaking vehicle loses control and leaves the carriageway

However, collisions with a vehicle travelling in the opposite direction dominate (85 per cent), so only these will be considered here.

Table 6.10 presents a detailed breakdown of fatal overtaking accidents in which the collision is with a vehicle travelling in the opposite direction. It shows the number of accidents according to the class of the overtaking vehicle, the class of the overtaken vehicle and the class of the vehicle travelling in the opposite direction. The classes of vehicle are: PTW; car; LGV; HGV20; and HGV21. Accidents involving other classes or an unknown class were excluded.

Table 6.11 is a summary of Table 6.10, combining the PTW, car, LGV classes but retaining the HGV classes which are of the most interest in this study.

Table 6.11 shows that of the 66 fatal overtaking accidents, 42 (64 per cent) involved an HGV21 being overtaken, 6 (9 per cent) involved an HGV20 being overtaken, 8 (9 per cent) involved an unknown HGV and 18 (27 per cent) involved another known vehicle being overtaken.

Some of the 42 fatal accidents involving an HGV21 being overtaken might not have occurred if the HGV21 had been travelling faster (because the number of overtaking manoeuvres might be reduced). If all of these accidents were eliminated (a best case scenario) the reduction would be 5 fatal accidents per year. However, overtaking a vehicle travelling at a higher speed takes longer and is more difficult to conduct safely, so that it is possible that a higher HGV21 speed might actually increase overtaking accidents.

Of the 29 fatal accidents which involve an HGV21 only when it is travelling in the opposite direction, it is debatable as to whether more of these would have occurred if HGV21 vehicles travelled faster.

Table 6.10: Number of fatal overtaking accidents by overtaking vehicle, overtaken vehicle and type of vehicle hit from opposite direction (HVCIS data)

		Type of vehicle hit from opposite direction					
Overtaking vehicle	**Overtaken vehicle**	**PTW**	**Car**	**LGV**	**HGV20**	**HGV21**	**HGV N/K**
PTW	PTW	-	-	-	-	-	-
	Car	-	-	-	-	3	-
	LGV	-	-	-	-	2	-
	HGV20	-	-	-	1	-	-
	HGV21	1	2	1	-	-	-
Car	PTW	-	-	-	-	-	-
	Car	-	-	-	-	9	-
	LGV	-	-	-	1	1	-
	HGV20	-	4	-	1	-	-
	HGV21	-	23	-	-	9	-
LGV	PTW	-	-	-	-	-	-
	Car	-	-	-	-	1	-
	LGV	-	-	-	-	1	-
	HGV20	-	-	-	-	-	-
	HGV21	-	1	-	-	3	-
HGV20	PTW	-	-	-	-	-	-
	Car	-	-	-	-	-	-
	LGV	-	-	-	-	-	-
	HGV20	-	-	-	-	-	-
	HGV21	-	-	-	-	-	-
HGV21	PTW	-	-	-	-	-	-
	Car	-	-	-	-	-	-
	LGV	-	-	-	-	-	-
	HGV20	-	-	-	-	-	-
	HGV21	-	2	-	-	-	-
Total		1	32	1	3	29	0

Table 6.11: Number of fatal overtaking accidents by overtaking vehicle, overtaken vehicle and type of vehicle hit from opposite direction (HVCIS data)

Overtaking	**Overtaken vehicle**	Type of vehicle hit from opposite direction **HGV20**	**HGV21**	**Other known**	**All known**
HGV20	HGV20	-	-	-	-
	HGV21	-	-	-	-
	Other known	-	-	-	-
HGV21	HGV20	-	-	-	-
	HGV21	-	-	2	2
	Other known	-	-	-	-
Other known	HGV20	2	-	4	6
	HGV21	-	12	28	40
	Other known	1	17	-	18
Total		3	29	34	66

6.8 Discussion

Material differences between the proportions by type of accident involving HGV21 and HGV20 vehicles occur only for single vehicle accidents (which is marginally lower for HGV21 vehicles for all severities of accident) and overtaking accidents (which is higher for HGV21 accidents).

The number of fatal accidents involving another vehicle overtaking an HGV21 vehicle is not large (about 5 per year) . This represents the maximum potential benefit that might occur for this type of accident if the HGV21 speed limit was raised. It is even possible that raising the speed limit would increase the numbers of this type of accident since even if the number of overtaking manoeuvres was reduced each one might carry a higher risk than at present.

The percentage of fatal accidents involving HGV21 vehicles (7.2 per cent) is notably greater than for HGV20 vehicles (4.7 per cent) and so is the percentage of serious injury accidents (21.4 per cent for HGV21 and 18.2 per cent for HGV20). These differences are statistically significant. This does necessarily imply that if HGV21 speeds increased the severity of the accidents involving them would increase (though it is hardly likely to reduce).

It is concluded that the relative frequency of accidents of various types is similar for HGV21 and HGV20 vehicles, but the severity of accidents involving HGV21 vehicles is higher than for HGV20 vehicles. This may be mainly attributable to their greater weight.

7 Collision data review

This section contains a summary of information obtained from an initial investigation using the OTS database. This was used to inform the analysis of detailed accident data which is the main focus of the following section. The information from the detailed data sources has also been combined with Stats19 data to provide estimates of the effect on the number and severity of accidents across Great Britain of changing the speed limit for HGVs with a gross vehicle weight exceeding 7.5 tonnes.

7.1 Initial investigation using OTS records

Prior to undertaking the analysis described in Sections 7.2 and 7.3, a review of OTS records was carried out.

The extent to which HGV21 speed will affect the occurrence and severity of accidents will depend on the type of accident. The main types that needed to be considered were:

- Other vehicle overtakes HGV21 and collides with a vehicle travelling in the opposite direction
- Other vehicle overtakes HGV21 and loses control
- Other vehicle is overtaking a third vehicle and collides with HGV21 travelling in the opposite direction
- Other vehicle loses control and collides with HGV21 travelling in the opposite direction
- Other vehicle shunts HGV21
- Other vehicle collides with manoeuvring HGV21
- HGV21 shunts other vehicle
- HGV21 loses control but does not collide with another vehicle
- HGV21 loses control and collides with another vehicle

Some examples of the way in which the above principles were applied to these accident types are set out below.

Consider accidents in which another vehicle overtakes an HGV21 vehicle travel at or near 40mph. An increase in the speed limit might be expected to increase the speed of the HGV21 vehicle which may reduce the occurrence of these types of accident. However, when overtaking does occur, the severity may be higher because of the higher speed of the overtaking vehicle. If the HGV21 was travelling some way below the existing speed limit or some way above it, then it was assumed that neither the probability of occurrence nor the severity would change.

Consider accidents in which an HGV21 vehicle shunts another vehicle. It was assumed that the higher the speed of the HGV21 vehicle, the higher would be the probability of occurrence and the greater the severity.

In 4 (14 per cent) of the 29 accidents for which speeds are known it is estimated that a higher speed limit would have been beneficial (accident less likely to have occurred).

- Van attempted to overtake HGV travelling at 40mph where two lanes merged into one. The van collided with oncoming traffic.
- Van overtook an HGV travelling at 35mph Van pulled in front of HGV to avoid oncoming traffic and braked hard, causing the HGV to collide with the rear of the van, pushing it off the road to the offside.
- Car overtook HGV which was travelling at 40mph. This forced an oncoming car to take evasive action and leave the road.

- HGV travelling at 55mph overtook slower moving HGV (unknown speed). This caused an oncoming car to brake and steer to the nearside. This car was impacted from behind by another car that had been following too close and was unable to stop.

However, in 11 (38 per cent) of the 29 accidents, it is estimated that a higher speed limit would have increased the severity of the accident. Three examples of these accidents are:

- HGV travelled round bend and rolled over. Speed estimated at 45mile/h
- HGV driver claimed to have swerved to avoid two oncoming cars that were being driven carelessly. HGV lost control and left the road. Travel speed estimated at 45mph
- HGV failed to stop behind a car that had slowed to turn right into a side road. The HGV had been travelling at 35mph and the impact occurred at 18mph

There was inevitably more uncertainty about the effect of an increase in the HGV21 speed limit in cases where the speed of the HGV was unknown and a more subjective interpretation was required. However, sometimes the investigator would mention a non specific term such as 'at speed' or 'slowly' even if an actual speed is not given. This approach suggested the following.

- In 2 (5 per cent) of the 37 accidents for which speeds are not known it is estimated that a higher speed limit would have been beneficial (accident less likely to have occurred).
- However, in 21 (57 per cent) of the 37 accidents, it is estimated that a higher speed limit would have increased the severity of the accident.

7.2 Data analysis framework

The figures shown in this section define the framework used for the analysis of the accident data. This framework was used for each of the data sources to allow output from each data source to be compared/combined appropriately.

Firstly, one of the key accident characteristics was whether the accident involved a single vehicle, or multiple vehicles. However, there is a group of accidents that are of particular interest to this study, accidents where an HGV is being overtaken. These accidents are a sub-category of the multiple vehicle category. However, it was decided that this group of HGV being overtaken (HBO) accidents should be separately identified for the analysis that follows. This resulted in three accident groups being identified as shown in Figure 7.2

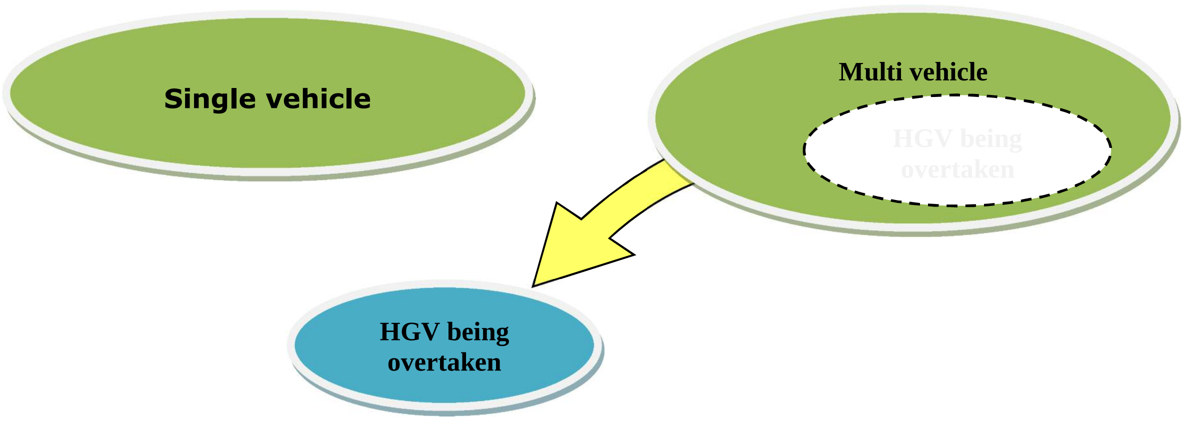

Figure 7.2: Accident types

In order to ensure traceability of the results of the analysis, the number of accidents was recorded for each step shown in Figure 7.3 for each of the data sources.

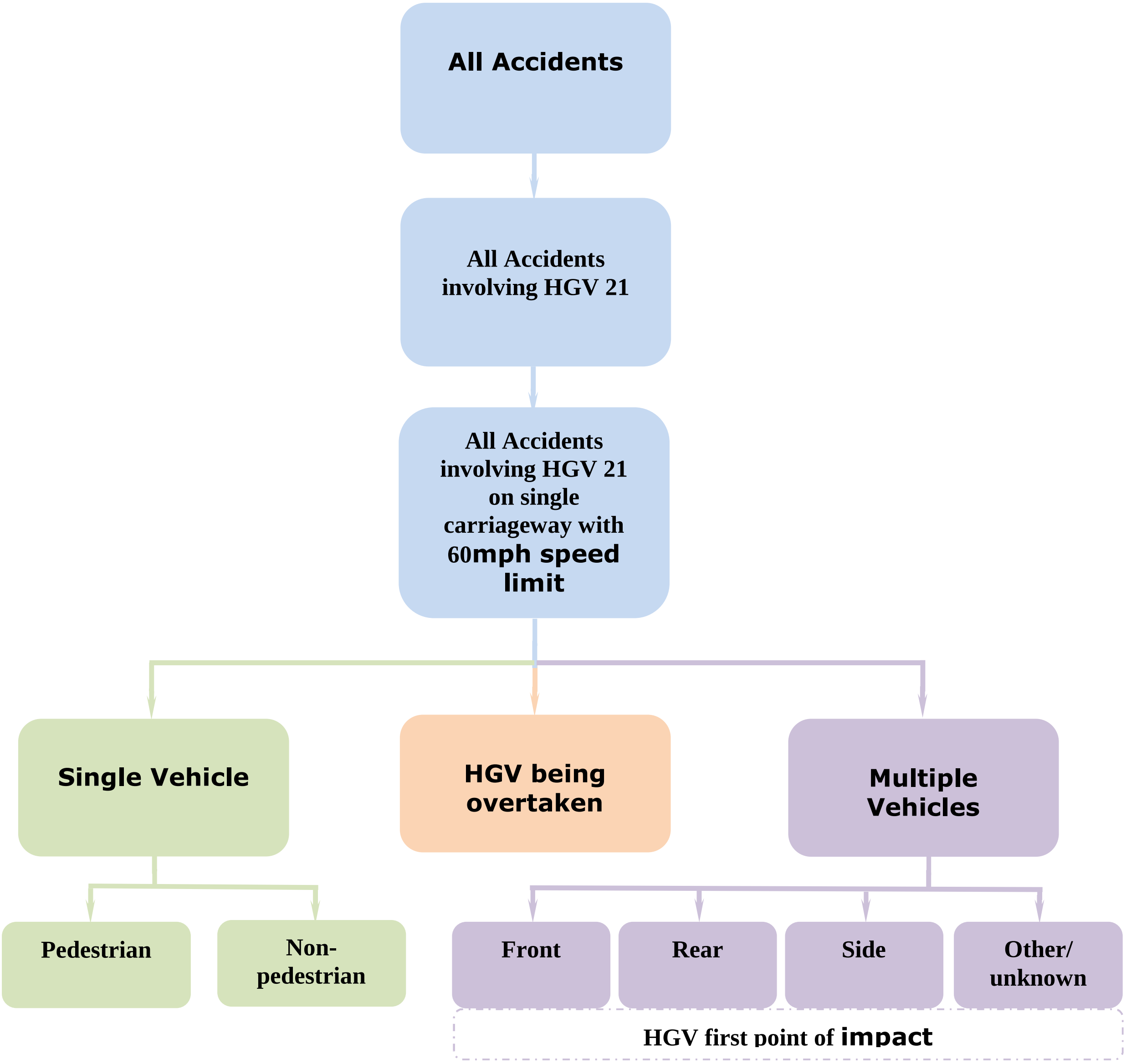

Figure 7.3: Data handling framework

Using the in-depth data sources (HVCIS fatals and OTS), the next stage in the analysis was to consider the travel speeds of the HGV21s involved in the accidents. This allows the proportion of accidents that are likely to be affected by a change in the speed limit to be determined. The following criteria were used to group the accidents:

- **Travel speed less than 36mph** – the HGV is travelling below the existing speed limit and there is likely to be a limiting factor (travelling uphill, round a bend, congestion) influencing the speed such that they are unlikely to increase their travel speed if the speed limit was changed.
- **Travel speed 36 to 44mph inclusive** – the HGV is travelling within 10% of the existing speed limit. It is assumed that these vehicles will travel at an increased

speed which could be as high as the new speed limit (although a maximum increase of about 3mph seems more likely).

- **Travel speed is greater than 44 mph** – the HGV is currently exceeding the speed limit. For simplicity it has been assumed that all HGVs in this category will remain at their current speed. However, depending on the distribution of the travel speeds, it is possible that some vehicles (travelling 45 to 49mph inclusive) will increase their speed.

At this stage in the methodology the proportion of accidents that are likely to be affected by a change in speed limit has been estimated, this is referred to as the target population (those travelling at a speed of between 36 and 44mph). The target population can be made up from a number of groups of accidents, each of which can be affected by the proposed change in different ways. The next step is to determine what the effect of the change in speed limit would be for each group of accidents that make up the target population. For each group of accidents, the accident descriptions and details were reviewed to identify any possible effects of changing the speed limit.

7.3 Findings

The following sections describe the results from the analysis of collision data for accidents involving HGV21s. The analysis was based on data from the following time periods:

- Stats 19 (1999 to 2008)
- HVCIS (1997 to 2006)
- OTS (October 2000 to July 2008)

7.3.1 Stats19

It is extremely difficult to identify accidents in Stats 19 where the HGV is being overtaken. The lack of a plain language description does not allow the selected accidents to be reviewed to ensure that they are relevant. There is also a risk that some relevant accidents could be excluded. To ensure all accidents where an HGV is being overtaken are captured, all accidents where any vehicle in the accident was overtaking have been identified. The selection criteria used for this group could be refined further to include impact location, HGV manoeuvre and direction of travel. However, it would still not be possible to confirm that the correct accidents had been identified. The difference between this group of overtaking accidents and those defined for the in-depth data is accounted for as described in Section 7.2

Table 7.1 summarises the Stats19 data as specified in the analysis framework for accidents involving HGV21.

Table 7.1: Summary of Stats19 results (1999 to 2008) for accidents involving HGV21

Accident type		Number of fatal accidents	Number of serious accidents	Number of slight accidents
Involving HGV21		3868	13695	74304
On single carriageway with 60 mile/h limit		1434	4247	14130
Multiple vehicle*	Front	787	1746	5217
	Rear	46	295	1153
	Side	174	836	3302
	Other/unknown	54	207	1120
Single vehicle	Pedestrian	65	70	95
	Non-pedestrian	28	284	1179
Any vehicle in the accident was overtaking		280	809	2064

* Multiple vehicle accidents involving more than one HGV21 vehicle are categorised under the impact of vehicle 1

7.3.2 HVCIS

The main HVCIS database (excluding the cases specifically coded for this study) was sub-divided into two groups of accident; single vehicle HGV accidents; and multi-vehicle HGV accidents. When reviewing the accident descriptions it became apparent that some of the multi-vehicle accidents were actually accidents where an HGV was being overtaken and these accidents needed to be identified so that they could be grouped together with the other accidents where the HGV was being overtaken that had been specifically coded (resulting in three types of accident group, "single vehicle", "multiple vehicle" and "HGV being overtaken").

The accidents where the HGV was being overtaken were identified by selecting accidents where a vehicle that was overtaking had a head-on (front-front) collision with a vehicle of interest (HGV, LCV, LPV, OMV, Agricultural) and where the accident involved more than 2 vehicles. The accident descriptions were reviewed to identify those where an HGV was being overtaken. There were 19 accidents where it was known an HGV was being overtaken from the accident description and a further 19 accidents where it was unclear what vehicle type was being overtaken. The fatal accident files for the 19 cases where the vehicle being overtaken was unknown were reviewed. There were two cases where the file was no longer available for review and one case where the type of vehicle was described as 7.5t HGV or box van. In the absence of further information, these three cases were left as multi-vehicle accidents. Of the remaining 16 cases reviewed there were four that involved an HGV being overtaken, with the remaining 13 recorded as multi-vehicle[1].

An alternative method of identifying overtaking accidents was to look for HGVs that did not have an impact. Reviewing the accident descriptions of these cases identified one further accident. A total of 23 accidents (HGV20 and HGV21) were added to the group of accidents where the HGV was being overtaken alongside those that had been specifically coded.

Table 7.2 summarises the results from the analysis of the HVCIS Fatal Accident Database using the analysis framework described. The number of accidents where the HGV speed was categorised are expressed as a percentage of the lowest level accident type (as defined in Figure 7.2) for accidents where the travel speed was known. These percentages can then be combined with the data in Table 7.1 to estimate the target population of accidents that may be affected by changing the speed limit (Section 7.3.4).

[1] One case mentioned that an HGV was in the queue of traffic ahead but a car was being overtaken at the time of the collision, this case was recorded as multi-vehicle where the overtaking vehicle collided with an HGV.

The target population is the group of accidents that could potentially be affected by a change in the speed limit.

Table 7.2: Summary of HVCIS results (1997 to 2006) for accidents involving HGV21

	Number of accidents	Accident type	Number of accidents	HGV travel speed range (mph)	Number of accidents
Involving HGV21	1398				
On single carriageway with 60 mph limit	571				
Multiple vehicle	495	Front	395	<36 36-44 >44 Unknown	60 (16.8%) 111 (31.1%) 186 (52.1%) 38
		Rear	17	<36 36-44 >44 Unknown	16 (100%) - - 1
		Side	95	<36 36-44 >44 Unknown	28 (35.0%) 18 (22.5%) 34 (42.5%) 15
		Other/unknown	5	<36 36-44 >44 Unknown	1 (25.0%) - 3 (75.0%) 1
Single vehicle	36	Pedestrian	25	<36 36-44 >44 Unknown	2 (8.3%) 6 (25.0%) 16 (66.7%) 1
		Non-pedestrian	11	<36 36-44 >44 Unknown	1 (14.3%) 2 (28.6%) 4 (57.1%) 4
HGV being overtaken	40	N/A	-	<36 36-44 >44 Unknown	1 (2.8%) 12 (33.3%) 23 (63.9%) 4

7.3.3 OTS

Table 7.3 summarises the OTS data relating accidents involving HGV21s. The total number of accidents involving HGV21 was not available because the differentiation between HGV20 and HGV21 had to be done on a case-by-case basis and the number of accidents was therefore restricted to those on de-restricted single carriageways.

Table 7.3: Summary of OTS results (October 2000 to July 2008) for accidents involving HGV21

	Accident type	HGV21 travel speed (mph)	Number of fatal accidents	Number of serious accidents	Number of slight accidents	Number of non-injury accidents
On single carriageway with 60 mile/h limit			2	5	11	24
Multiple vehicle	Front	<36	-	-	1	3
		36-44	-	-	-	2
		>44	1	-	1	-
		Unknown		1	1	1
	Rear	<36	-	-	-	-
		36-44	-	-	-	-
		>44	-	-	-	-
		Unknown	-	1	-	1
	Side	<36	-	1	3	1
		36-44	-	-	-	-
		>44	-	-	1	-
		Unknown	-	1	-	2
	Other/ unknown	<36	-	-	-	-
		36-44	-	-	-	-
		>44	-	-	-	1
		Unknown	-	1	1	-
Single vehicle	Pedestrian	<36	-	-	-	-
		36-44	-	-	-	-
		>44	-	-	-	-
		Unknown	1	-	-	-
	Non-pedestrian[2]	<36	-	-	-	2
		36-44	-	-	-	1
		>44	-	-	2	1
		Unknown	-	-	1	4
HGV being overtaken	N/A	<36	-	-	-	1
		36-44	-	-	-	2
		>44	-	-	-	1
		Unknown	-	-	-	1

The speed of the HGV21 was not within the range 36 to 44mph for any of the injury accidents in the OTS sample. It is therefore not possible to take the analysis of OTS data any further.

7.3.4 Target population

This section combines the in-depth data sources with Stats19 to provide an estimate of the number of accidents that are likely to be affected by a change to the speed limit (target population). However, before carrying out this part of the analysis it is important to understand how the distribution of accidents in the HVCIS sample compares with the national data (Stats19). Table 7.4 compares the distribution by accident types of the two data sources. The percentages refer to all fatal accidents recorded in the databases and not only those on single carriageway roads with a 60mph speed limit.

[2] One accident where injury severity was unknown has been excluded from the results.

Table 7.4: Comparison of accident distributions for Stats19 and HVCIS

Accident type	Stats19	HVCIS
Single vehicle	2.4%	2.6%
Multiple vehicle	27.4%	35.4%
Any vehicle in accident overtaking	7.2%	-
HGV being overtaken	-	2.9%

Only two of the three accident types are currently directly comparable and it appears that the HVCIS sample over-represents the accidents involving multiple vehicles. However this is likely to be accounted for by the difference in definitions of the "overtaking" accident group, with the Stats19 group including some accidents classified in HVCIS as multiple vehicle accidents rather than accidents where the HGV is being overtaken.

It was not possible to confidently separate accidents where the HGV was being overtaken from accidents where any vehicle was being overtaken in Stats 19. Therefore, in order to account for the difference in the definitions of the accident groups, the relationship between the two groups was identified using the HVCIS fatal accident database. The analysis showed that there were 83 accidents in the sample that involved an HGV21 on a single carriageway, 60mph road, where any vehicle in the accident was overtaking. For the same sample, 40 accidents involved the HGV21 being overtaken. Therefore, it can be estimated that 46% of the Stats 19 group of accidents where any vehicle is overtaking are actually accidents where the HGV21 is being overtaken. This results in a Stats19 group of accidents where the HGV being overtaken comprising of 129 fatal, 371 serious and 949 slight injury accidents.

The remaining 54% of the any vehicle overtaking group (151 fatal, 437 serious and 1114 slight accidents) are therefore multiple vehicle accidents. However, because there are no specific accident records for these accidents (they are merely a proportion of a group of accidents) it was not possible to group the accidents by first point of impact. Therefore these accidents have been added to other/unknown first point of impact group for multiple vehicle accidents. However, it is possible that this could result in the target population being under-estimated. Table 7.5 shows the distribution of accident types for Stats19 and HVCIS following this adjustment process.

Table 7.5: Updated comparison of accident distributions for Stats 19 and HVCIS

Accident type	Stats 19		HVCIS	
Single vehicle	93	2.4%	36	2.6%
Multiple vehicle	1212	31.3%	495	35.4%
HGV being overtaken	129	3.3%	40	2.9%

The number of cases from the OTS database was insufficient to provide an appropriate estimate of the speed distribution for non-fatal accidents. In the absence of any alternative source of data, it has been assumed that the speed distribution for non-fatal accidents is the same as that for the fatal accidents.

The proportion of accidents from HVCIS where the HGV21 was travelling between 36 and 44mph has been multiplied by the number of accidents within the relevant accident type from Stats 19. The total has then been divided by the number of years that the Stats19 data covered (10) to provide an annual average number of accidents. The results from this process are shown in Table 7.6 and represent the estimated annual target populations for GB based on Stats 19 and HVCIS fatal accident data.

Table 7.6: Estimated annual target populations for GB based on Stats19 and HVCIS fatal accident data

Accident type		Number of fatal accidents	Number of serious accidents[3]	Number of slight accidents[3]
Multiple vehicle	Front	25	54	162
	Rear	-	-	-
	Side	4	19	74
	Other/unknown	-	-	-
Single vehicle	Pedestrian	2	2	2
	Non-pedestrian	1	8	34
Overtaking		4	12	32
Total		36	95	304

7.3.5 Assessing the effect of changing speed limit

For each group of accidents that are likely to be affected (target population), in-depth cases were reviewed to identify the main accident characteristics and the likely effect of changing the speed limit for the HGV21. The following questions were considered:

- Would the accident have been less likely to have occurred? Would the accident have been likely to have occurred anyway? Would more of these types of accident have been likely to have occurred?
- Would the severity of the accident have been likely to have been reduced? Would the severity of the accident have been likely to have been unchanged? Would the severity of the accident have been likely to have been increased?

This second question is very difficult to answer, particularly as the majority of in-depth cases are related to fatal accidents. For each group of accidents within the target population the following sections discuss the potential effect on accident frequency and severity based on the evidence available.

Multiple vehicle – frontal

There are details of 111 fatal accidents within this group. Reviewing the accident descriptions allowed the accidents to be categorised as follows:

- The other vehicle failed to give way junction (17)
- The other vehicle lost control (oversteer/spin) (31)
- The other vehicle was travelling in the wrong lane (overtaking/drifted/understeer) (47)
- HGV collided with rear of other vehicle (4)
- HGV crossed into oncoming lane (6)
- Other (relating to actions of other vehicle) (6)

All but 10 of these accidents were caused by the actions of the drivers of the other vehicles involved. It is therefore unlikely that increasing the speed limit will have an effect on 91% of these accidents. It should be noted that these are 91% of the fatal accidents in which the front of the HGV21 vehicle was involved. Most are accidents in

[3] Assuming the same speed distribution for non-fatal accidents as for fatal accidents.

which the HGV21 vehicle was not the primary cause of the accident and there were only 4 accidents in which an HGV21 shunted another vehicle.

It is also worth noting that Advanced Emergency Braking Systems (AEBS) are to be mandatory for heavy goods vehicles and the technical specifications are currently under discussion in Europe. These systems are intended to increase the braking effort or to apply the brakes automatically in emergency situations and are intended to prevent accidents where a heavy goods vehicle runs into the rear of another vehicle. It is currently being debated if the systems will be required to detect the presence of stationary vehicles ahead where the largest benefits can be achieved (Grover et al, 2008).

The accidents where the actions of the HGV driver were contributory, involved the HGV failing to react or reacting late to vehicles ahead, overtaking, losing control under braking or crossing into the oncoming lane for another reason. It is unlikely that any of these accidents would have been avoided if the speed limit was 45 or 50mph.

These accidents are all fatal and therefore the severity cannot increase. However, it is possible that the number of casualties per accident might increase.

In the absence of a sufficient number of detailed accident cases for non-fatal injuries, the effect on severity can only be considered theoretically, using the knowledge gained from the fatal accidents and other data sources. Injury risk curves are often used to determine the effect of changes in impact conditions. Such curves are available for passenger cars (Figure 7.4), but no equivalent is available for HGV accidents. However, it is possible to use the curves for passenger cars to illustrate potential implications of increasing the speed limit for HGVs.

The solid lines in Figure 7.4 represent central estimates and the dashed lines represent the 95 per cent confidence intervals.

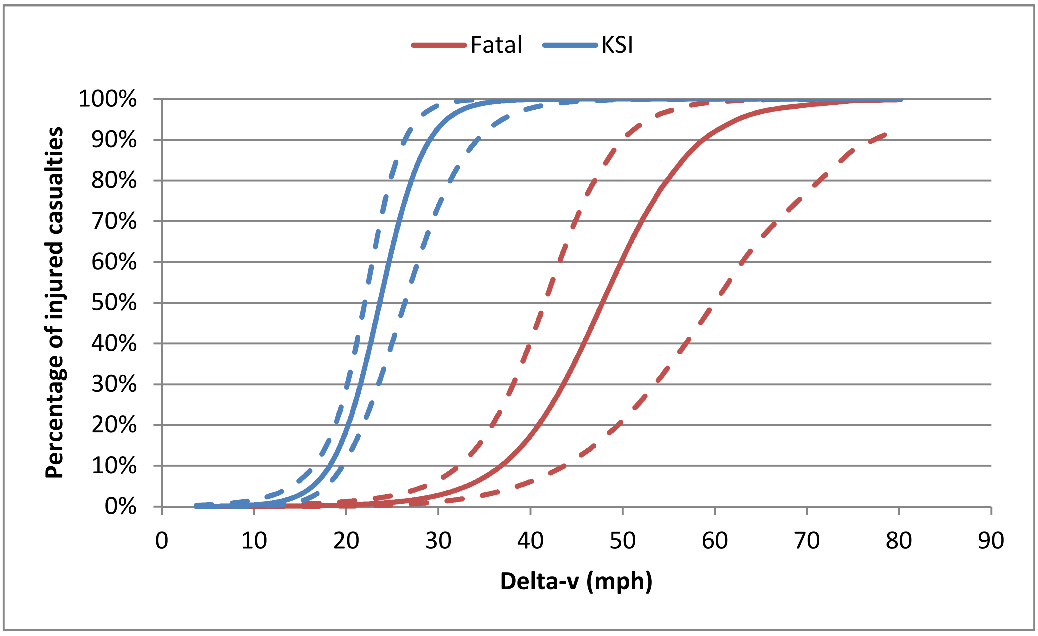

Figure 7.4: Speed injury risk curve for car drivers in frontal impacts with other cars

Delta-v is the change in speed of the vehicle. Therefore, if two cars of equal mass are both travelling at 30mph and come to rest on impact, then delta-v is 30mph. The risk of sustaining a fatal injury would be approximately 2% and risk of sustaining a fatal or serious injury would be approximately 98%.

In contrast, a car travelling at 60mph in a head-on collision with a 44 tonne HGV travelling at 40mph would lead to a delta-v of 96mph for the car. If this delta-v was attributed to a car-car impact it would be a 100% risk of fatal injury. Increasing the speed of the HGV to 50mph would have a minimal effect. However, this can be considered a worst case because it assumes that the HGV is not braking prior to impact, although the analysis has shown that a number of accidents involve HGV travelling at speeds in excess of the speed limit.

If the HGV braked for 20 metres prior to the impact on a dry road at a deceleration of 0.6g (type approval requires 0.5g), then the impact speed would be 21mph and 37mph for travel speeds of 40mph and 50mph respectively. This would result in a delta-v of 77mph and 93mph for a 44 tonnes HGV if they had been travelling at 40mph and 50mph respectively and braked prior to impact as stated above. If the HGV had a gross vehicle weight of 12 tonnes, then the delta-v would be 69mph and 83mph respectively if they had the same braking performance. If these delta-v occurred in a car to car impact it would still have been 100% risk of injury.

This analysis suggests that an increase in the speed limit from 40mph to 50mph could lead to an increase in delta-v of as much as 15mph though the likely increase would be considerable less. In any case, to determine how this will affect accident risk, injury risk curves would be required for HGV to car impacts. Unfortunately, these do not exist at present.

Multiple vehicle – side

From the 18 accident descriptions the accidents can be grouped as follows:

- Other vehicle lost control (3)
- Cyclist riding off footpath (2)
- HGV moving into oncoming lane (4)
- Other vehicle in oncoming lane (7)
- Impact with detached HGV trailer (1)
- Loss of control induced by wind (1)

As with the frontal impacts, the majority of the accidents are caused by the actions of the non-HGV drivers. Increasing the speed limit is again unlikely to affect the cause of the majority of these accidents. There could potentially be an increase in accidents involving detached trailers or the wind-induced loss of control, but this is not possible to quantify.

Although speed injury risk curves are available for car to car side impacts as they were for frontal, it is not possible to do a similar analysis because there is a greater variation in the types of impact that are occurring. There are more cases of side-swipe accidents for which the calculations are not as appropriate.

Single vehicle – pedestrian

Four of the six pedestrian accidents involved the pedestrian walking or standing in the road. One involved a pedestrian who had fallen into the road and the sixth accident involved a pedestrian crossing the road. The speed at which the HGV was travelling was unlikely to have affected the outcome of these accidents.

Figure 7.5 shows the cumulative frequency of fatal pedestrian accidents according to the HGV impact speed for collisions involving an HGV and a pedestrian. It is clear that approximately 70% of pedestrian collisions occur below 64km/h (40mph), suggesting that impact speed is only one factor in HGV-pedestrian collisions. Equivalent data for non-fatal injuries is not available for comparison.

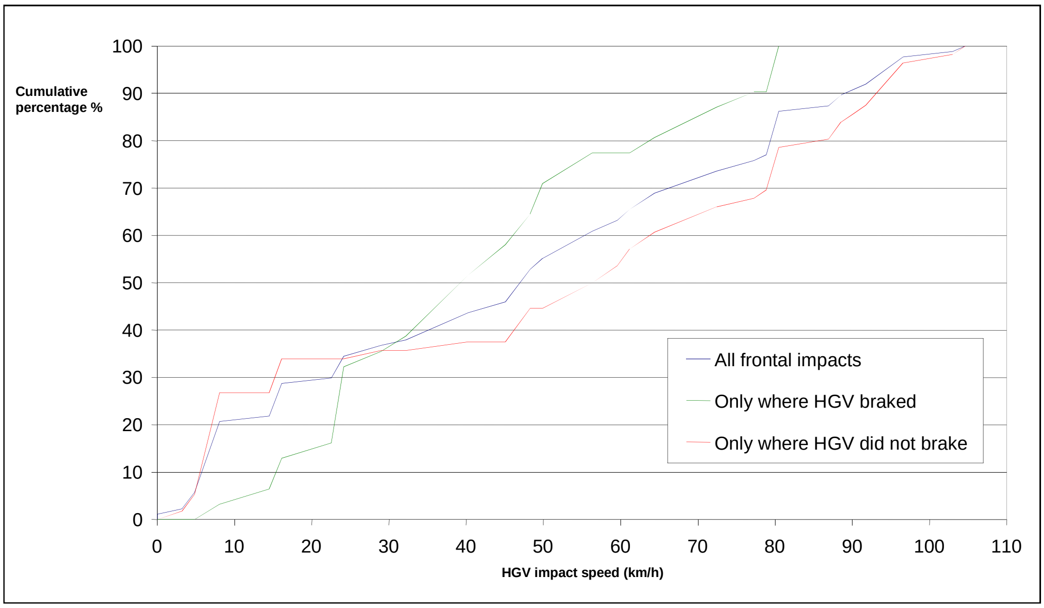

Figure 7.5: Cumulative frequency of fatal pedestrian accidents according to HGV impact speed (Smith, 2008)

Single vehicle – non-pedestrian

The two single vehicle accidents involved the HGV drifting to the nearside of the road. In one accident the driver reacted, but over-corrected the steering, in the second, the HGV went down a bank. Both of these accidents were not related to the speed the HGV was driving and therefore increasing the speed limit was unlikely to have changed the likelihood of these accidents occurring.

One effect of increasing the speed limit may be to increase the risk of accidents where an HGV rolls over. There are no instances of rollover in the speed category reviewed above. However, three of the four accidents in the higher speed category (>44mph) involved rollover. The travel speeds of these vehicles were 53mph, 58mph and 63mph. If a speed limit of 50mph was implemented, it is possible that there could be an increase in vehicles travelling at critical speeds round bends. However, it is not possible to quantify this further within the scope of this study.

The performance of an HGV cab is often tested at low speeds (<30km/hr). Therefore it is likely that the change in deformation between impacts at 40mph and 50mph is unlikely to have significant effect on the severity of injuries to the occupants of the HGV.

HGV being overtaken

The group of accidents where the HGV was being overtaken is the group of accidents where it was anticipated that the greatest effect on accident frequency would be found. Increasing the speed of the HGV could reduce the number of accidents where the HGV is being overtaken.

In order to make a judgement about the likelihood of the overtake still taking place if the speed of the HGV is increased to 50mph, some criteria had to be set:

- If the travel speed of the overtaking vehicle is less than 55mph then the overtake would not go ahead;
- If the travel speed of the overtaking vehicle was between 55 and 65mph inclusive then the overtake may go ahead;

- If the travel speed of the overtaking vehicle exceeded 65mph then the overtake would go ahead; and
- If the travel speed was unknown, but reckless and/or excessive speed had been coded as a driver behaviour factor then the overtake would also go ahead.

For each accident, a probability weighting was applied and the total score was calculated as shown in Table 7.7.

Table 7.7: Number of fatal overtaking accidents likely to be prevented

Overtaking vehicle travel speed (mph)	Driver behaviour reckless/excess speed	Number of accidents	Probability weighting	Score
<55	-	3	1	3
55-65 inclusive	-	1	0.5	0.5
>65	-	3	0	0
Unknown	Yes	3	0	0
Unknown	No	2	1	2
Total	-	12	2.5	5.5

This analysis suggests that 46% (5.5/12) of the overtaking accidents in this group would not have occurred if the speed limit for HGVs was 50mph. Although this analysis has provided an indication of the effect of changing the speed limit, it is based on a small number of cases and therefore should be treated with caution. A range for the effect of the change can be generated by assuming that the probability weighting is the same for all accidents (i.e. all accidents assigned probability of 0 and all accidents where there was a possible effect assigned 1). This results in a range of 0% to 54%. This effect is related to the occurrence of the accident and therefore although based on fatal accidents, this can also be applied to non-fatal accidents.

Although a reduction in the frequency of accidents involving an HGV21 being overtaken by another vehicle seems likely if the speed of the HGV21 was higher, an increase in the frequency of such accidents is also possible. Even if the frequency of overtaking was reduced, the overtaking that did occur would tend to be more risky owing to the increased time and distance required to conduct the overtaking manoeuvre.

The effect on the severity of overtaking accidents is difficult to judge because the speed of the overtaking vehicle is often more relevant than the speed of the HGV itself. It is not possible to identify from the accident data whether the speed of the overtaking vehicle would change.

Summary

Table 7.8 summarises the possible effects in terms of accident occurrence and severity for each of the target populations.

Table 7.8: Summary of possible effects

Accident type	Number of accidents in HVCIS sample	Accident occurrence	Accident severity
Multiple vehicle – front	111	Minimal	Unclear – although possible 15% increase in delta-v
Multiple vehicle – side	18	Minimal but possible increase	Unclear
Single vehicle – pedestrian	2	Minimal	Unclear – although majority of fatal accidents occur at impact speeds below 40mph
Single vehicle – non-pedestrian	1	Possible increase in rollover accidents – not quantified	Minimal
Overtaking	12	Reduction likely but increase possible	Unclear but increase possible

7.3.6 Discussion

In order to fully assess the potential safety risk of increasing the speed limit of HGVs on single carriageway de-restricted roads, large samples of accident data for all injury severities would need to be combined with behavioural studies, traffic flow simulations and injury risk curves. However, not all this data is available and other information sources would require extensive research outside the scope of this study.

Although it has not been possible to quantify all the effects of changing the speed limit, reviewing the types of accident that occur has enabled a subjective view as to the likely effects for each group of accidents. For the largest target population (multiple vehicle – front) there is likely to be a minimal effect on the occurrence of such accidents if the speed limit were increased. There is a potential risk that there could be an increase in delta-v which may affect the severity of the non-fatal accidents, but this is dependent on the existing change in velocity of the vehicles involved in non-fatal accidents, of which there is insufficient information.

Notwithstanding the limitations of the data available, it has been possible to estimate the number of accidents that could be affected by changing the speed limit. This number of accidents was estimated by applying the proportion of HGV21 vehicles that were travelling at speeds between 36 and 44mph in the HVCIS fatal accident sample to the groups of accidents identified in Stats 19. It was estimated that there were 36 fatal accidents per year where an HGV21 vehicle was travelling at a speed between 36 and 44mph on a single carriageway road with a 60mph speed limit. This estimate represents the maximum number of fatal accidents that might be affected by a change in the speed limit. However, a careful inspection of the characteristics of accidents in the HVCIS sample suggests that an increase in HGV21 speed would be likely to affect only a small proportion of these fatal accidents.

The information for fatal accidents has been applied to non-fatal accidents, however, there is some uncertainty about the appropriateness of assuming the same speed distribution for the HGVs involved in non-fatal accidents as for fatal accidents. However, given this assumption, it is estimated that the maximum numbers of serious and slight injury accidents per year that might be affected by a change in the speed limit are 95 and 304 respectively. Again, it is considered that only a small proportion of these might be affected by a change in the speed limit.

8 Distance and time requirements for overtaking

8.1 Background

The opportunity for a car to overtake a heavy goods vehicle depends on many factors and one of the more important of these is the speed of the heavy goods vehicle.

If the speed limit for heavy goods vehicles with gross vehicle weight exceeding 7.5 tonnes were to be raised, then it may be expected that the speed of these vehicles would also increase. It is of interest to consider what effect such an increase in speed may have on a car wishing to overtake a heavy goods vehicle on a single carriageway road with an overall speed limit of 60mph.

Overtaking manoeuvres can be either 'accelerative' or 'flying'. Often a faster vehicle slows to the speed of a vehicle in front whilst the driver waits for an opportunity to overtake. Once an opportunity becomes available the overtaking vehicle accelerates past the slower vehicle. This is termed 'accelerative' overtaking. By contrast a 'flying' overtake is one in which the overtaking vehicle does not slow before overtaking but overtakes at a speed similar to its approach speed.

The following analyses will be based on an 'accelerative' overtaking manoeuvre since these will be the more common except at low traffic flow and on a relatively straight section of road.

On single carriageways, opportunities to overtake may be constrained by vehicles approaching from the other direction or by sight distances. Whether the driver can make use of the opportunities presented depends on driver and vehicle characteristics, on the speed of the vehicles involved and on the road geometry, particularly sight distance.

Three approaches are considered. The first is based on calculations of the time and distance required to overtake based on the laws of motion. The second is based on the results of a previous study (Maycock, Brocklebank and Hall, 1998) of the probability of overtaking using data obtained from the TRL car driving simulator and from on-road observations. The third is based on a study of overtaking behaviour on a road in South Wales conducted by Hunt and Mahdi (1992).

The three approaches and the main findings are briefly presented here. Appendix A presents a more detailed description of the analyses and a comparison of their findings.

8.2 Analysis based on the laws of motion

The accelerative performance of a 1600cc Honda Civic car as driven by a test subject on the TRL car driving simulator was used to estimate the time and distance required to overtake heavy goods vehicles. This test subject drove the car from an emergency refuge area into the nearside lane of a busy motorway. The urgency of getting up to speed in these conditions is considered to be likely to be similar to that which occurs when overtaking on a single carriageway road. It was assumed that the car would not accelerate to a speed beyond 70mph.

The analysis considered a range of determining variables: heavy goods vehicle length; heavy goods vehicle speed; speed of oncoming vehicle travelling in the opposite direction; following headway adopted by the car prior to acceleration; leading headway adopted by the car after completion of the overtaking manoeuvre; safety time headway between the time when overtaking is completed and the time of arrival of the opposing vehicle.

The time to draw alongside the heavy goods vehicle varies from 3.6sec for a following headway of 1sec when the speed of the heavy goods vehicle is 35mph to 15.1sec for a following headway of 3sec and when the speed of the heavy goods vehicle is 55mph. The corresponding times to complete overtaking are 4.7sec and 19.2 sec respectively. The distance to complete overtaking are 118m and 603m respectively and the corresponding sight distance requirements are 298m and 1,172m respectively.

8.3 Probability of overtaking based on car driving simulator and on-road observations

(Maycock, Brocklebank and Hall, 1998) studied accelerative overtaking behaviour on the TRL car driving simulator and on public roads.

The studies on public roads are of most interest here and hence those on the TRL car driving simulator will not be described further. The results from the latter were broadly similar to those obtained from public roads.

A straight section of road with a bend at either end was selected for the study. A instrumented vehicle was parked in a layby until a vehicle travelling in the sqame direction approached. The instrumented vehicle then led the following vehicle onto the straight section of the road. The instrumented vehicle maintained a constant speed along the straight section. Details of the overtaking opportunities available to the driver of the following vehicle were recorded, whether or not overtaking took place and if it did, the time and distance over which overtaking occurred.

The average gap in the oncoming traffic (or the sight distance) increased by 35m for each 1m/sec increase in the speed of the overtaken vehicle; was 224m less for drivers who drove 10,000 miles a year or more; was 119m greater for female drivers than for male drivers; and was 66m greater if the driver was 45 years of age or older.

8.4 Observations of overtaking on a section of road in South Wales

Hunt and Mahdi (1992) observed overtaking on a 1,175m overtaking section of the A4059 road between Mountain Ash and Aberdare in South Wales. The road was single carriageway with 1.2m footways and had a design speed of 80kph (50mph). The section was straight and level providing unrestricted sight distances. The adjacent sections were not suitable for overtaking and were bendy, which helped in the formation of platoons and increased the demand for overtaking in the chosen section. Behaviour was recorded and measured using video cameras located on the summit of a nearby hill.

The distance gap (gap in the oncoming traffic) required for a car to overtake an HGV travelling at 45mph was about 50m greater and at 50mph was about 110m greater than when overtaking an HGV travelling at 40mph. The distance travelled by a car when overtaking an HGV travelling at 45mph was about 30m greater and at 50mph was about 70m greater than when overtaking an HGV travelling at 40mph. The time taken by a car to overtake an HGV travelling at 45mph was about 0,5sec longer than when overtaking an HGV travelling at 40mph.

9 Heavy goods vehicle braking performance

An increase in the speed of a vehicle will lead to an increase in the distance required for that vehicle to stop. The technical performance of a braking system for heavy goods vehicles and their trailers used in Europe is outlined in EC Directive 71/320/EEC and UNECE Regulation 13. Type-approval sets a minimum standard for brake performance and there are voluntary industry standards that set out different test methods but not performance requirements. This section of the report describes the type-approval requirements and in-service performance of HGVs over 7.5t and discusses the effect on stopping distances of increasing the travel speed from 40mph to 50mph

9.1 European type-approval requirements

The performance of the braking systems for category N2 and N3 vehicles (goods vehicles exceeding 3.5t, excluding trailers) is measured in terms of:

- the vehicle stopping distance – the distance travelled by the vehicle from the instant when the driver begins to actuate the control of the system until the instant when the vehicle stops; and
- the mean fully developed deceleration – the average deceleration during the interval between 80% and 10% of the vehicles initial speed.

There are three test conditions:

- Type-0 Cold brake performance test both with the engine connected (in gear) at 60km/h and disconnected (out of gear) at 50km/h for vehicles with a mass not greater than 12tonnes and 40km/h for those over 12tonnes.
- Type-I Hot brake performance test which examines the decrease in service brake torque and stopping performance as the temperature of the brakes increases. This involves repetitive braking manoeuvres prior to the Type-0 test with engine disconnected. The MFDD must be at least 80% of the requirement for the Type-0 test and at least 60% of the vehicles own result from the Type-0 test.
- Type-II Downhill behaviour test which involves the vehicle being subjected to an energy input equivalent to a laden vehicle driven at an average speed of 30km/h on 6% down gradient for a distance of 6km before being subjected to the Type-0 test with the engine disconnected.

Table 9.1 shows the performance requirements for the Type-0 and Type-II tests.

Table 9.1: Brake performance requirements for HGVs.

Engine	Performance measure	Type-0	Type-II
Disconnected	Stopping distance (m)	$0.15v+v^2/130$	$0.15v+1.33v^2/115$
	MFDD (m/s)	5.0	3.3
Connected	Stopping distance (m)	$0.15v+v^2/103.5$	
	MFDD (m/s)	4.0	

For vehicles fitted with ABS the vehicle must use at least 75% of the available adhesion during a braking manoeuvre. Tests are also carried out at speeds of 40km/h and up to 80km/h on high adhesion surface and 70km/h on a low adhesion surface to ensure that wheels controlled by the ABS do not lock when full force is applied to the control.

Performance requirements for category O vehicles (trailers) are defined separately but are based around a braking efficiency of between 45% and 50%. There are also some additional requirements. The following section describes the in-service performance of a range of vehicles including those towing trailers, illustrating the overall performance of a tractor-semitrailer combination.

9.2 In-service performance

Knight et al (2002) performed a series of straight line braking tests based on the Type-0 test using a range of HGVs. These tests were carried out with the engine disconnected.

Table 9.2: Vehicle specifications and test results from tests at 60km/h on a dry surface (Knight et al, 2002).

Vehicle		Brake system		Stopping distance (m)	Mean fully developed deceleration (m/s^2)
Reference	**Combination**	**Tractor**	**Semi-trailer**		
1	2-axle tractor and 2-axle semi-trailer	Air operated drum with ABS	Air operated drum with ABS	35.1	6.1
2	2-axle tractor and 3-axle semi-trailer	Air operated drum with ABS	Air operated disc with ABS	34.7	5.9
3	3-axle tractor and 2-axle semi-trailer	EBS disc	Air operated drum with ABS	37.1	5.4
4 (laden)	3-axle tractor and 3-axle semi-trailer	EBS disc	Air operated disc with ABS	27.7	7.6
4 (unladen)	3-axle tractor and 3-axle semi-trailer	EBS disc	Air operated disc with ABS	29.9	6.5
5	2-axle rigid (12t)	Air operated disc/drum no ABS		43.5	4.7
6	3-axle rigid (26t)	Air operated disc with ABS		42.1	5.3

The stopping distances ranged from 27.7m to 43.5m, with three of the vehicles exceeding the 36.7m which is set out in EC Directive 71/320/EEC and UNECE Regulation 13. The prescribed limit of $5m/s^2$ for the MFDD was achieved by all vehicles except the 2 axle rigid vehicle. This data shows that the shortest stopping distance and highest MFDD was achieved for the laden 3-axle tractor unit with 3-axle semi-trailer which was equipped with an electronic braking system (EBS).

Figure 9.1 shows how the stopping distance changes with test speed for the range of vehicle types tested. Changing the speed from 40mph to 50 mph is equivalent to 64km/h to 80km/h.

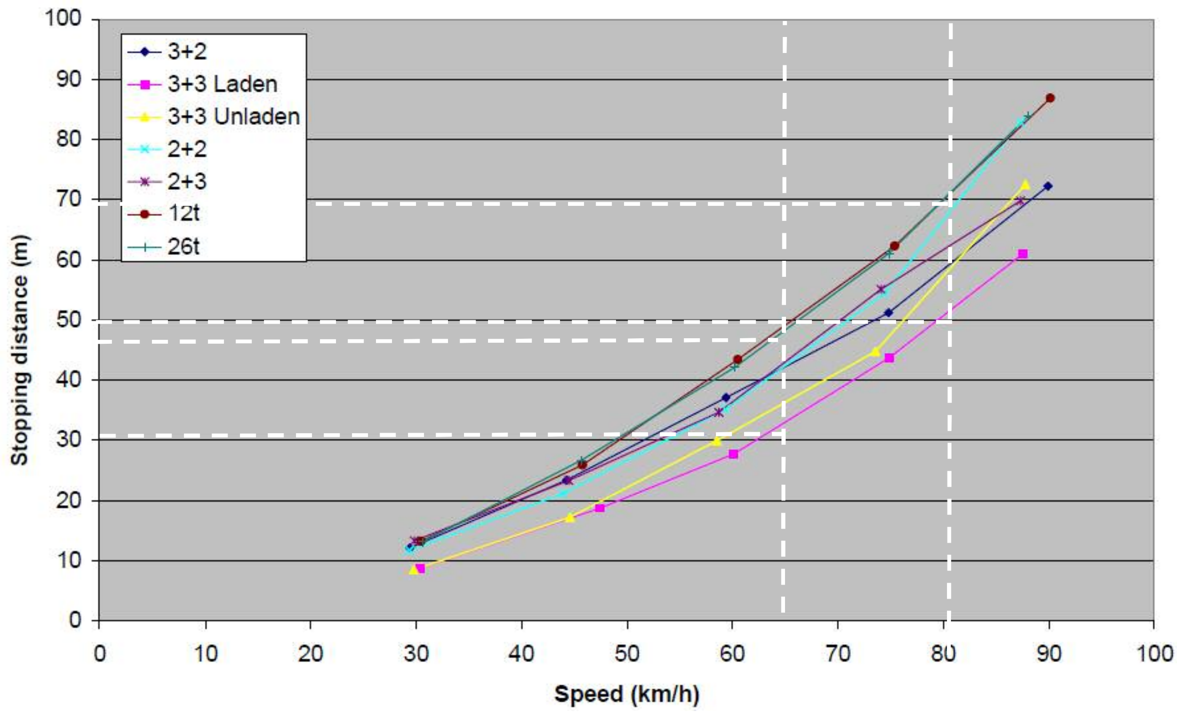

Figure 9.1: Comparison of stopping distance with speed on a dry surface for different types of vehicle and braking systems.

It can be seen from Figure 9.1 that this would result in an increase in stopping distance of 22m from 48m to 70m for the worst performing vehicle. However the increase in stopping distance for the vehicle with the shortest stopping distance was 18m (from 32m to 50m). The stopping distance for the laden 3+3 combination with EBS at 80km/h was approximately 3m greater than the worst performing vehicle at 64km/h. Electronic braking systems (EBS) reduce the reaction time within the braking system, improve the distribution of the braking force between the wheels and also incorporate self-diagnostic capability. The effect of EBS is an important consideration when looking at the potential effect of increasing the speed limit from 40mile/h to 50mile/h. Currently EBS is not mandatory for HGVs, however many new vehicles are voluntarily equipped with it now and it will soon become mandatory to fit electronic stability control (ESC) to HGVs. All current ESC systems are only available for EBS equipped vehicles so it is likely that mandating ESC will result in almost 100% fitment of EBS without any further specific requirements.

10 Discussion

This section draws together the discussions related to the previous sections of the report and seeks to identify some overall conclusions.

10.1 Contributory factors

If the speed limit for HGV21 vehicles was raised to 50mph it could be argued that these vehicles might be expected to have a similar involvement in accidents to HGV20 which have a speed limit of 50mph. The counter argument might be that HGV21 vehicles are heavier and many are articulated.

The CF analysis for link accidents indicates that a greater percentage (1.7 per cent) of HGV21 vehicles are recorded as 'exceeding the speed limit' compared with HGV20 vehicles (0.7 per cent). It may be that this is simply a recognition of the fact that the speed limit for HGV21 vehicles is lower than for HGV20 vehicles whilst the average travel speeds for these classes of vehicle are similar.

There was no material difference between the percentage of HGV21 (4.9 per cent) and HGV20 (5.2 per cent) recorded as 'travelling too fast for conditions'. This suggests that the influence of speed in accident involvement is similar for HGV21 and HGV20 vehicles. This is not surprising given that their average speeds are similar.

A lower percentage (1.7 per cent) of HGV21 vehicles were recorded as having 'swerved' than HGV20 vehicles (2.9 per cent). A possible explanation may be that swerving is a behaviour which is avoided by the drivers of HGV21 vehicles many of which are articulated.

The CF analysis for junction accidents revealed no material difference for speed related CFs between HGV21 and HGV20 vehicle involvements.

Raising the speed limit for HGV21 vehicles to 50mph would make legal the speeds that most of them currently adopt. They already travel on average close to the speeds of HGV20 vehicles and it seems unlikely that an increased speed limit would encourage them to travel faster than HGV20 vehicles. Thus the maximum potential increase in the average speed would be about 3mph and the actual change in average speed could well be less. However, any increase in speed is likely to increase the numbers of accidents, except perhaps those involving the overtaking of HGVs by other vehicles.

10.2 Heavy goods vehicle accident characteristics

Material differences between the proportions by type of accident involving HGV21 and HGV20 vehicles occur only for single vehicle accidents (which is marginally lower for HGV21 vehicles for all severities of accident) and overtaking accidents (which is higher for HGV21 accidents).

However, the number of fatal accidents involving another vehicle overtaking an HGV21 vehicle is not large (only about 5 per year) so this represents the maximum potential benefit that might occur for this type of accident if the HGV21 speed limit was raised. It is even possible that raising the speed limit would increase the numbers of this type of accident since even if the number of overtaking manoeuvres was reduced each one might carry a higher risk than at present as might their severity.

The percentage of fatal accidents involving HGV21 vehicles (7.2 per cent) is notably greater than for HGV20 vehicles (4.7 per cent) and so is the percentage of serious injury accidents (21.4 per cent for HGV21 and 18.2 per cent for HGV20). This is the case for all the major types of accident.

This does necessarily imply that if HGV21 speeds increased the severity of the accidents involving them would increase (though it is hardly likely to reduce).

It is concluded that the relative frequency of accidents of various types is similar for HGV21 and HGV20 vehicles, but the severity of accidents involving HGV21 vehicles is higher than for HGV20 vehicles. This may be mainly attributable to their greater weight.

10.3 Collision data review

In order to fully assess the potential safety risk of increasing the speed limit of HGVs on single carriageway de-restricted roads, large samples of accident data for all injury severities would need to be combined with behavioural studies, traffic flow simulations and injury risk curves. However, not all this data is available and other information sources would require extensive research outside the scope of this study.

Although it has not been possible to quantify all the effects of changing the speed limit, reviewing the types of accident that occur has enabled a subjective view as to the likely effects for each group of accidents. For the largest target population (multiple vehicle – front) there is likely to be a minimal effect on the occurrence of such accidents if the speed limit were increased. There is a potential risk that there could be an increase in delta-v which may affect the severity of the non-fatal accidents, but this is dependent on the existing change in velocity of the vehicles involved in non-fatal accidents, of which there is insufficient information.

Notwithstanding the limitations of the data available, it has been possible to estimate the number of accidents that could be affected by changing the speed limit. This number of accidents was estimated by applying the proportion of HGV21 vehicles that were travelling at speeds between 36 and 44mph in the HVCIS fatal accident sample to the groups of accidents identified in Stats 19. It was estimated that there were 36 fatal accidents per year where an HGV21 vehicle was travelling at a speed between 36 and 44mph on a single carriageway road with a 60mph speed limit. This estimate represents the maximum number of fatal accidents that might be affected by a change in the speed limit. However, a careful inspection of the characteristics of accidents in the HVCIS sample suggests that an increase in HGV21 speed would be likely to affect only a small proportion of these fatal accidents.

The information for fatal accidents has been applied to non-fatal accidents, however, there is some uncertainty about the appropriateness of assuming the same speed distribution for the HGVs involved in non-fatal accidents as for fatal accidents. However, given this assumption, it is estimated that the maximum numbers of serious and slight injury accidents per year that might be affected by a change in the speed limit are 95 and 304 respectively. Again, it is considered that only a small proportion of these might be affected by a change in the speed limit.

10.4 Braking performance

An increase in the speed of a vehicle will lead to an increase in the distance required for that vehicle to stop. The technical performance of a braking system for heavy goods vehicles and their trailers used in Europe is outlined in EC Directive 71/320/EEC and UNECE Regulation 13. Type-approval sets a minimum standard for brake performance and there are voluntary industry standards that set out different test methods but not performance requirements.

Advanced Emergency Braking Systems (AEBS) are to be mandatory for heavy goods vehicles and the technical specifications are currently under discussion in Europe. These systems are intended to increase the braking effort or to apply the brakes automatically in emergency situations and are intended to prevent accidents where a heavy goods vehicle runs into the rear of another vehicle. It is currently being debated if the systems will be required to detect the presence of stationary vehicles ahead where the largest benefits can be achieved.

10.5 Distance and time requirements for overtaking

Studies have allowed the effect of the speed of the overtaken vehicle on the size of gap required for overtaking, the distance travelled whilst overtaking and the time taken to overtake to be quantified. They also provide an indication of the extent to which these variables are sensitive to whether a car or a heavy goods vehicle is being overtaken.

The study by Maycock et al shows how the probability of overtaking increases with the size of the gap available to do so. However, it seems unlikely that some drivers would overtake regardless of how large the gap might be, especially when following a heavy goods vehicle travelling at a relatively high speed. The study did not address this issue. Furthermore the study was based on the overtaking of a car not a heavy goods vehicle. That said the study by Hunt and Mahdi suggests that the overtaking requirements, durations and times are not substantially extended when heavy goods vehicles are overtaken, i.e. only 2-3 seconds if HGV speeds increased from 40mph to 50mph.

10.6 Further thoughts

The focus of this study has been to estimate the likely effects of an increase in the speed limit for heavy goods vehicles with gross weight exceeding 7.5 tonnes based on information about accidents involving these vehicles.

Any increase in the speed of these heavy goods vehicles may influence the speed of other vehicles in the traffic stream. The extent of this was not known until recently but a study based on micro-simulation modelling of a section of the A9 in Scotland has estimated that if the speed limit was increased to 50mph, the speed of the traffic as a whole would be expected to increase by about 1mph. There was variation in the effect between locations and evidence that the increase was greater at those locations where the existing speed was lower. Given that speeds on the A9 are relatively high compared to the average for rural roads with 60mph speed limits in GB, it seems likely that the effect on the speed of the traffic on GB roads would be greater than 1mph (even though the proportion of heavy goods vehicles on the A9 is high).

The scope of the A9 study did not permit a relationship between increased overall traffic speed, the existing traffic speed and the proportion of heavy goods vehicles to be developed. A multiple regression analysis of the data to establish such a relationship may be useful since it now seems likely that the main effect of increasing the heavy goods vehicle speed limit would be its effect on accidents involving traffic as a whole travelling at a higher speed than previously.

11 Summary and conclusions

11.1 Introduction

The Department for Transport (DfT) commissioned the Transport Research Laboratory (TRL) to provide an evidence-base, analysis and reasoned opinion on whether or not there is likely to be any road safety risk involved in increasing the speed limit of HGVs exceeding 7.5 tonnes on single carriageway de-restricted roads from 40mph to 50mph (or possibly 45mph).

The findings are based on analyses of accident data held at TRL from the following sources: Stats19; On-The-Spot (OTS); and the Heavy Vehicle Crash Injury Study (HVCIS). Additional analysis was based on studies of the time and distance required to conduct overtaking manoeuvres.

11.2 Analysis of Stats 19 contributory factors

The characteristics of link accidents are different from those of junction accidents and the percentage of vehicles that occur on links is different for the various types of vehicle so it was decided to analyse link and junction accidents separately.

11.2.1 Total link accidents

Of the 1,188 HGV20 vehicles 8 were recorded as exceeding the speed limit (0.67 per cent) whereas among the 3,387 HGV21 vehicles 56 were recorded as exceeding the speed limit (1.65 per cent). The difference between the two proportions was found to be statistically significant, that is, the probability of the two percentages coming from the same population is less than 0.05, so we can be 95 per cent sure that they are different (hence we can conclude that HGV21 vehicles involved in accidents are more often reported as exceeding the speed limit than are HGV20 vehicles). The difference between the proportions in which a vehicle swerved was statistically significant, insofar as the HGV21 vehicles involved in accidents were less of reported as having swerved than HGV20 vehicles.

11.2.2 Total junction accidents

The differences between the speed related contributory factors for HGV20 and HGV21 vehicles were tested for statistical significance using a test comparing proportions. None of the differences were statistically significant.

11.2.3 Accident severity

Although it was possible that analysing the speed related contributory factors according to severity would provide useful further insights, the results proved to be disappointing. The only statistically significant differences are for slight injury accidents and total injury accidents on links where more HGV21 vehicles were recorded with contributory factor 306 (exceeding speed limit) than would be expected but fewer with contributory 409 (swerved) than would be expected.

11.3 Vehicle involvement rates

Based on vehicle counts obtained from 26 ATC sites operated by DfT on single carriageway roads with a 60mph speed limit, light goods vehicles, HGV20 and HGV21 all had a lower injury accident involvement rate than the car/taxi/minibus group. However, published DfT involvement rates for rural roads (which includes dual carriageways) indicate that the involvement rate for heavy goods vehicles (no distinction is made between HGV20 and HGV21 vehicles) is similar to that for cars. The rate for light goods vehicles is substantially lower than for either heavy goods vehicles or cars. The reasons for the differences between the rates obtained using the DfT ATC site and the published DfT data for rural roads are unclear; the DfT rates are based on sites which may not be representative of all none built-up single carriageway roads.

11.4 Characteristics of heavy goods vehicle accidents

The characteristics of heavy goods vehicle accidents were evaluated to obtain a greater understanding of the types of accident and which are the more common. This can provide a better insight into what the effects of changing the speed limit for HGV21 vehicles might be. Plain anguage descriptions from the HVCIS database were used for this purpose.

Material differences between the proportions by type of accident involving HGV21 and HGV20 vehicles occur only for single vehicle accidents (which is marginally lower for HGV21 vehicles for all severities of accident) and overtaking accidents (which is higher for HGV21 accidents).

However, the number of fatal accidents involving another vehicle overtaking an HGV21 vehicle is not large (only about 5 per year) so this represents the maximum potential benefit that might occur for this type of accident if the HGV21 speed limit was raised. It is even possible that raising the speed limit would increase the numbers of this type of accident since even if the number of overtaking manoeuvres was reduced each one might carry a higher risk than at present.

The percentage of fatal accidents involving HGV21 vehicles (7.2 per cent) is notably greater than for HGV20 vehicles (4.7 per cent) and so is the percentage of serious injury accidents (21.4 per cent for HGV21 and 18.2 per cent for HGV20). This is the case for all the major types of accident.

This does necessarily imply that if HGV21 speeds increased the severity of the accidents involving them would increase (though it is hardly likely to reduce).

It is concluded that the relative frequency of accidents of various types is similar for HGV21 and HGv20 vehicles, but the severity of accidents involving HGV21 vehicles is higher than for HGV20 vehicles.

11.5 Collision data review

The review considered the broad types of accident that involved heavy goods vehicles based on information from the OTS and HVCIS fatal accident databases. A proportion of the accident records in these databases have entries for the speed of the vehicles. These were used to estimate whether these accidents would be likely to have occurred with greater or less frequency and greater or less severity had the speed of the heavy goods vehicle been higher. The estimates were scaled using Stats 19 data to provide national estimates.

Table 11.1 summarises the possible effects in terms of accident occurrence and severity for each of the target populations.

Table 11.1: Summary of possible effects

Accident type	Number of accidents in HVCIS sample	Accident occurrence	Accident severity
Multiple vehicle – front	111	Minimal	Unclear – although possible 15% increase in delta-v
Multiple vehicle – side	18	Minimal but possible increase	Unclear
Single vehicle – pedestrian	2	Minimal	Unclear – although majority of fatal accidents occur at impact speeds below 40mph
Single vehicle – non-pedestrian	1	Possible increase in rollover accidents – not quantified	Minimal
Overtaking	12	Reduction likely but increase possible	Unclear but increase possible

In order to fully assess the potential safety risk of increasing the speed limit of HGVs on single carriageway de-restricted roads, large samples of accident data for all injury severities would need to be combined with behavioural studies, traffic flow simulations and injury risk curves. However, not all this data is available and other information sources would require extensive research outside the scope of this study.

Notwithstanding the limitations of the data available, it has been possible to estimate the number of accidents that could be affected by changing the speed limit. This number of accidents was estimated by applying the proportion of HGV21 vehicles that were travelling at speeds between 36 and 44mph in the HVCIS fatal accident sample to the groups of accidents identified in Stats 19. It was estimated that there were 36 fatal accidents per year where an HGV21 vehicle was travelling at a speed between 36 and 44mph on a single carriageway road with a 60mph speed limit. This estimate represents the maximum number of fatal accidents that might be affected by a change in the speed limit. However, a careful inspection of the characteristics of accidents in the HVCIS sample suggests that an increase in HGV21 speed would be likely to affect only a small proportion of these fatal accidents.

The information for fatal accidents has been applied to non-fatal accidents, however, there is some uncertainty about the appropriateness of assuming the same speed distribution for the HGVs involved in non-fatal accidents as for fatal accidents. However, given this assumption, it is estimated that the maximum numbers of serious and slight injury accidents per year that might be affected by a change in the speed limit are 95 and 304 respectively. Again, it is considered that only a small proportion of these might be affected by a change in the speed limit.

11.6 Distance and time requirements for overtaking

If the speed limit for heavy goods vehicles was increased and this led to an increase in speed of these vehicles, the distance and time required to overtake them would increase.

Three approaches were used to estimate the distance required to complete overtaking, the time required to complete overtaking and the distance gap required to allow a car driver to overtake a heavy goods vehicle safely in relation to the speed of the overtaken vehicle: an approach based on the laws of motion; a study of driver behaviour when overtaking a car on a driving simulator an on an actual road; and a study at a single site where cars overtook other cars and heavy goods vehicles.

The findings varied between the approaches especially in the estimated effect of the speed of the heavy goods vehicle. For an increase in the speed of the overtaken vehicle of 1mph the estimated increases in distance and time were as follows: 6m to 14m (distance required to complete overtaking); 0.06sec to 0.56sec (time required to complete overtaking); and 9m to 24m (distance gap required to overtake). Even if HGVs increased their speed from 40mph to 50mph only a further 2-3 seconds would be required for an overtake.

11.7 Heavy goods vehicle braking performance

An increase in the speed of a vehicle will lead to an increase in the distance required for that vehicle to stop. The technical performance of a braking system for heavy goods vehicles and their trailers used in Europe is outlined in EC Directive 71/320/EEC and UNECE Regulation 13. Type-approval sets a minimum standard for brake performance and there are voluntary industry standards that set out different test methods but not performance requirements.

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References

Department for Transport (2004). Instructions for the completion of road accident reports. Stats 20. London:DfT.

Department for Transport (2007a). How the National Road Traffic Estimates are made. London: DfT.

Department for Transport (2007b). Road Casualties Great Britain: 2006. London: DfT.

Department for Transport (2008). Transport Statistics Bulletin: Road Statistics 2007: Traffic, Speeds and Congestion: 2007. London: DfT.

Department for Transport (2009). Reported Road Casualties Great Britain: 2008. London: DfT.

Finch D J, Kompfner P, Lockwood C R and Maycock G (1994). Speed, speed limits and accidents. TRL Project Report PR58. Crowthorne: Transport Research Laboratory.

Grover C, Knight I, Okoro F, Simmons I, Couper G, Massie P and Smith B (2008). Automated Emergency Brake Systems: technical requirements, costs and benefits. TRL Report PPR227. Wokingham: Transport Research Laboratory.

Hunt J G and Mahdi T A (1992). Overtaking sight distances on single carriageway roads. PTRC 20th Summer Annual Meeting. London: PTRC.

Knight I, Chinn B, Fenn B and Dodd M (2002).Factors that limit improvements in commercial vehicle brake performance – final report. TRL unpublished report PR/SE/534/02.

Maycock G, Brocklebank J and Hall R D (1998). Road layout standards and driver behaviour. TRL Report 332. Crowthorne: Transport Research Laboratory.

Richards D and Cuerden R (2009). The relationship between speed and car driver injury severity. Department for Transport, London. http://www.dft.gov.uk/pgr/roadsafety/research/rsrr/theme5/rsrr9.pdf accessed 1st October 2009.

Smith T (2008). Heavy Goods Vehicles and Vulnerable Road Users – Accidentology. SP2 Workshop on Vulnerable Road User Protection for Heavy Goods Vehicles, 7th May 2008, Neumünster, Germany.

Summersgill I (1999). Overtaking sight distances on 7.3m single carriageway roads. TRL Unpublished project Report PR/TT/016/99. Crowthorne: Transport Research Laboratory.

Taylor M C, Baruya A and Kennedy J V (2002). The relationship between speed and accidents on rural single-carriageway roads. TRL Report TRL511. Crowthorne: Transport Research Laboratory.

Appendix A: Distance and time requirements for overtaking

A.1 Approach based on the laws of motion

The time and distance required to overtake a heavy goods vehicle depend on the accelerative performance of the overtaking vehicle. The estimates presented here are based on the performance of a car accelerating from an emergency refuge area into the nearside lane (lane 1) of a busy motorway. This data has been used because data for accelerative overtaking on a single carriageway road with a 60mph speed limit is not available. It is considered that the accelerative performance in the two sets of circumstances are likely to be similar.

The acceleration data was not obtained from an actual motorway but from experimental data obtained using the TRL car driving simulator undertaken as part of another project. The acceleration profile is a typical example of a test subject driving on the simulator. The performance characteristics of the car are that of a 1600cc Honda Civic.

One obvious difference between acceleration from a motorway emergency refuge and from behind a heavy goods vehicle is that the acceleration is from rest in the former case. It has been assumed that the acceleration profile from behind a heavy goods vehicle would be similar to that from an emergency refuge at the same speed.

It was further assumed that the speed of the car would not exceed 70mph so that once this speed was reached the car would continue to travel at 70mph until the manoeuvre was completed. The acceleration profile is presented in Table A.1.

Table A.1: Acceleration profile of the car

distance (m)	speed (mph)	speed (m/sec)	cum time (sec)
0	0.0	0.00	0.00
10	12.8	5.72	3.49
20	21.5	9.61	4.80
30	28.5	12.75	5.69
40	35.5	15.88	6.39
50	40.7	18.20	6.98
60	45.9	20.53	7.49
70	51.2	22.90	7.96
80	54.1	24.19	8.38
90	57.6	25.76	8.78
100	60.5	27.06	9.16
110	64.0	28.62	9.52
120	66.9	29.92	9.86
130	69.8	31.21	10.19
140	70.0	31.30	10.51
150	70.0	31.30	10.83
160	70.0	31.30	11.15
170	70.0	31.30	11.47
180	70.0	31.30	11.78
190	70.0	31.30	12.10
200	70.0	31.30	12.42
210	70.0	31.30	12.74
220	70.0	31.30	13.06
230	70.0	31.30	13.38
240	70.0	31.30	13.70
250	70.0	31.30	14.02

The analysis considered the following ranges of determining variables:

- Heavy goods vehicle length (10m and 20m).
- Car length (4m).
- Heavy goods vehicle speed (35mph, 40mph, 45mph, 50mph and 55mph).
- Speed of an oncoming vehicle travelling in the opposite direction (60mph).
- Following time headway between the rear of the heavy goods vehicle and the front of the car prior to the acceleration (1sec, 2sec and 3sec).
- Leading time headway after completion of overtaking manoeuvre between the rear of the car and the front of the heavy goods vehicle (1sec).
- Safety time headway between the time the overtaking manoeuvre is completed and the time of arrival of the front of a vehicle travelling in the opposite direction (2sec).
- Decision time is the time during which a decision is made as to whether to overtake or not. This has been set to 0sec. The gap in the traffic or the sight distance required to perform the overtaking manoeuvre will increase by about 50m for each second of decision time.

The following dependent variables were estimated:

- Time from the start of acceleration to the time when the front of the car and the front of the heavy goods vehicle are alongside each other.
- Time from the start of acceleration to the completion of the overtaking manoeuvre.
- Following distance headway between the rear of the heavy goods vehicle and the car prior to acceleration.
- Leading distance headway after completion of the overtaking manoeuvre between the rear of the car and the front of the heavy goods vehicle.
- Safety distance between the oncoming vehicle and the overtaking vehicle at the time when the overtaking manoeuvre is completed.
- Sight distance required to allow the overtaking manoeuvre to be completed safely.

A.2 Findings based on the laws of motion

The results of the analysis are presented in Table A.2 (HGV 10m long) and Table A.3 (HGV 20m long).

Table A.2 shows that the time to draw alongside the heavy goods vehicle varies from 3.6sec for a following headway of 1sec when the speed of the heavy goods vehicle is 35mph to 15.1sec for a following headway of 3sec and when the speed of the heavy goods vehicle is 55mph. The corresponding times to complete overtaking are 4.7sec and 19.2 sec respectively. The distance to complete overtaking are 118m and 603m respectively and the corresponding sight distance requirements are 298m and 1,172m respectively.

The above results provide an indication of the wide range of overtaking times and required sight distances depending on the speed of the heavy goods vehicle and the following headway adopted by the overtaking vehicle. In practice it is unlikely that the car would attempt to overtake a heavy goods vehicle travelling at 55mph and the sight distance required to overtake safely is so great that few sections of road could provide it and the ability of the overtaking driver to estimate distances of this size is doubtful. Further discussion will therefore be restricted to comparing the requirements to overtake a heavy goods vehicle travelling at 40mph (at the current speed limit of 40mph) with one travelling at 45mph (slightly above the current speed limit) and with one travelling at 50mph (with an increased speed limit of 50mph).

The effect of the following headway compared to the assumed central value of 2sec is such that the time to complete the overtaking manoeuvre is reduced by about 20 per cent if the following headway is 1sec and is increased by about 20 to 25 per cent if the following headway is 3sec. If the following headway is 2sec, the times to complete overtaking are as follows: 6.5sec (40mph); 7.9sec (45mph); and 10.1sec (50mph). The corresponding distances to complete overtaking are: 182m (40mph); 232m (45mph); and 304m (50mph). The corresponding sight distance requirements are: 410m (40mph); 498m (45mph); and 629m (50mph). It is worth noting in this context that the full overtaking sight distance for a single carriageway road with a 100km design speed built to the Highway Link Design Standard TD 9 is 580m. This suggests that it is likely to be difficult for a car to overtake a heavy goods vehicle travelling at a speed greater than 47 mph.

A speed of 47mph is slight faster that the published (Department for Transport, 2008) overall average mean speeds for heavy goods vehicles: 2 axle rigid (46mph) – some of these are subject to a 40mph speed limit and others to a 50mph speed limit; 3 axle rigid and 4 axle rigid (43mph and subject to a 40mph speed limit); 4 axle articulated (44mph) and 5 or more axle articulated (45mph), both subject to a 40mph speed limit. It is worth noting that these mean speeds are only slightly lower than cars and light goods vehicles (48mph).

It would not be productive to consider in detail the results for a somewhat longer 20m heavy goods vehicle that are presented in Table A.3. However some comparisons with the results for overtaking a 10m heavy goods vehicle are instructive.

The times to complete an overtaking manoeuvre are about 1 sec longer for a 20m heavy goods vehicle compared with a 10m heavy goods vehicle and the sight distances required are about 50 to 60m longer.

Table A.2: Time and distance required for a car to perform an accelerative overtake on a 10m long heavy goods vehicle

		HGV speed (mph) 35			40			45			50			55		
Following headway	(sec)	1.0	2.0	3.0	1.0	2.0	3.0	1.0	2.0	3.0	1.0	2.0	3.0	1.0	2.0	3.0
Time to draw alongside	(sec)	3.6	4.7	5.7	3.8	5.0	6.4	4.2	5.9	7.8	5.1	7.3	10.3	5.2	11.4	15.1
Time to complete overtaking	(sec)	4.7	5.8	6.8	5.3	6.5	7.9	6.2	7.9	9.8	7.9	10.1	13.1	9.3	15.5	19.2
Following distance headway	(m)	16	31	47	18	36	54	20	40	60	22	45	67	25	49	74
Leading distance headway	(m)	16	16	16	18	18	18	20	20	20	22	22	22	25	25	25
Safety distance	(m)	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54
Distance to alongside	(m)	83	117	147	95	135	177	115	169	230	148	217	311	158	355	475
Distance to complete overtaking	(m)	118	152	182	142	182	224	178	232	293	235	304	398	286	483	603
Sight distance required	(m)	298	361	418	338	410	490	398	498	609	501	629	803	589	952	1,172

Note: All times and distances relative to start of acceleration.

Table A.3: Time and distance required for a car to perform an accelerative overtake on a 20m long heavy goods vehicle

		HGV speed (mph) 35			40			45			50			55		
Following headway	(sec)	1.0	2.0	3.0	1.0	2.0	3.0	1.0	2.0	3.0	1.0	2.0	3.0	1.0	2.0	3.0
Time to draw alongside	(sec)	4.3	5.3	6.4	4.6	5.9	7.4	5.0	6.8	8.9	6.1	8.6	11.6	8.8	12.9	18.1
Time to complete overtaking	(sec)	5.4	6.4	7.5	6.1	7.4	8.9	7.0	8.8	10.9	8.9	11.4	14.4	12.9	17.0	22.2
Following distance headway	(m)	16	31	47	18	36	54	20	40	60	22	45	67	25	49	74
Leading distance headway	(m)	16	16	16	18	18	18	20	20	20	22	22	22	25	25	25
Safety distance	(m)	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54
Distance to alongside	(m)	104	137	169	121	162	209	142	197	262	180	257	355	271	403	571
Distance to complete overtaking	(m)	139	172	204	168	209	256	205	260	325	267	344	442	399	531	699
Sight distance required	(m)	337	397	459	385	461	548	446	550	671	559	703	882	799	1,041	1,348

Note: All times and distances relative to start of acceleration.

A.3 Probability of overtaking based on car driving simulator and on-road observations

(Maycock, Brocklebank and Hall, 1998) studied accelerative overtaking behaviour on the TRL car driving simulator and on public roads.

The studies on public roads are of most interest here and hence those on the TRL car driving simulator will not be described further. The results from the latter were broadly similar to those obtained from public roads.

The public road studies involved driving an instrumented vehicle at a constant speed along a section of road which included an overtaking section. Prior to the overtaking section, any member of the driving public followed the controlled vehicle at the start of the overtaking section was presented with an overtaking opportunity which could be accepted or rejected. The instrumented vehicle travelled at a speed of 15kph or 30kph lees than the design speed of the road. The 85th percentile speeds at the 18 sites studied varied from 47mph to 67mph. The straight sections varied between 113m and 629m and were on two-lane 7.3m wide single carriageway roads with 1m hardstrips.

There were 2,228 overtaking opportunities presented to 624 drivers but many were short repeated opportunities for the same driver between oncoming vehicles in platoons. Hence, only the longest opportunities presented and refused or the opportunity selected was selected for analysis. There were 1,390 opportunities on this basis. None resulted in crashes but only 4 per cent were accepted.

A model based on the public road data was developed using multiple regression analysis was developed and is of the form:

$$\ln(p/(1-p)) = 1.87+0.0135(GAP)-0.47(SPEED)+3.02(MILE)-1.61(SEX)-0.89(AGE)$$

where GAP(m) is the length of the opportunity, SPEED(m/sec) is the speed of the overtaken vehicle, MILE=1 if the driver exceeds 10,000 miles per year and is 0 otherwise, SEX=1 if the driver is female and is 0 otherwise, AGE=1 if the driver is more than 45 years old and 0 otherwise. There was no statistically reliable distinction between the way drivers treated an overtaking opportunity with limited sight distance from one where an opposing vehicle limited the size of the gap.

By reformulating the above equation so as to make GAP the subject of the formula it can be shown that for any value of p:

- The gap increases by 35m for each 1m/sec increase in the speed of the overtaken vehicle.
- The gap was 224m less for drivers who drove 10,000 miles a year or more.
- The gap was 119m greater for female drivers than for male drivers.
- The gap was 66m greater if the driver was 45 years of age or older.

The effects of the speed of the overtaken vehicle are of most interest here. For a male driver under the age of 45 who drives less than 10,000 miles a year the proportion of opportunities accepted is 50 per cent for a gap length of: 498m (40mph); 565m (45mph); 645m (50mph). The gap lengths for which the acceptance is 20 per cent and 10 per cent are 103m and 163m less than for 50 per cent acceptance.

There are a number of issues raised by these results. The first is that the instrumented vehicle was not a heavy goods vehicle and it may be that longer gaps are demanded when overtaking these vehicles. The second is a technical point in that the structure of the model is such that it implies that if the gap was sufficiently long there would be 100 per cent acceptance which seems unlikely. There would seem likely to be some drivers who would not overtake regardless of the size of gap especially at higher speeds. The third is that gaps of the size that have a relatively high probability of acceptance may be relatively rare either because on oncoming traffic or of sight distances. In this context, the Highway Link design standard requires a full overtaking sight distance of 580m for a road with a 100kph (63mph) design speed. It will also be difficult to assess the size of such large gaps.

Based on the results of this study, many drivers will find it difficult to overtake a heavy goods vehicle travelling at 40mph and increasingly less so at a higher speed. On the other hand, the desire to overtake will be less the higher the speed.

A.4 Observations of overtaking on a section of road in South Wales

Hunt and Mahdi (1992) observed overtaking on a 1,175m overtaking section of the A4059 road between Mountain Ash and Aberdare in South Wales. The road was single carriageway with 1.2m footways and had a design speed of 80kph (50mph). The section was straight and level providing unrestricted sight distances. The adjacent sections were not suitable for overtaking and were bendy, which helped in the formation of platoons and increased the demand for overtaking in the chosen section. Behaviour was recorded and measured using video cameras located on the summit of a nearby hill.

Recordings were made of all types of overtaking which involved different types of overtaking vehicle, overtaken vehicle, sight distance restriction, vehicle speed, and other variables. The two-way traffic flow varied from 620 vehicles per hour (off-peak) to 1,120 vehicles per hour (peak), and the proportion of heavy goods vehicles varied from 10 to 19 per cent. There were 1,143 overtaking manoeuvres observed.

Although the design speed of the road of 50mph was less than the 60mph speed limit that is of interest in the current study, Hunt and Mahdi recorded the overtaking manoeuvres involving heavy goods vehicles as well as cars.

Both flying and accelerative overtaking manoeuvres were recorded but only the latter will be considered here. Also not considered are overtaking manoeuvres in which more than one vehicle was overtaken.

Hunt and Mahdi studied a wide range of variables associated with various aspects of the overtaking manoeuvres but only three are considered here. These are:

- The 50%ile accepted gap distance , AGD (m). This is the median gap between the overtaking vehicle and either an oncoming vehicle or the sight distance.
- The 50%ile overtaking distance, OVD (m). This is the distance travelled by the overtaking vehicle when making the manoeuvre.
- The 50%ile overtaking time, OVT (sec). This is the time taken by the overtaking vehicle to complete the manoeuvre.

These variables depend on:

- The speed of the overtaken vehicle, U (m/sec).
- The type of vehicle being overtaken, TOL: TOL=0 (car); TOL=1 (heavy goods vehicle).
- The type of vehicle overtaking, TOP. TOP=0 (car); TOP=1 (heavy goods vehicle).
- The type of gap, TOG: TOG=0 (gap limited by an oncoming vehicle); TOG=1 (gap limited by sight distance).

The relationships were as follows:

Accepted distance gap

$$AGD = \exp(k+aU)$$

where $k=5.682+0.082(TOP)+0.102(TOL)-0.134(TOG)$

$a=0.037$

Overtaking distance

$$OVD = \exp(k+aU+bAGD)$$

where $k=3.772+0.082(TOP)+0.081(TOG)$

$a=0.064+0.007(TOP)+0.005(TOL)$

$b=0.000270$

Overtaking time

$$OVT = \exp(k+aU)AGD^{b}$$

where $k=0.673+0.198(TOP)-0.073(TOL)+0.098(TOG)$

$a=0.012+0.008(TOL)$

$b=0.168$

Table A.4 shows how the accepted distance gap varied according to the type of overtaking vehicle, the type and speed of the overtaken vehicle and whether the gap was limited by the presence of an oncoming vehicle or by the available sight distance. The speeds of the overtaken vehicle that are considered are 40mph, 50mph and 60mph. These reflect the requirements of the current study but are relatively high for a road with a 50mph design speed and may be somewhat outside the range of the data obtained by Hunt and Mahdi.

The distance required for a car to overtake an HGV was about 60m greater than that required for a car to overtake a car. The distance required for a car to overtake an HGV travelling at 45mph was about 50m greater and at 50mph was about 110m greater than when overtaking an HGV travelling at 40mph.

Table A.4: The 50th percentile distance gap required to overtake a vehicle according to type and speed of the overtaken vehicle (AGD)

Overtaking vehicle	Overtaken vehicle	Speed of overtaken vehicle 40mph (17.9/sec)	45 mph (20.1 m/sec)	50 mph (22.4 m/sec)
Gap determined by oncoming vehicle (m)				
car	car	569	618	672
car	HGV	630	684	745
HGV	car	618	670	730
HGV	HGV	684	742	808
Gap determined by sight distance (m)				
car	car	498	540	588
car	HGV	551	598	651
HGV	car	540	556	638
HGV	HGV	598	649	707

Table A.5 presents equivalent values for overtaking distance. The distance travelled by a car when overtaking an HGV was about 25m greater than when overtaking a car. The distance travelled by a car when overtaking an HGV travelling at 45mph was about 30m greater and at 50mph was about 70m greater than when overtaking an HGV travelling at 40mph.

Table A.5: The 50th percentile distance to overtake a vehicle according to type and speed of the overtaken vehicle (OVD)

Overtaking vehicle	Overtaken vehicle	Speed of overtaken vehicle 40 mph (17.9 m/sec)	45 mph (20.1 m/sec)	50 mph (22.4 m/sec)
Gap determined by oncoming vehicle (m)				
car	car	159	186	219
car	HGV	177	209	244
HGV	car	199	236	282
HGV	HGV	221	266	322
Gap determined by sight distance (m)				
car	car	170	197	232
car	HGV	188	222	264
HGV	car	212	250	298
HGV	HGV	234	281	340

Table A.6 presents values for the time taken to overtake. The time taken by a car to complete an overtaking manoeuvre when overtaking an HGV was about 0.8sec longer than when overtaking a car. The time taken by a car to overtake an HGV travelling at 45mph was about 0.5sec longer and at 50mph was about 1.0sec longer than when overtaking an HGV travelling at 40mph.

Table A.6: The 50th percentile time to overtake a vehicle according to type and speed of the overtaken vehicle (AVT)

Overtaking vehicle	Overtaken vehicle	Speed of the overtaken vehicle		
		40 mph (17.9 m/sec)	45 mph (20.1 m/sec)	50 mph (22.4 m/sec)
Gap determined by oncoming vehicle (m)				
car	car	7.1	7.3	7.7
car	HGV	7.7	8.2	8.7
HGV	car	8.7	9.1	9.5
HGV	HGV	9.5	10.1	10.7
Gap determined by sight distance (m)				
car	car	7.6	7.9	8.3
car	HGV	8.3	8.8	9.3
HGV	car	9.4	9.8	10.2
HGV	HGV	10.3	10.9	11.5

A.5 Comparing the findings of the three approaches

It is instructive to summarise and compare the findings of the three approaches.

Table A.7 compares the 50%ile distance gap required to overtake a car and an HGV. It shows that they do not differ substantially in absolute terms. However, the effect of the speed of the overtaken vehicle was substantially different insofar as a 1mph increase in the speed of the overtaken vehicle had the following effects: current study (about 23m); Maycock et al (about 15m); and Hunt and Mahdi (about 10m).

Table A.8 compares the 50%ile distance to overtake a car and an HGV. It shows that they do not differ substantially in absolute terms. However, the effect of the speed of the overtaken vehicle is substantially different insofar as a 1mph increase in the speed of the overtaken vehicle had the following effect: current study (about 13m); and Hunt and Mahdi (about 7m).

Table A.9 compares the 50%ile time to overtake a car and an HGV. It shows that they do not differ substantially in absolute terms. However, the effect of the speed of the overtaken vehicle is substantially different insofar as a 1mph increase in the speed of the overtaken vehicle had the following effect: current study (about 13m); and Hunt and Mahdi (about 7m).

Table A.7: Comparison of the results of studies to determine the distance gap required to overtake

Study	Overtaking vehicle	Overtaken vehicle	Overtake limited by	Speed of overtaken vehicle 40 mph (17.9m/sec)	45 mph (20.1m/sec)	50 mph (22.4m/sec)	Additional distance per mph (m)
Current	car	HGV 10m	-	410	498	629	22
	car	HGV 20m	-	461	550	703	24
Hunt and Mahdi	car	car	oncoming vehicle	569	618	672	10
	car	car	sight distance	498	540	588	9
	car	HGV	oncoming vehicle	630	684	745	12
	car	HGV	sight distance	551	598	651	10
Maycock et al	car	car	-	498	565	645	15

Table A.8: Comparison of the results of studies to determine the distance to overtake

Study	Overtaking vehicle	Overtaken vehicle	Overtake limited by	Speed of overtaken vehicle 40 mph (17.9m/sec)	45 mph (20.1m/sec)	50 mph (22.4m/sec)	Additional distance per mph (m)
Current	car	HGV 10m	-	182	232	304	12
	car	HGV 20m	-	209	260	344	14
Hunt and Mahdi	car	car	oncoming vehicle	159	186	219	6
	car	car	sight distance	170	197	232	6
	car	HGV	oncoming vehicle	177	209	244	7
	car	HGV	sight distance	188	222	264	8
Maycock et al	car	car	-				

Table A.9: Comparison of the results of studies to determine the time to overtake

Study	Overtaking vehicle	Overtaken vehicle	Overtake limited by	Speed of overtaken vehicle 40 mph (17.9m/sec)	45 mph (20.1m/sec)	50 mph (22.4m/sec)	Additional distance per mph (m)
Current	car	HGV 10m	-	6.5	7.9	10.1	0.56
	car	HGV 20m	-	7.4	8.8	11.4	0.40
Hunt and Mahdi	car	car	oncoming vehicle	7.1	7.3	7.7	0.06
	car	car	sight distance	7.6	7.9	8.3	0.07
	car	HGV	oncoming vehicle	7.7	8.2	8.7	0.10
	car	HGV	sight distance	8.3	8.8	9.3	0.10
Maycock et al	car	car	-				

A.6 Discussion

These studies have allowed the effect of the speed of the overtaken vehicle on the size of gap required for overtaking, the distance travelled whilst overtaking and the time taken to overtake to be quantified. They also provide an indication of the extent to which these variables are sensitive to whether a car or a heavy goods vehicle is being overtaken.

The study by Maycock et al shows how the probability of overtaking increases with the size of the gap available to do so. However, it seems unlikely that some drivers would overtake regardless of how large the gap might be, especially when following a heavy goods vehicle travelling at a relatively high speed. The study did not address this issue. Furthermore the study was based on the overtaking of a car not a heavy goods vehicle. That said the study by Hunt and Mahdi suggests that the overtaking requirements, durations and times are not substantially extended when heavy goods vehicles are overtaken.

HGV speed limit increase evaluation: final report

The Department for Transport (DfT) commissioned the Transport Research Laboratory (TRL) to provide an evidence-base, analysis and reasoned opinion on whether or not there is likely to be any road safety risk involved in increasing the speed limit of HGVs exceeding 7.5 tonnes on single carriageway de-restricted roads from 40mph to 50mph (or possibly 45mph).

Based on analyses of accident data sources Stats19, On-The-Spot (OTS), and the Heavy Vehicle Crash Injury Study (HVCIS), analysis suggests that the maximum potential increase in the average speed would be about 3mph and an increase in HGV21 speed would be likely to make only a small difference to the number of fatal accidents.

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