WHAT LIMITS SPEED?
Factors that affect how fast we drive

Ross Silcock Limited
in association with
Social Research Associates

Final report: summary and conclusions
June 2000

Foundation for Road Safety Research

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This *Final report* presents the summary and conclusions of the research project *What limits speed?,* part of which (the video-drive survey) was completed after the *Interim report* was published in July 1999. Details of the methodology and analysis of the video-drive survey are included here in a supplement to the *Final report* (Appendices A and E, taken from the final *Technical report*). Copies of the *Interim report* are available on request from the AA Foundation for Road Safety Research. A copy of the *Technical report* is held by the AA Foundation.

Foundation for Road Safety Research

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Definitions

In this report we follow the trend in professional practice and use the word "crash" where historically "accident" or "road accident" has been used. This reflects the view that many crashes can be prevented; describing them as accidents implies an unfortunate but uncontrollable event and too readily allows participants to externalise blame.

Use of the word crash does create some difficulties. For example, the national data system uses accident (strictly, personal injury accident (PIA)) which has been reported to the police) and in cases such as this where we are quoting from others we retain the word accident or use PIA.

Also, in Chapter 3, reporting on surveys of the general public, the word accident is used as this still remains the word in common use and was used both by interviewers and respondents.

"Speeding" means driving at a speed above the legal limit.

National speed limits for cars at the time of survey

Our surveys focussed on car drivers and speed limits for cars. At the time of survey the prevailing speed limits for cars were as shown below. Note that different limits apply outside of urban areas to cars whilst towing trailers or caravans and to large commercial vehicles.

Type of road	National limit mile/h	Exceptions
Urban	30	Unless other limit posted. 20 mile/h zones and 40 mile/h are both fairly common. 50, 60 and 70 mile/h are occasionally used on urban dual carriageways.
Rural single carriageway	60	Unless other, lower limit, posted. 50 mile/h sometimes used.
Rural dual carriageway	70	Unless other, lower limit, posted. 60 mile/h sometimes used, but rarely less.
Motorway	70	Unless other, lower limit, posted. Rarely less than 70 unless an urban motorway.

Acknowledgements

Many people have contributed their time in responding to surveys and carrying out video-drives; without their assistance this research could not have been carried out. This includes members of the public and our own staff for their efforts in conducting the surveys and the data processing involved. We are particularly grateful to them.

Our thanks are given to all who participated in the Delphi survey and the subsequent workshop. The Delphi method relies on the time and effort of the panellists and we are particularly grateful to them and to those who attended the workshop.

We received assistance, advice and data from the local authorities in North Tyneside, Leicestershire, Lincolnshire, Hertfordshire, Watford; Stamford and North Tyneside Colleges; and from the police in Northumbria and Hertfordshire, for which we are most grateful.

Particular thanks are due to those who have advised on technical issues during the research:

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AA Foundation for Road Safety Research

The AA Foundation for Road Safety Research was formed by the AA in December 1986 as part of its continuing efforts in the road safety field and as a major contribution to European Road Safety Year.

Registered as a charity (number 295573), the objectives of the Foundation are:

> to carry out, or procure, research into all factors affecting the safe use of public roads;
>
> to promote and encourage the safe use of public roads by all classes of road-users through the circulation of advice, information and knowledge gained from research;
>
> and
>
> to conceive, develop and implement programmes and courses of action designed to improve road safety, these to include the carrying out of any projects or programmes intended to educate young children or others in the safe use of public roads.

Control of the Foundation is vested in a Council of Management under the chairmanship of Sir Brian Shaw with day-to-day activity being the responsibility of the Foundation Management Committee. The Research Advisory Group, members of which include academics, road safety practitioners and health and transport industry professionals, recommends topics worthy of research to the Management Committee.

Sponsors

Support for the Foundation's research programme is encouraged through sponsorship from companies and other bodies that have a concern for and an interest in road safety. The Foundation continues to seek sponsors in order to ensure its research programme can continue into the twenty first century. Since 1986, the Foundation has enjoyed sponsorship from many companies; those supporting our activities in 2000 are:

> The AA, Amery-Parkes, Capital Bank, The Caravan Club, Europcar (UK), Herbert Smith, Vauxhall Motors, as well as the following insurance companies:
>
> AGF (now part of Allianz-Cornhill), Commercial Union (now part of CGU), Cornhill (now part of Allianz-Cornhill), Eagle Star (now part of Zurich), Fortis, Groupama, Guardian, Hiscox, Iron Trades and Norman.

Summary and conclusions

To most drivers "speeding" means exceeding the posted speed limit, that is breaking the law. However, this particular law is so widely abused that the conventional view that the great majority of people in the UK are law abiding citizens simply does not hold true in this case.

Road safety professionals separate speeding into "excess speed" which is above the legal limit; and "inappropriate speed" for the prevailing circumstances. To the road safety professional appropriate speeds are most likely to be below the legal limit. But ordinary drivers reveal by their driving behaviour that the common view of appropriate speed is that it is often above the legal limit. It is important to understand why this is so if progress is to be made in reducing speeds and hence the death and injury caused.

This report summarises the findings of a two year study of the factors which influence the choice of speed. It draws on the findings from: more than 1,000 home interviews in Tyneside, Leicester, rural Lincolnshire and Watford; 12 group discussions in the same areas; a Delphi survey of road safety professionals; and gives detailed account of video-drive surveys[1] of 243 drivers in Newcastle and Watford.

Drivers' views of speed limits

Most respondents in our surveys were content with the current 30 mile/h and 70 mile/h limits.

On dual carriageways, 83 per cent of those interviewed felt that 70 mile/h was about right. In contrast, on motorways, a sizeable minority (36 per cent) favoured raising the limit, although the majority (60 per cent) felt it was about right.

The great majority of drivers in our survey knew that the national maximum speed limit is 70 mile/h and that a 30 mile/h speed limit is the norm in urban areas. However there was confusion about the maximum on single carriageway roads (60 mile/h). There was widespread belief that intermediate speed limits (eg 40 mile/h and 50 mile/h) are applied inconsistently and often, in the opinion of the driver, for no apparent reason. We found many criticisms and claims of inconsistent application of speed limits. Similar or identical roads (in the driver's eye) with different limits lead to disrespect of the system which translates into a justification for speeding.

Choice of speed – "it feels right"

On a self-reporting basis, 85 per cent of survey respondents found themselves exceeding the speed limit on occasion, and there was general agreement that everyone did it. This is borne out by the video-drives where, on those occasions where drivers had a free choice of speed, 98 per cent of drivers exceeded the prevailing limit at least once during their one hour drive.

Although it proved difficult for drivers to articulate clearly quite what they mean by the phrase, the principal reason drivers gave for their choice of speed was "because it feels right". Drivers appear to set themselves an internal speed limit which, in their judgement, is the appropriate speed for them at that time and place under the prevailing conditions.

This internal speed limit is often, but not always, above the posted speed limit. As a result speeding is widespread. There was also considerable confusion about speed limits other than 30 mile/h and 70 mile/h, which may exacerbate the problem.

[1] A survey technique where the road ahead is filmed during a drive of a fixed route and drivers are interviewed immediately after the drive using the video as a prompt. Actual speeds are derived from the video tape.

Whilst speeding was acknowledged as illegal, it was justified by drivers on a number of grounds. The most common can be paraphrased as:

- unintentional;
- in a hurry (eg to collect a child at school);
- being "forced" to speed (by someone tailgating me);
- the limit is wrongly set for this location (based on experience of similar roads with higher limits);
- my modern car can stop more quickly than those on the roads at the time the limit was set, therefore my speeding is safe;
- the same limit should not apply at all times (the empty road, late at night);
- the limit does not apply to me because I am an above-average driver; and
- my speeding is acceptable because it is not a lot over the limit and others abuse it more flagrantly.

This does not mean that all speeding was acceptable in the public mind. But there is a dichotomy between "my" speeding – for which there are good reasons – and "others'" speeding, which is not always accepted. There was also a view that a modest amount over the limit doesn't do any harm. Problems are caused by "boy racers" and "company car drivers", not "me". It may be that using these stereotypes is one of the means by which the speeders justify their behaviour, as they will rarely admit to being within one of these groups.

In the video-drive interviews, drivers were asked whether they thought their speed was within the prevailing limit at each location. Twenty-five per cent thought they were above the limit, and of these 84 per cent were indeed exceeding the limit. Of those who thought they were below the limit only eight per cent were actually speeding. It seems that speeding is often a conscious decision and that "accidental" speeding is relatively rare.

Why does it feel right?

Our surveys have revealed a number of factors which have an influence on a speed "feeling right" to an individual:

- self-image as a driver;
- the vehicle;
- the road environment;
- cultural factors;
- presence of passengers; and
- perceived risk of detection and prosecution.

Self-image as a driver

In common with several previous surveys, we found that the great majority of drivers rated their own driving abilities as average or above. Watford drivers gave themselves particularly high ratings with 47 per cent rating themselves above average, compared with 33–36 per cent in other areas.

Our group discussions revealed two widely held images of the speeding driver: "the boy racer" and the "company car driver". This often undermined the general awareness that all sorts of people speed. A further image was also common; "the old fogey who causes accidents by driving too slowly". Such an image tends to reinforce the view that driving fast is the norm and that failing to conform is somehow dangerous.

We also found a tendency to distinguish between "dangerous speeding drivers" and "skilled and moderate speeding drivers". Not surprisingly the majority located themselves in the latter category. This perception reinforces the widely held view that moderate speeding is not a dangerous practice.

These images and stereotyping of different categories of speeding driver allow individuals to distance themselves from the problem and to place blame elsewhere.

The vehicle

There were two aspects of vehicle design commonly cited as affecting speeding – power and comfort – although the two tend to go hand in hand in the case of large, expensive cars.

People admitted to driving faster in more powerful cars. Some found this alarming, particularly if access to a more powerful car was only occasional, whilst others argued that it was safer because they "could accelerate out of trouble". It was also claimed that the more powerful car had more efficient braking, therefore speeding was less risky.

The "car-coon" effect was also acknowledged. The quiet comfortable ride offered by many modern cars was contrasted with older vehicles, especially by people who drive both. Choice of speed is partly determined by feedback from the vehicle and if it is quiet and comfortable, then the perception of speed is greatly reduced.

Some also linked choice of speed to in-vehicle safety features such as air-bags and side-impact bars. Their presence gave some people confidence in driving faster.

There seems to be little doubt that modern vehicles encourage speeding. This is not necessarily by the direct promotion of power and the pleasure of speed *per se*, but in a more passive way by insulating the driver from many of the effects of speed. Noise, vibration and "wind in the hair" are perhaps the most obvious, but other features such as comfort, internal protection and sound systems were also cited by drivers. However, a powerful car is not a prerequisite for speeding. Car engine size was not a significant variable affecting speeding in our video-drive surveys, although the range of engine size encountered was small.

Cultural factors

Many drivers found driving fast an exhilarating and pleasurable experience. This is reinforced by positive media images. Music and car culture were related to speeding and people find it difficult to imagine alternatives to the car. Even those who were critical of the car culture did not think that things would change.

Fast driving as "macho" and slow driving as "old fogey" or "feminine" were powerful images to those involved in the discussion groups. This also reflects peer group pressure to conform to a particular image.

Whilst a substantial minority of survey respondents felt that it was possible to get ahead by skillful driving and driving faster to make up for delays, the group discussions suggested that these behaviours are more to relieve stress and frustration rather than being based in a strong belief that they will actually save time.

There were also references to pressure from employers to meet schedules as another factor leading to speeding.

Presence of passengers

The majority of those surveyed admitted driving differently with passengers in the car. This varied by sex, and particularly by age. Three-quarters of young males reported that they drive differently with passengers.

In some cases this implied driving faster, typically when young people were with friends. In other cases the tendency was to drive more slowly, especially with children or parents in the car.

These findings suggest that immediate peer pressure is an important factor in speeding for some groups, young males in particular. They also suggest that there is an awareness of risk which does modify behaviour, for example to protect a child in the car.

Enforcement and penalties

The fact that speeding is so widespread reinforces the views expressed that there is little fear of detection and prosecution – for at least "moderate speeding". Group discussions suggested a widespread belief that the police allow a fair degree of tolerance on top of the legal limit.

Speed cameras were supported because they are equitable – they catch all or none, without discrimination, and were also considered the most effective means of detection. However, there was a widespread lack of confidence in their use on the ground. This stemmed from a belief that most are not operational (no camera in the box, or no film) and that fixed sites rapidly become known and thus detection is avoidable. The apparent lack of confidence in the operation of the cameras was consistent with the video drive data where it was found that one speed camera location had the highest 85th percentile speed above the speed limit.

Fines (for speeding) were considered low, and thus ineffective. For some groups other forms of penalty were considered to be more effective; community service or compulsory driver re-training would have an impact because of the loss of face involved.

The road environment

It is clear from our surveys that drivers generally make their own assessment of the speed at which they will drive, irrespective of the speed limit, based on their own judgement of the road environment. As well as physical dimensions and layout of the road, this includes prevailing traffic conditions, and whether a road is perceived as urban or rural.

The video-drives explored the influence of the road environment in some depth. We found that, as a broad generalisation, the sections of route that had the highest proportions of speeding drivers were those with low limits (30 or 40 mile/h) which were also wide, straight, with good forward visibility and with little frontage activity.

Dual carriageways with 30 or 40 mile/h limits were particularly susceptible to speeding. For example, the location with the most speeding drivers (98 per cent) on the Newcastle route was on the only 30 mile/h stretch with dual carriageway. Whilst the proportions of speeding drivers on 40 mile/h roads was generally lower than on 30 mile/h roads, it was still high (more than 70 per cent) if the road was dual carriageway or four lane single carriageway.

Regional differences

There were differences between interview responses in the four survey areas which may be explained by a combination of local conditions and by regional differences in attitudes and/or behaviours. In the Watford area home interviews there was generally more agreement with statements that associate with aggressive driving, whilst in Newcastle there

was less. This could be as a consequence of higher traffic volumes and greater levels of congestion in the Watford area.

This difference between Newcastle and Watford is supported by the judgements of the observers undertaking the video-drives who made a subjective assessment of each driver's style. Overall, Watford drivers were judged to be more aggressive; however, no difference was found between the ratings given (to male drivers) by the only two observers who carried out video-drives on both routes.

In terms of actual speeds, comparisons between drivers' speeds on the two routes are possible at nine pairs of matched locations. Overall, at these locations, Watford drivers exceeded the limit 19 per cent of the time, whereas the Newcastle proportion was 16 per cent. At three of the four pairs of site where drivers exceeded the speed limit, the proportion of speeding drivers was greater in Watford. However, mean speeds at the comparable sites were broadly similar at most locations.

These three pieces of evidence all point to a tendency for Watford drivers to be more aggressive and faster drivers than those in Newcastle, but the differences are not clear cut and should be treated with caution.

What could be done? (to reduce speeding)

Changing attitudes

Speeding is not seen as a crime. Whilst "serious speeding" is accepted as dangerous, "moderate speeding" is not. There is a widespread view that the stereotypical images of the "boy racer" and the "company car driver" are the problem, not "me". Until there is a general acceptance of the breadth and depth of the problem it is unlikely that attitudes will change. Indeed it may be that the targeted campaigns have inadvertently offered the excuse to many (who do not identify with the target group) that the problem lies with limited groups of drivers.

Whilst our surveys support the view that some categories of driver are more likely to speed, and to have more serious crashes as a result, speeding is not restricted to such groups. An important message to get across is that we all speed, and we all cause increased risk as a result.

Current campaigns to persuade drivers to observe speed limits seem to reinforce the view held by some drivers that they are able to speed safely as they do not identify with the drivers in the advertisements, even when targeted at drivers like themselves. Drivers in general feel that radio advertisements are more effective than TV, primarily because they listen to the radio whilst driving whereas TV adverts are remote from the driving task.

Expert opinion is that a long term strategy is essential if attitudes are to change. The success of the campaign to change attitudes to drinking and driving is often cited as an example to emulate, whilst recognising that there is no simple solution that will eradicate speeding.

Our surveys have revealed the potential impact of passengers in the car. Behaviour is influenced by others in this case. Also, as drivers already recognise their responsibility for passenger safety, especially children in the car, then this acceptance of responsibility could be extended to those outside the vehicle – particularly to vulnerable road users.

The attitude surveys also identified other ways which could reduce speeding by harnessing the drivers' self interest. Many of the drivers with high propensities to speed also had pride in their driving skills and were interested in opportunities to demonstrate this. Thus they viewed "advanced driving tests" in a very positive light and imagined that this would emphasise fast driving. When exposed to the philosophy of the test some drivers claimed to have changed their driving style, including speeding less, whilst retaining pride in their driving skills. This was especially likely where the driving instructor for the advanced test

was a rôle model, for example a retired police officer who was perceived as a skilled driver. Such findings suggest that there is potential for changing attitudes to speeding via the provision of advanced driving courses for "skilled" drivers. However this approach is only likely to be acceptable if it acknowledges the driver's positive self-image and/or leads to a benefit such as reduced insurance costs. It is unlikely to work as well if seen as part of a penalty.

There are also indications that drivers can be motivated to reduce speeding by the knowledge that lower speed limits on congested roads can enable smoother flow and quicker progress (as in the variable speed limit trial on the M25). Cost savings may also result, such as improved fuel consumption and less tyre wear from stop/start traffic, which offer an attractive package of benefits.

"Joined-up thinking"

The Delphi workshop revealed a strong belief amongst professionals active in road safety that actions tend to take place in isolation rather than as part of an overall strategy. This was felt to be true of both central and local government. As road safety in general, and speed-related activities in particular, straddle several traditional departmental boundaries this is understandable, if disappointing.

In England DETR (Department of the Environment, Transport and the Regions) has the leading rôle in road safety, but the Home Office (for legislation and policing), DfEE (for education), Department of Health (who deal with the consequences), the Lord Chancellor's Office (for the courts), Local Authorities with a growing range of devolved powers and new structures such as the Scottish Parliament and Welsh Assembly all have important parts to play.

Unlike in some countries there is no national Road Safety Council, or similar, in the UK, although there are regional bodies such as the Scottish Road Safety Campaign and the London Accident Prevention Council. We recommend that a national body be established, in order to coordinate actions in road safety in general, and on speeding in particular. The *Speed Policy Review*, prepared by DETR, should offer a basis on which such a Council could build a strategy for a substantial reduction in speeding.

It may be that such a Council can best be created within a lead ministry, rather than as an independent body. The point stressed by the expert opinion consulted through the Delphi process, is that coordinated actions are more likely to succeed than isolated initiatives.

A technological "fix"

Expert opinion is that technology now exists which could be used to control vehicle speeds from the roadside. However there was little public support for this, or the intermediate step of speed limiters to control the maximum speed of a vehicle (as now is done with trucks and coaches).

Initial public reaction was a marked reluctance to accept control being taken away from the driver. This was felt to remove some of the pleasure of driving and to be potentially dangerous both by taking away the driver's ability to respond to dangerous situations and by removing responsibility. However when the issue was discussed in more depth in focus groups, for example after pointing out that speed limiters are already fitted to trucks and coaches, responses became more positive. Speed control was seen by some as part of an integrated transport policy, which was broadly accepted. It may be that this reveals the beginning of a shift in attitudes away from unrestrained car use, of which speed control could be part.

Although the attitude studies show that drivers resent the idea of speed limiters, technology such as cruise control and dashboard information about fuel consumption was well

received. These features often resulted in drivers claiming to lower their speeds when the connection between speed and fuel consumption was highlighted. Young drivers, and males in general, were especially interested in such technology and favourably inclined to its use in "helping the driver". Our research suggests that the introduction of such features to a wider range of cars would encourage drivers to internalise the value of driving at lower speeds on grounds of self interest.

The Delphi participants felt that technological change must influence long term strategy. Assuming that car design continues to offer greater insulation from the immediate physiological effects of speed, and greater protection (for the vehicle occupants at least) from the consequences of a crash, we believe that it is essential that this be offset by mechanisms to reduce the driver's unrestrained control over vehicle speed.

Speed limits and the road environment

Although the majority of our survey respondents accepted the existing speed limits, confusion prevailed about their application. Our surveys and the Delphi workshop reveal a widespread public view that the existing limits are not consistently applied. Other than 30 mile/h and 70 mile/h they are not well understood.

Current policy to devolve decisions about levels and location of speed limits to local government provides an opportunity for rationalisation, but also threatens to make the situation worse if, for example, neighbouring local authorities adopt different policies.

We strongly recommend a review of intermediate speed limits (those between 30 mile/h and 70 mile/h) and the introduction of firm guidelines for their use by local authorities. It is essential that drivers are presented with consistent use of limits if they are to respond to the speed limit sign rather than make their own judgement. This review needs to incorporate drivers' perceptions of the road environment and the features which influence driving behaviour.

Our surveys suggest that the absence of any apparent reason (to the driver) for a specific speed limit is one factor leading to abuse. There are examples of advisory speed limits and variable message signs which display reasons for the limit, but it has long been policy that speed limit signs are used without any supplementary information. We recommend that this policy be reviewed, particularly for intermediate speed limits, and that consideration be given to the addition of supplementary plates to speed limit signs which identify the reason for the limit.

Drivers choose a speed which feels right to them and our surveys reveal that the sections of route that had the highest proportions of speeding drivers were those with low limits (30 or 40 mile/h) which were also wide, straight, with good forward visibility and with little frontage activity.

Whilst most drivers may accept current speed limits as appropriate, they pay little attention to them in choosing their speed. A range of factors was found to influence drivers' choice of speed, suggesting that modifying the road environment could be used to influence speed. However the implied cost of, for example, re-engineering a straight road to make it "bendy", suggests that this is not a feasible way forward other than in the design of new roads, or in major traffic calming schemes where reducing road widths may be practicable (and desirable for other reasons).

We also found that familiarity is an important factor in influencing speed, particularly amongst fast drivers. There was a tendency for features such as bends to have a greater influence when the driver is unfamiliar with the location, suggesting that the potential impact of changes to the road environment may be short lived, unless they introduced substantial physical change, such as with traffic calming measures.

The presence of other vehicles was the most often cited factor causing drivers to slow down, and paradoxically the third most frequently cited factor causing drivers to speed up

(ie "the car ahead pulled away, therefore I could also speed up"). It seems that traffic conditions are as important as the road environment in influencing choice of speeds. Comprehensive traffic management, in its broadest sense, may therefore have a role to play in managing speeds as traffic volumes grow. This may be an area where information technology has much to offer, both on a large scale such as with the M25 variable speed limit system, and on less major routes by the use of in-car information systems.

Enforcement and penalties

In the short-term cameras are accepted by the public and expert opinion alike as the most effective means of detection. However we found some evidence of a lack of confidence in fixed locations, as they are known and avoidable. This may be based on a perception that their only purpose is to catch speeders, rather than deter speeding, but we found a general feeling that mobile cameras have a much wider effect due to the uncertainty of their location.

Whilst cameras are costly to operate we recommend their much greater use on the presumption that it will soon be possible for operating costs to be recovered from the resultant fines.

For some drivers the prospect of a "ticking off" from a police officer is an effective deterrent. The expert view was that this provides the opportunity for an element of explanation and education which a fixed penalty fine does not provide. An idea which emerged at the Delphi workshop, which we believe merits detailed consideration, is a more formal "yellow card" system for police warnings. The parallel is with the use of red and yellow cards in a number of sports, where the yellow card alone does no more than act as a warning, but another similar offence leads to a greater sanction (ie two yellow cards equate to a red card, and the player is sent off).

Current levels of fines were seen as low and thus ineffective. Other forms of penalty were cited as likely to have a greater impact, particularly on young drivers. Community service and re-training (driver improvement schemes) were given as examples, due largely to the loss of face involved in having to take part. We recommend that the penalties currently applied be reviewed and that the courts be encouraged to make greater use of a wider range of penalties.

Education and driver training

In contrast to punitive approaches to speed reduction, our research also suggests a range of positive factors which could be developed to raise general standards of driving and *inter alia* to discourage speeding.

There was a majority view that the current driving test is poor preparation for driving[2]. There was support, in varying degrees, for more thorough testing with some form of probationary period. Additional diagnostic or refresher sessions received some support, with some young drivers, looking back on their early days of driving, acknowledging their failings and suggesting a higher minimum age before a driving licence can be held. However there was little support for this in rural areas, where access to a car was seen as essential to maintain an independent lifestyle.

The thought of having to undergo compulsory retraining seems to be a particularly effective deterrent to those drivers with the highest opinion of their own driving abilities. This links to views on using appropriate penalties and reinforces our recommendation that a wider range of penalties be used. Professional opinion was that driver improvement schemes also make an impact on the attitudes and behaviour of the participants so they are particularly valuable.

[2] At the time of our surveys the changes to the driving test in May 1999 had not been introduced.

Routine opportunities for self-diagnosis of driving were seen as a positive way forward in the group discussions. One use for such opportunities would be after crashes. Many drivers found the experience, of even quite minor crashes, traumatic and felt they would benefit by addressing what happened in a "neutral forum". Comment was made that the "deny everything" advice from insurers did not promote opportunities for constructive criticism of events and behaviours leading to a crash. Expert opinion was that a more positive image needs to be presented of re-training; rather than seen as a punishment by the "boy racer". For many drivers the idea of developing skills and periodic reviews – a kind of MoT for the driver – has merit and would receive public support.

The project, *What Limits Speed?*

This two-year project has explored drivers' attitudes and behaviours with respect to speed in a number of ways. It has identified a wide disrespect for the laws governing speed and many reasons for it. On the basis of our research we have suggested above a number of policy initiatives which government could incorporate into the pending road safety strategy which would help to reduce the incidence of speeding and the consequent death and injury on the road.

Topics for further research

Speed hierarchy

It is our view that a speed hierarchy, motivated by the safety needs of all road users, should be overlaid on the road network. Although linked to current notions of a functional road hierarchy, this would recognise that the multiple use made of many roads means that lower speeds must prevail in certain locations. Examples might be where a radial trunk road passes through a district shopping centre and 20 mile/h may be appropriate, or on minor rural lanes where the current national speed limit of 60 mile/h is wholly inappropriate to their use by walkers, cyclists and equestrians. The concept of a speed hierarchy merits further study, linked to the recommendation for a national review of the criteria for the application of speed limits.

Technology and car design

Current trends in car design which offer greater comfort and insulate drivers from feedback about their speed were acknowledged as a factor which contribute to speeding. There are a variety of ways in which so-called intelligent vehicles could provide appropriate feedback or remove the decision about choice of speed from the driver. Further research in this area is necessary to get a better understanding of the likely behavioural responses to different levels of technological intervention.

The Highways Agency is considering ways in which capacities can be increased on the Motorway network, using technological developments. The variable speed limit signs on the M25 are an early example of attempting to use speed control to achieve capacity benefits.

We believe that the development of road user charging will eventually provide the basic infrastructure for communication between vehicle and roadside which can then be used to provide information about the limit or direct control of maximum speed in addition to its primary purpose of charging for road use. Further research is needed into the technical and the behavioural issues involved.

Road design and "natural traffic calming"

We refer above to the influence of the road environment on choice of speed. We are also aware of on-going research in the Highways Agency. Whilst factors such as other vehicles and familiarity also have a strong influence on a driver's choice of speed, there appears to be an opportunity here for using the layout and features of a road and its environment to influence speeds without overt traffic calming features. This notion of "natural traffic calming" could be built into new roads and some aspects may be possible additions to existing roads. Further research is needed to investigate this.

Setting and advising appropriate speeds

There is a presumption in the concept of an appropriate speed that it can be determined on some scientific basis, and that once determined it can be communicated to drivers who will respond. Both presumptions need careful study.

It is not sufficient to argue that speeds are too high and should be reduced. If advice or regulation is to be applied then the lower speed should be determined by more than an arbitrary reduction in those which currently prevail. Evidence does exist which relates speeds to crash risk and severity, although this is far from precise at any specific location. There are also other factors to be taken into account in setting an appropriate speed, such as environmental impact and journey time. We are aware that the government's *Speed Policy Review* is considering such issues.

It can also be argued that the appropriate speed will vary by time of day (perhaps reflecting traffic conditions or light) and by weather. An example of this exists in France where the limit is lower on motorways in the rain. Pursuing this to its conclusion leads to an extensive infrastructure to monitor conditions and to provide information or control on an almost continuous basis. Even were this practical, it is a long way into the future before it could exist.

Further research is needed to develop knowledge of the consistency (or otherwise) of a driver's choice of speed along a route and during the course of a journey, and to relate this to risk. This would inform the way in which an appropriate speed for a route, or an element of a road hierarchy, can be determined and applied.

If a rational basis for determining appropriate speed can be developed, there still remains the issue of informing drivers what it is and influencing them to adopt it. A combination of road design features and technology may offer solutions, but further research is needed in both these areas, as discussed above.

Employer pressure

It was alleged during our surveys that some speeding is caused by employers, perhaps unintentionally, setting unreasonable work schedules. If true, this appears to be equivalent to incitement to commit an offence and the practice should be penalised. There may be a rôle for the Health and Safety Executive in this respect. Research is needed to test the truth of the allegation, and if true, the extent of the practice.

On the other hand, it is clear that there is also potential for employers to introduce defensive driving programmes. These initiatives are now well developed for freight transport but have yet to make great inroads into white collar work-based driving. The potentially rapid payback from such programmes, which can be incorporated into green commuter programmes, would be an added incentive. We see employer-motivated advanced driving programmes as a positive opportunity to tackle speeding by a high mileage driver group.

Unlicensed driving

A serious concern which emerged from our surveys was that there is a minority of drivers for whom the sanction of disqualification is not effective, as they are willing to drive illegally. The extent and nature of illegal driving is little known. As it could increase substantially if passing a test and keeping a licence are made more difficult, this is a large area where further research is essential.

Driving tuition

There was much discussion in the focus groups about how people first learn and then continue to gain driving skills. In particular there was criticism of the driving test as not providing opportunity for "driving fast" (note that the interviews preceded the changes to the test in May 1999 which introduced driving on high-speed roads). It would be informative to monitor the impact of the test on driver attitudes and behaviour.

It would also be helpful to explore in more detail attitudes to increasing the take-up of "advanced driving tests" which our research suggests has the potential to attract drivers with a high propensity to speed.

Enforcement

Attitudes to enforcement (of speed limits) appear to be very relaxed and current methods of enforcement do not appear to be much of a deterrent. Views on different methods seem to differ as to their effectiveness and perceived fairness and equity. Further research would help to clarify these issues and inform the allocation of enforcement resources.

Our interviewees claimed that mobile cameras would be a greater deterrent than fixed cameras but it is not clear how many would need to be used to have an impact. It may be that greater use of fixed cameras would have a similar effect. Research into the potential impact of much greater use of cameras would be of value in justifying the substantial expenditure implied.

Propaganda

There is a need to discover more about attitudes to anti-speeding propaganda. In particular our research suggests that individuals in target groups re-interpret anti-speeding messages to exclude themselves from the target group. This appears particularly the case with TV advertisements and there is an urgent need to examine the effectiveness of this type of propaganda.

Supplement – video-drive analysis

Appendix A from the Technical Report: video-drive survey methodology

Appendix E from the Technical Report: analysis of video-drive data

APPENDIX A from the Technical Report: video-drive survey methodology

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1 Introduction

The video drive technique used in this study was developed and used as part of previous research conducted by the study team (Knox *et al.*, 1998[1]). For this AA Foundation study volunteers were recruited to complete a test drive, driving their own vehicle along a predetermined route accompanied by an observer to provide directions and to take notes, whilst the road ahead of the vehicle was video filmed from within the car. The observer's notes and video film clips were used during a subsequent interview of the volunteer where questions were asked as to what the driver was thinking and doing along various sections of the drive route. The film was also later used to derive speed measurements at various locations on each drive. Subsequent analysis investigated speeds and factors affecting choice of speeds by different categories of drivers and by different types of road.

2 Design of routes

To allow for a north/south comparison of drivers, two test routes were designed; one in Newcastle upon Tyne/ North Tyneside/ South Northumberland (the Newcastle route), the other in Watford/ South Hertfordshire (the Watford route). Each of the routes was designed to satisfy the following criteria:

- The route should allow the drive to start and finish at the same location where the subsequent interview takes place immediately after the drive;
- The drives should not normally take more than one hour to complete;
- The route should include a range of road types, traffic control facilities and situations;
- The two routes should include similar sections of road to allow direct north/south comparison;
- The route should include locations where speed-related crashes have been recorded; and
- The route should include sections where engineering measures have been installed to influence speed.

Assistance was sought from both the Local Authorities and Police in Newcastle and Watford to provide valuable local knowledge on the locations of engineering measures and areas where speeding was thought to be prevalent.

The two final routes are shown on Figures A1 and A2. These maps highlight the posted speed limit for each section along the route. The characteristics of each route, including the number of lanes, frontage and features, are described in Tables A1 and A2.

The two routes are deliberately similar in a number of ways. Firstly, the overall distance of the Newcastle and Watford routes is similar (41.75 km and 43.5 km respectively). The proportions of the various posted speed limits is also reasonably similar, except that the Watford route has a higher proportion of 30 mph limit roads. This reflects the nature of the roads generally in the Watford route area. A further similarity between the routes is the fact that they both include a comparable section of 70 mph, two lane dual carriageway of near motorway standard.

[1]Knox D J and Packham D (1998). Young male drivers' perception of pedestrians. Final report to DETR, London (unpublished).

Table A1 Newcastle route characteristics

Speed Limit Time Distance % Distance	Lanes	Frontage/Type of area	Features				Road Numbers
			Pelican	Signals	R'dbout	Other	
30 mph 27:13 17.78km *42.6%*	**Single** 23:16 14.13km *33.8%*	**Urban housing** 20:27 12.27km	8	2x 3 arm 1x 4 arm 1x staggered 4 arm	5x 4 arm 9x 3 arm	2 zebras	B1307 Sandyford Road A188 Benton Lane B1505 Benton Lane/ Great Lime Road C221 Southgate C101 Brunton Lane C154 Dinnington A191 Kenton Lane/ Salters Road
		Traffic calmed 2:49 1.86km			2 mini 3 arm 2x 3 arm	7 pinch points 2 cushion gateways	Unclassified West Bailey and East Baley
	Single 4 lanes 1:50 2.24km *5.4%*	**Shopping street** 1:50 2.24km	5				B1318 Gosforth High Street
	Dual 2:06 1.41km *3.4%*	**Urban housing** 2:06 1.41km	4				A1888 Bentdon Road
40 mph 5:25 3.55km *8.5%*	**Single** 1:30 0.94km *2.2%*	**Semi rural** 1:30 0.94km			1x 3arm 1x 4 arm	merge to two lanes	B1318 Past Gosforth Hotel
	Dual 3:55 2.61km *6.3%*	**Urban** 3:55 2.61km	1	1x 3 arm 1x 4 arm	1x 4 arm	bus lane	A1058 Jesmond Road/ Benton Bank/ Stephenson Road B1318
50 mph 2:55 2.42km *5.8%*	**Single 4 lane** 2:55 2.42km *5.8%*	**Urban housing** 0:25 0.27km			grade separated + countdown		A1058 Stephenson Road
		Semi rural 2.30 2.15km		1x 3 arm	1x 4 arm	bus lane	B1318 Great North Road
De-restricted (60 mph) 13:29 13.02km *31.2%*	**Single** 11:59 11.77km *28.2%*	**Semi rural** 4:36 4.29km			1x 3 arm 2x 4 arm		C221 Northgate A0156 Sandy Lane
		Rural-(narrow) 3:00 2.81km				wide changing to narrow, also chicane	Unclassified Brunton Lane
		Rural-(wide) 4:23 4.67km				30 mph gateway	C101 Brunton Lane C154 Dinnington to Prestwick
	Dual 1:30 1.25km *3.0%*	**Urban** 0:30 0.33km			1x 4 arm	3 lane approach to roundabout	A167 Ponteland Road
		Semi rural 1:00 0.92km			2x 4 arm	30 mph gateway	A188 Benton Lane
Motorway standard (70 mph) 3:35 4.98km *11.8%*	**Dual** 3:35 4.98km *11.8%*	**Rural** 3:35 4.98km			1x 3 arm at beginning 1x grade separated		A696 Woolsington Bypass

Notes: This table is based on a trial drive completed on 13 May 1998. The total time taken to traverse each section type along the route is given in minutes and seconds followed by the corresponding total distance in kilometres measured from a map. The percentage of the total distance is given in italics. The total time taken to traverse the route on this occasion was 52 minutes 30 seconds and the distance of the route measured from a map is 41.75km.

Table A2 Watford route characteristics							
Speed Limit Time Distance % Distance	**Lanes**	**Frontage/Type of area**	**Features**				**Road Name/Numbers**
			Pelican	**Signals**	**R'dbout**	**Other**	
30 mph 36:31 22.93km *52.7%*	**Single** 36:31 22.93km *52.7%*	**Urban** 9:38 5.15km	2no	2x 3 arm 2x 4 arm	1x 4 arm	4x speed cameras	Langley Road A411 Hempsted Road A4251 London Road Durrants Hill Primrose Hill Station Road
		Urban Housing 9:07 5:26km	1no		8x 3 arm mini	Traffic calming zone	St Albans Road Leys Road Barnacres Road
		Urban Shopping 2:34 1.44km	3no		1x 4 arm double mini	Marked parking bays	High Street Bovingdon High Street Kings Langley A4251 London Road
		Urban/Rural 7:59 5.05km		1x 3 arm 1x 4 arm	2x 3 arm	4x 30 mph roundels 1x speed camera Narrow railway bridge	The Street Tower Hill Chipperfield Road B4505 Hempstead Road B4505 Box Lane A4251 Watford Road A4251 Hempstead Road Lower Road Railway Terrace Home Park Link Road
		Rural 7:13 6.03km			1x 3arm	4x 30 mph roundels double bends wide to narrow following Motorway crossing	Fir Tree Hill Chandler's Lane Bucks Hill Chipperfield Common Tower Hill Chipperfield Road B4505 Hempstead Road A4251 Watford Road
40 mph 7:30 3.75km *8.6%*	**Single** 7:30 3.75km *8.6%*	**Urban/Rural** 0:52 0.86km					A4251 Hermpstead Road
		Rural 6:38 2.89km				2x Gateway to 30 mph	Bucks Hill Chipperfield Common B4504 Box Lane A411 Hempstead Road
50 mph 1:31 0.59km *1.4%*	**Single** 1:31 0.59km *1.4%*	**Rural** 1:31 0.59km		1x dual entry to r'bout	1x 4 arm (2x D2)	End of dual	A41 Watford Road
National Speed Limit 11:41 8.74km *20.1%*	**Single (60 mph)** 9:44 7.24km *16.6%*	**Rural-(narrow)** 3:32 3.43km				Humpback Bridge into double bends	Grove Mill Lane Chipperfield Road
		Rural-(wide) 6:12 3.81km			2x 3 arm 1x 5 arm (2x D2 2x M3)	Gateway to 40 mph	A4505 Box Lane A4251 London Road A4251 Watford Road
	Dual (70 mph) 1:57 1.5km *3.4%*	**Rural** 1:57 1.5km		1x 4 arm			A41 Watford Road
Motorway standard (70 mph) 4:35 7.53km *17.3%*	**Dual** 4:35 7.53km *17.3%*	**Rural** 4:35 7.53km			1x 5 arm (2x D2 2x M3)	Merge diverge at junctions. 2x Laybys Countdown markings approaching end r'bout	A41 Kings Langley Bypass

Notes: This Table is based on a trial drive completed on 23 June 1998. The total time taken to traverse the route on this occasion was approximately 1 hour 1.75 minutes. During this drive both the A411 and B4505 were subject to abnormal congestion. It is estimated that this resulted in delays totalling approximately 7 to 8 minutes. The total time taken to traverse each section type along the route is given in minutes and seconds followed by the corresponding total distance in kilometres measured from a map. The percentage of the total distance is given in italics. The distance of the route measured from a map is 43.50km.

As well as incorporating comparable sections of road, the two routes also include unique sections of particular interest. For example there are four speed cameras located along the Watford route which the Newcastle route does not have, and the Newcastle route incorporates a section of road through a residential area which is traffic calmed by speed cushions and giveway priority pinch points.

3 Recruitment of drivers

An attempt was made during the recruitment process to encourage equal numbers of male and female drivers in three age groups (17 to 20, 21 to 29 and 30+) to take part, and a target of 25 volunteers in each age/sex category was set. The age group bands were chosen based on the results of the crash data analysis completed earlier in the study. Methods of recruitment included household mailshots, the display of posters in various establishments and through local press articles. A valuable number of volunteers were also recruited by issuing invitations to AA members living in the study areas. Incentives were provided in the form of cash payments to cover expenses, entry into £100 prize draw and a further cash payment for introducing a friend to take part in the study.

It was important during the recruitment process not to mention to the volunteers that the research was investigating choice of speed. Instead volunteers were simply told that the research was investigating "different drivers on different types of road".

In practice it proved quite difficult to recruit younger people, and females in particular, perhaps because there is a smaller driving population within these categories, and they may also be less interested in taking part in such a study. Table A3 below shows the final numbers of drivers recruited. Although the number of drivers in the youngest age group is small, it was intended that part of the subsequent analysis could be conducted by combining some age and gender groups as well as northern and southern groups.

Table A3 Number of drivers in each age group

		17–20	21–29	30+	Total
Newcastle	Males	19	26	30	**75**
	Females	10	24	28	**62**
	Total	**29**	**50**	**58**	**137**
Watford	Males	11	18	24	**53**
	Females	6	20	27	**53**
	Total	**17**	**38**	**51**	**106**
All	Males	30	44	54	**128**
	Females	16	44	55	**115**
	Total	**46**	**88**	**109**	**243**

4 Drive protocol

A standard procedure was used to give an introduction and instructions to each volunteer upon arrival at the start of each test drive, and a brief questionnaire was used to gather some basic driver information. It was emphasised to the volunteer that the drive was not intended as a test, and that they should try, if possible, to drive as they would do normally. They were also reassured that although the drive observer accompanying them would be taking notes during the drive, these would relate to what was happening outside the car and not on what the driver was doing.

The drive route was then traversed with a video camera mounted within the passenger's side of the volunteer's car to film the road ahead. A trained drive observer accompanied the volunteer to provide directions along the route and also to make note of any incidents along the route that the filming would perhaps miss. A copy of the questionnaire and drive observation record which was combined onto one form is included as Appendix G. A supplementary rear-view mirror was fitted to allow the observer to note incidents of 'tail gating'.

To minimise the chances of any gender interactions between the volunteer and the drive observer which previous research suggests could affect the driver's behaviour (McKenna *et al.,* 1998), and for reasons of propriety where interviews were taking place out of hours and away from our office, it was ensured that the observer and volunteer were of the same sex for every drive.

5 Interview locations

A number of locations along each route were chosen as the stretches of road for use during the subsequent interview. During the interview the video recording of the drive through each interview location was played back to the driver, and questions were asked about each clip. It was found during trials that a total of around 15 core locations would fulfil the following criteria, and would result in an interview usually lasting not longer than one hour:

- The first location should be used as a practice location during the subsequent interview, so as to allow the volunteer to become familiar with the interview questions and procedure, and would not therefore, be used for data analysis;
- The interview locations should include a range of road types, facilities and situations and speed control features of particular interest;
- A number of interview locations on the northern and southern routes should be chosen to be similar, so as to allow for a direct north/south comparison;
- The interview locations chosen should include stretches of road where there was a higher possibility of drivers being able freely to determine their own speed; and
- Each location should normally take between 10 to 30 seconds to traverse to allow for a suitable length of video playback clip during the subsequent interview.

The start and end of the interview locations, once chosen, were then precisely defined with reference to road markings and street furniture. The drive observers could ensure therefore, that he/she could replay the video clip for the same locations during every interview. A description of the Newcastle and Watford route interview locations, including a description of comparable locations, is included in Appendix H. The interview locations are also highlighted on Figures A1 and A2.

By reference to the notes made during the drive on the drive observation record form, the method was also flexible enough to allow the observers to extend interview location clips or to insert new ones to include, where relevant, incidents of interest.

6 Interview protocol

After the drive, a standard procedure was followed during which the volunteer was reminded at the start of the interview that the process was intended to recreate their thoughts at the time of the drive, and not any subsequent thoughts that the driver may have after viewing the video filming. They were also reminded that the study was confidential and that they therefore should also try to tell the truth.

The interview room for both routes in the north and south was arranged to provide a triangular configuration between the television, the drive observer who conducted the interview, and the driver. This allowed the interviewer to select, then view, the clip of one of the predetermined interview locations at the same time as the driver before pausing the video to question the driver about that particular section of road. This was repeated for each of the interview locations and the questions remained the same for each driver and location. The interview responses were noted by the interviewer for each location and the interview session was audio taped as an additional record and aid to later analysis.

The standard set of questions used during the interview were developed as a result of several trial drives and interviews. A copy of the question sheet provided to the drivers, and the sheet used by the interviewer to record the responses, is included in Appendix G. It can be seen that for some of the questions a choice of standard responses is provided, but the drivers were advised that these were included only to act as a guide, and that they should elaborate as they thought appropriate. It was intended that a semi-structured interview would therefore ensue.

7 Actual speed measurements

An important part of the video drive surveys was to collect data on the actual speeds that the drivers were travelling at on different roads and situations. The speed at locations of interest were calculated using the video film tape frame counter and internal clock to measure the length of time elapsed as the subject vehicle passed between roadside features, the distance between which had been accurately measured on site. Two types of measurement of this nature were used:

- Measurements to the accuracy of 1/25th of a second over a typical total period of around 4 seconds using the single frame advance feature of the video equipment; and
- Measurements to the accuracy of one second over a typical period of around 20 to 30 seconds using the video recording internal clock.

As with the interview locations, the speed measurement locations were chosen to a set of criteria:

- The speed locations should include a range of road types, facilities and situations and speed control features of particular interest;
- A number of speed locations on the Newcastle and Watford routes should be chosen to be similar, so as to allow for a direct north/south comparison;
- The speed locations chosen should include stretches of road where there was a higher possibility of the driver being able freely to determine their own speed; and
- Some speed locations chosen should coincide with the interview locations so that the objective speed data could be compared with the subjective interview data.

Figures A1 and A2 show the positions of the chosen speed locations along each of the routes. A list of the speed locations in relation to the interview locations is included in Appendix H. Speed measurements were only made where it could be determined from the filming that the driver had a “free choice of speed”, defined as follows:

- The driver is free to choose the speed of their own vehicle and the driver has not had cause to reduce or maintain speed because of external factors such as other road users, traffic signals, parked vehicles or other obstructions.

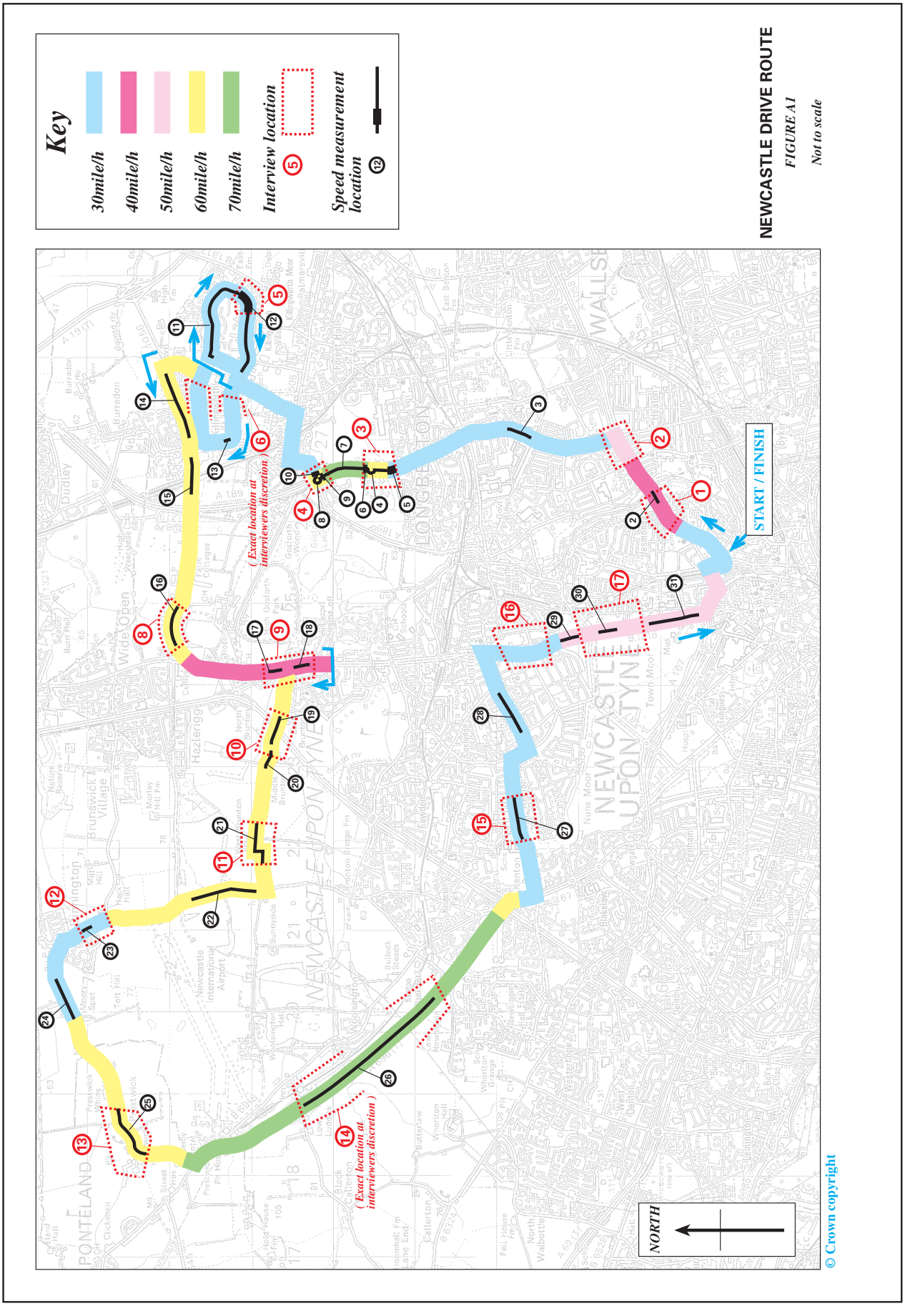
Instances where the subject vehicle was following other vehicles in a platoon were not included as it was impossible to determine whether the driver would otherwise have travelled at a faster speed. However difficulty sometimes arose when deciding whether the vehicle ahead was close enough to be defined as a platoon situation. In the event it was

decided that only a subjective decision could be made by the observers in this matter because the appropriate distance ahead of the vehicle in front to define a platoon would depend on the speed and the nature of the road. Using the time in seconds between the vehicle ahead and the subject vehicle would not take into account what was further ahead in the road, or what the vehicle ahead is likely to do next, both of which may affect the subject driver. In borderline cases the observers would confer, and would also err on the side of caution if there was any doubt.

The study team endeavoured to schedule the test drives during less busy times of day to try to maximise the occasions of "free choice of speed". Table A4 below shows that enough instances of "free choice of speed" were achieved to enable a large amount of speed measurements to be made.

Table A4 Number of speed measurements made	**Newcastle**	**Watford**
Number of drivers	137	106
Number of speed measurement locations	30	27
Potential number of speed measurements	4,110	2,837*
Actual number of "free choice" speed measurements made	2,473	1,945
Percentage of actual measurements to potential	60%	69%

* NB The first 25 drivers on the Watford route did not pass one of the speed measurement locations due to a slight alteration in the route because of road works.


Key
30mile/h
40mile/h
50mile/h
60mile/h
70mile/h
Interview location
5
Speed measurement location
12
NEWCASTLE DRIVE ROUTE
FIGURE A1
Not to scale
START / FINISH
NORTH
(Exact location at interviewers discretion)
(Exact location at interviewers discretion)
© Crown copyright

Key
30mile/h
40mile/h
50mile/h
60mile/h
70mile/h
Interview location
5
Speed measurement location
12
WATFORD DRIVE ROUTE
FIGURE A2
Not to scale
START / FINISH
(Exact location at interviewers discretion)
(North bound)
NORTH
© Crown copyright

Appendix E from the Technical Report: analysis of video-drive data

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1 Basic comparison of driver samples (Newcastle and Watford)

Table E1 below shows the mean values for drivers' self reported age, experience, car engine size and annual mileage for the female and male drivers in the Newcastle and Watford samples.

Table E1 Basic comparison of male and female drivers – Newcastle and Watford

		Newcastle			Watford		
		Male	**Female**	**Total**	**Male**	**Female**	**Total**
NUMBER		75	62	**137**	53	53	**106**
AGE	**Mean**	31.85	35.31	**33.42**	34.51	32.87	**33.69**
EXPERIENCE (no. of years since passing Driving-test)	**Mean**	12.77	13.90	**13.29**	15.36	13.04	**14.20**
CAR ENGINE SIZE (in litres)	**Mean**	1.44	1.32	**1.39**	1.58	1.47	**1.52**
MILEAGE (estimated annual mileage)	**Mean**	12,224	8,366	**10,483**	14,741	8,014	**11,279**

It can be seen from the above table that there is a similar mean age for the males and females in the Newcastle and Watford samples, and using Student's t-test no significant difference (at the 5 per cent level) was found.

The mean numbers of years since passing the driving test were also found to be similar and again no significant difference was found between male and female drivers.

When comparing the mean engine sizes of the cars used by the sample drivers in Newcastle with those in Watford it was found that the Watford drivers have a significantly larger car engine size. It was also found that the mean car engine size of the Newcastle male drivers is significantly higher than for the Newcastle females. Although these differences are statistically significant, their absolute values are small.

No significant difference was found when comparing the mean estimated annual mileage for the Newcastle drivers and the Watford drivers. However the larger mean mileage of the males when compared to the females was found to be a significant difference for both locations.

As stated previously, an attempt was made during the recruitment process to encourage equal numbers of drivers in three age groups to take part. Table E2 below shows the mean for self reported age, experience, car engine size and annual mileage for the three age groups in the Newcastle and Watford samples.

Table E2 Basic comparison of driver age groups – Newcastle and Watford							
		Newcastle			Watford		
		1	2	3	1	2	3
		17–20	21–29	30+	17–20	21–29	30+
NUMBER		29	50	58	17	38	51
AGE	Mean	18.48	24.68	48.41	18.17	24.82	45.47
EXPERIENCE (no. of years since passing Driving-test)	Mean	1.21	6.44	25.14	0.88	6.26	24.55
CAR ENGINE SIZE (in litres)	Mean	1.28	1.34	1.48	1.37	1.47	1.61
MILEAGE (estimated annual mileage)	Mean	8,355	11,073	10,938	7,476	12,880	11,237

It can be seen that the corresponding age groups in the Newcastle and Watford samples have very similar mean ages and number of years experience. The mean car engine sizes in Watford are generally larger but the differences were not found to be significant when comparing corresponding age groups. There is variation in the mileages between corresponding age groups but again the differences were not found to be significant.

When comparing the mean car engine sizes between the age groups for the Newcastle sample it can be seen that the mean size increases with age. The differences in mean car engine size were found to be significant between age groups 2 and 3, and between age groups 1 and 3. A similar pattern of increasing car engine size with age also exists for the Watford sample and a significant difference was found between age groups 1 and 3. The absolute values of the differences are not large, ranging from a mean of 1.3 litres for the youngest Newcastle group to a mean of 1.6 litres for the oldest Watford group.

The Newcastle and Watford samples follow a similar pattern when comparing the mean annual mileage between age groups. The age group 2 has the highest mean mileage followed by age group 3 then age group 1. However, the differences between age groups within each sample were not found to be significant.

1.1 Summary

- The males in the Newcastle and Watford samples tended to drive further than the females.
- The males in the Newcastle sample used cars with larger engine sizes than the females.
- The mean engine size of the cars used in both samples increased with the older the age group.
- The mean mileage was greatest for age group 2 followed by age groups 3 then 1 for both samples, but the differences were not found to be significant.

2 Analysis of actual speed data, by location

2.1 Introduction

When considering the results of the analysis of the actual speeds of drivers, it is important to remember that the speed data used only relates to those cases where drivers had a "free

choice of speed" as defined within the methodology. There is no speed data for speed locations 4 and 8 on the Newcastle route because the distances could not be physically measured on site (data for these locations consists only of time elapsed)[1].

Speed measurements were made for a total of 30 different locations along the Newcastle route (numbered 2 to 31) and 27 locations along the Watford route (numbered 2 to 28)[2]. In total this resulted in a total of 2,473 and 1,945 "free choice of speed" events on the Newcastle and Watford routes respectively. The position of the speed locations in relation to the interview locations are tabulated in Appendix H and can be seen in Figures A1 and A2 in Appendix A (held by the AA Foundation). Table E3 below provides a summary of the total number of locations and "free choice of speed" events within each speed limit.

Table E3 Number of speed measurement locations and "free choice of speed" events in each speed limit

Speed Limit	Newcastle		Watford	
	Number of locations	Number of "free choice of speed" events	Number of locations	Number of "free choice of speed" events
30	9	710	16	1,019
40	3	254	3	227
50	3	155	0	0
60	9	750	6	517
70	4	438	2	182
Mixed	2	166	0	0
Total	**30**	**2,473**	**27**	**1,945**

Analysis has been completed for each route and speed location by:

- the proportions of speeding drivers and the amount that the 85th percentile speed exceeded the speed limit;
- the proportions of males and females above and below the mean speed;
- comparison of the mean age of those drivers travelling at the 85th percentile speed or higher, with the mean of the other drivers;
- comparison of the mean number of years experience of those drivers travelling at the 85th percentile speed or higher, with the mean of the other drivers;
- comparison of the mean annual mileage of those drivers travelling at the 85th percentile speed or higher, with the mean of the other drivers; and
- comparison of the mean car engine size of those drivers travelling at the 85th percentile speed or higher, with the mean of the other drivers.

The 85th percentile speed was used as the level for which the drivers could be divided into "fast drivers" and "other drivers" for the simple reason that it was the level that was found would provide enough numbers of the very fastest drivers to allow confidence in the calculations of their mean characteristics for use when comparing with the "other drivers". The 85th percentile speed is also commonly used for design purposes, although its choice is largely arbitrary.

[1] These time measurements were made as the vehicles negotiated a large roundabout for which different lanes and therefore distances could be traversed by different drivers.
[2] Location 1 on each route is a record of the total time taken to traverse the route.

A summary of the method of each category of analysis and overall conclusions for the actual speed data is presented below. A detailed description and the findings from the actual speed data for each speed location in turn are included in Appendix F (held by the AA Foundation). Tables E4 and E5 summarise the findings for the Newcastle and Watford routes in turn.

2.2 Analysis by proportions of speeding drivers, by location

2.2.1 Method

The charts in Figures E1 and E2 show the proportions of drivers who, with a "free choice of speed", were travelling at speeds greater than the speed limit for each location on the Newcastle and Watford routes. Tables E4 and E5 highlight the same locations and also provide a rank score in order of the highest proportion of speeding drivers. There are several speed locations where there were no drivers recorded as speeding. It should be noted that the characteristics of some of these locations would make it realistically impossible to speed (eg 70 mile/h limit on the approach to a roundabout).

2.2.2 Newcastle results

On the Newcastle route there were found to be 14 locations where speeding occurred, covering 692 instances in total. Speed measurements were not possible for locations 4 and 8, only time elapsed. Location 5 was chosen as it was on the approach to a roundabout but the speeds could not be compared to the speed limit here because the drivers passed from a 30 mile/h into a 60 mile/h limit zone. Therefore their speeds within each of the individual speed limits, were not known.

Table E4 Newcastle route summary table of actual speed analysis

	Analysis of 85th percentile speed and number of drivers above and below the speed limit							Analysis of characteristics of fast drivers				Analysis of the proportions of males and females above or below the mean speed						
Speed Location	Speed limit (mile/h)	85th percentile speed (mile/h)	85th percentile speed exceeds speed limit (rank)	Number of drivers below speed limit	Number of drivers above speed limit	Proportion of drivers above speed limit (%)	Proportion of drivers over the speed limit (rank)	Fast drivers mean age is significantly lower than other drivers (rank)	Fast drivers mean experience is significantly lower than other drivers (rank)	Fast drivers mean mileage is significantly higher than other drivers (rank)	Fast drivers mean car engine size is significantly higher than other drivers (rank)	Mean speed (mile/h)	Significant proportion of males above mean speed?	Number of males below mean speed	Number of female below mean speed	Number of males above mean speed	Number of females above mean speed	Total number of drivers with free choice of speed
2	40	49.2	2	17	47	73	8					43.77		18	20	17	9	64
3	30	37.38	4	2	50	96	1				1	33.99		12	14	14	12	52
4	30/60/70	n/a	n/a	n/a	n/a	n/a		1	1			n/a		14	14	16	17	61
5	30/60	42.38	n/a	n/a	n/a	n/a						38.38		14	19	20	17	70
6	70	37.26		111	0	0						34.7		29	30	31	21	111
7	70	45.53		102	0	0		3	5			42.21	yes	23	27	36	16	102
8	70/60/30	n/a	n/a	n/a	n/a	n/a						n/a		8	7	12	8	35
9	70	39.62		101	0	0						36.37		26	21	33	21	101
10	30	33.39	10	40	55	58	10	15	14			30.77		27	25	24	19	95
11	30	37.02	5	10	80	89	3					33.96		27	17	23	23	90
12	30	38.13	3	27	96	78	6					33.84		39	28	29	27	123
13	30	30.87	12	74	18	20	12	2	2			27.72		30	24	20	18	92
14	60	45.46		93	0	0		8	11			40.48		27	31	17	18	93
15	60	42.43		79	0	0		12	4			39		19	25	20	15	79
16	60	45.86		59	0	0						43.54		12	12	19	16	59
17	40	41.88	11	58	29	33	11	7	7			38.33		23	25	25	14	87
18	40	46.29	7	30	73	71	9	11	10			42.59		26	26	33	18	103
19	60	47.53		127	0	0		5	3			43.1	yes	32	38	36	21	127
20	60	31.99		101	0	0		6	6			27.83	yes	22	29	33	17	101
21	60	25.19		85	0	0		13	15			22.76	yes	15	25	29	16	85
22	60	48.3		118	0	0		4	9			43.28	yes	24	32	40	22	118
23	30	35.07	8	15	67	82	5	16				32.08		16	23	25	18	82
24	30	40.89	1	4	87	96	2					36.41		25	25	20	21	91
25	60	37.42		88	0	0		10	16			34.14		24	27	22	15	88
26	70	70.43	13	104	20	16	13					63.05	yes	23	36	43	22	124
27	30	34.41	9	6	21	78	7					31.96		12	6	6	3	27
28	30	36.7	6	10	48	83	4		13			33.67		14	15	17	12	58
29	50	38.21		38	0	0						36.52		13	4	12	9	38
30	50	42.98		72	0	0		14	8			38.08		23	17	20	12	72
31	50	48.66		45	1	2	14	9	12			44.45		15	10	15	5	45

NB Fast drivers are those travelling at or exceeding the 85th percentile speed.
Shading indicates those locations where speeding took place, or where a significant finding was made (P<5 per cent).

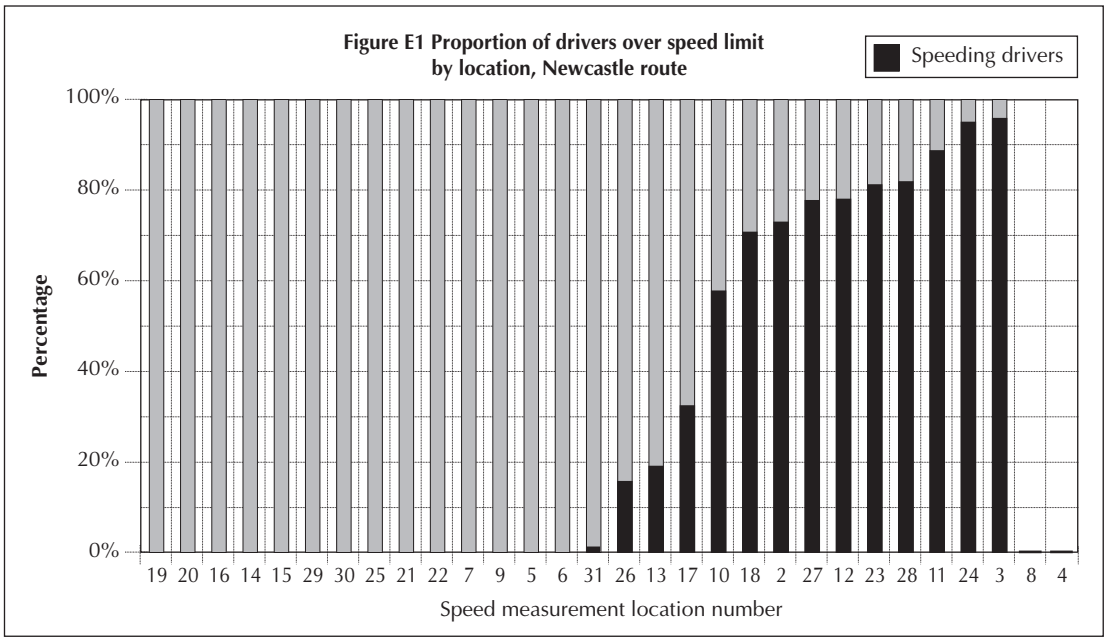
Table E5 Watford route summary table of actual speed analysis

	Analysis of 85th percentile speed and number of drivers above and below the speed limit							Analysis of characteristics of fast drivers				Analysis of the proportions of males and females above or below the mean speed						
Speed Location	Speed limit (mile/h)	85th percentile speed (mile/h)	85th percentile speed exceeds speed limit (rank)	Number of drivers below speed limit	Number of drivers above speed limit	Proportion of drivers above speed limit (%)	Proportion over the speed limit (rank)	Fast drivers mean age is significantly lower than other drivers (rank)	Fast drivers mean experience is significantly lower than other drivers (rank)	Fast drivers mean mileage is significantly higher than other drivers (rank)	Fast drivers mean engine size is significantly higher than other drivers (rank)	Mean speed (mile/h)	Significant proportion of males above mean speed?	Number of males below mean speed	Number of female below mean speed	Number of males above mean speed	Number of females above mean speed	Total number of drivers with free choice of speed
2	40	40.46	17	52	17	25	16					38.05		11	19	20	19	69
3	30	35.64	9	10	33	77	7					32.35		7	14	10	12	43
4	30	32.48	15	35	39	53	13			1		30.57	yes	10	25	24	15	74
5	30	29.59	20	77	11	13	19	11				24.43	yes	20	29	27	12	88
6	30	33.41	13	47	44	48	14					30.13	yes	19	29	27	16	91
7	30	34.46	11	12	37	76	9			2		31.74		8	14	10	17	49
8	30	42.39	1	10	60	86	5	*	*			36.14		18	21	9	22	70
9	30	39.04	3	16	50	76	8	*	*			33.68		16	18	12	20	66
10	70	50.38		91	0	0						45.17	yes	22	36	22	11	91
11	30	32.55	14	18	15	45	15					29.45		6	12	9	6	33
12	30	35.35	10	10	30	75	10					32.17		7	9	16	8	40
13	30	36.47	6	3	41	93	4					33.2		12	12	8	12	44
14	30	36.09	8	14	38	73	11					32.03		15	16	7	14	52
15	60	24.25		78	0	0		7	7	4		22.2	yes	14	23	26	15	78
16	60	37.24		102	0	0					1	34.13		24	29	28	21	102
17	60	36.47		99	0	0		9		3		32.89	yes	20	35	30	14	99
18	30	36.36	7	13	73	85	6	4	4			32.77	yes	17	30	24	15	86
19	40	38.08	21	85	10	11	20	5	6			35.14	yes	18	35	24	18	95
20	30	34.27	12	38	43	53	12	6	3			30.9		20	30	16	15	81
21	40	39.85	19	68	7	9	21	1	2			36.49	yes	13	32	17	13	75
22	30	37.96	4	4	79	95	3	2	1			34.28		24	31	14	14	83
23	60	49.29		70	0	0		10	8			44.06	yes	10	27	20	13	70
24	40	40.11	18	51	12	19	18	8	9			37.37		12	20	15	16	63
25	30	36.75	5	1	51	98	1	12				34.35		13	23	7	9	52
26	60	42.5		93	0	0		3	5			38.68		18	30	25	20	93
27	70	70.59	16	73	18	20	17					63.08	yes	13	33	33	12	91
28	30	40.08	2.	2	65	97	2					36.03		15	21	15	16	67
														402	653	495	395	1,945

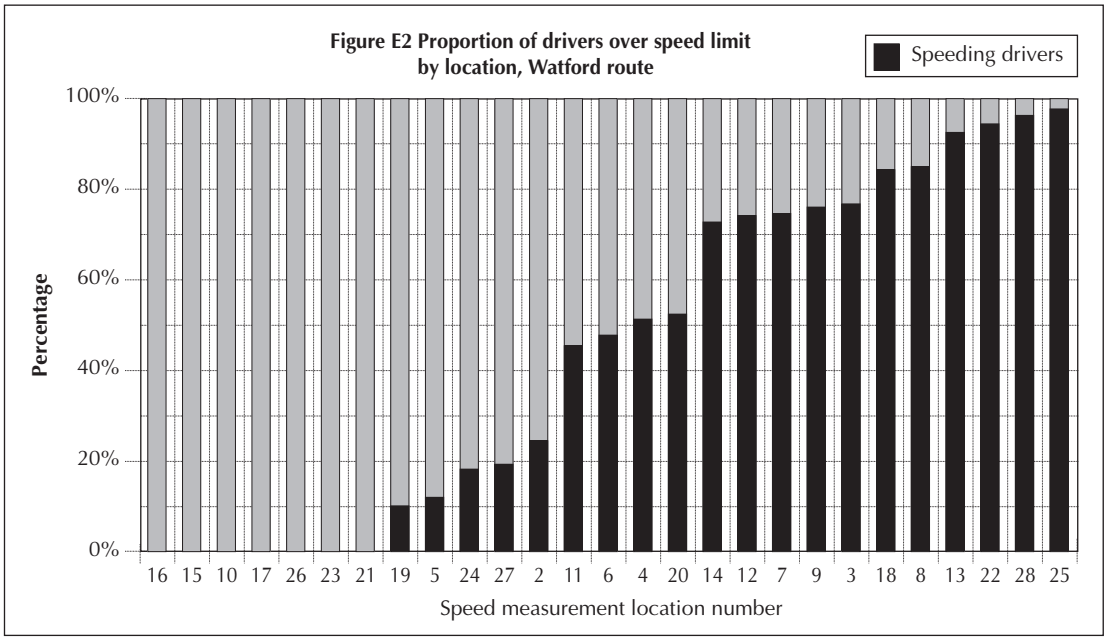
NB Fast drivers are those travelling at or exceeding the 85th percentile speed.

*Approaching significance for mean age and experience of fast drivers being higher rather than lower when compared to other drivers.

Shading indicates those locations where speeding took place, or where a significant finding was made (P<5 per cent).



NB Location 1 was used as a record of the time to traverse the whole route. Only time measurements, not speed measurements were possible for Locations 8 and 4.



NB Location 1 was used as a record of the time to traverse the whole route.

30 mile/h location

For the Newcastle route it can be seen that all nine of the 30 mile/h speed measurement locations have speeding drivers, and that these include the seven locations with the highest proportion of speeding drivers for the whole route. Of these 30 mile/h locations, the location with the highest proportion of speeding drivers (location 3) was the only location which included a section of dual carriageway. Nearly every driver broke the speed limit at this location (96 per cent). A location with a similar high proportion of speeding drivers (location 24, also 96 per cent), though single carriageway, was the only location not bordered by housing and a footway on both sides. The nearside consisted only of a verge and hedge. Similarly, locations 11 and 28, ranked 3 and 4 respectively, were the only other 30 mile/h locations that did not have a footpath and housing access on both sides along the whole of their length. For example location 11 was bounded mostly by footways, wide

grass verges and only the sides or back garden fences of housing, and location 28 had no housing on the nearside, only a wide footway and continuous high wall. These locations also had good forward visibility.

The 30 mile/h section with the least proportion of speeding drivers was location 13 which was the only traffic calmed section of road. There were two 30 mile/h locations (10 and 23) which included large 30 mile/h "please drive carefully" signs. Location 10, despite the sign and a lower ranking (10), still had over half (58 per cent) of all the drivers breaking the speed limit. Other factors at this location that may have caused less drivers to break the speed limit were that it was positioned just after a bend and not long after the exit from a roundabout. In contrast the other location with a 30 mile/h "please drive carefully" sign (location 23), was a straight section with good visibility. This location had 82 per cent of drivers exceeding the speed limit and was ranked 5th highest of the sections by proportion speeding.

40 mile/h locations

All three of the 40 miles/h locations also had speeding (locations 2, 18 and 17) and these were ranked 8, 9 and 11 respectively, with 73, 71 and 33 per cent of drivers exceeding the speed limit respectively. Location 17, which had a much lower proportion than the other two, was the only section consisting of a single lane carriageway.

50 mile/h locations

There was only one 50 mile/h location where it was realistically possible to speed (location 31) and this only had a very small proportion of speeding drivers (2 per cent). The other locations were on the approach and exit of a busy roundabout.

60 mile/h locations

No drivers were found to be speeding on any of the eight, 60 mile/h speed locations on the Newcastle route. However, for three of these locations (locations 20, 21 and 25) it would be realistically impossible to speed due to their geometry of bends and narrow widths.

70 mile/h locations

The single location with a 70 mile/h limit where it was realistically possible to speed (location 26) consisting of dual carriageway, only had a relatively small proportion of speeding drivers (16 per cent, rank 13).

2.2.3 Watford results

On the Watford route there were found to be 21 locations out of 27 where a number of drivers exceeded the speed limit, covering 766 instances in total.

30 mile/h locations

Every one of the sixteen 30 mile/h speed locations on the Watford route had drivers exceeding the speed limit and 15 of these locations were ranked as the locations with the highest proportion of speeding drivers. The other location (5), was probably not ranked as high because it was positioned across a roundabout where drivers would obviously have to slow down.

The location with the highest proportion of speeding drivers was location 25 where nearly all drivers (98 per cent) exceeded the speed limit. This location is positioned on a stretch of single carriageway road and starts at a 30 mile/h speed limit gateway consisting of signs, roundels and coloured surfacing. Earlier on the same stretch of road the drivers had also to pass from a 60 mile/h limit through a similar 40 mile/h gateway. However, during these changes in speed limit the road has not otherwise changed very much in terms of geometry

or surfacing. It is not known whether the 30 mile/h gateway has reduced speeds compared to when it was not there, but in our survey hardly any drivers obeyed the speed limit. Other locations that start from 30 mile/h limit posts with additional signing or gateway features are locations 18 and 22 which have 85 per cent (rank 6), and 95 per cent (rank 3) of drivers exceeding the speed limit respectively. These locations, despite being 30 mile/h zones, had little frontage activity and good forward visibility and it would appear that despite additional signing or gateway features, many drivers break the speed limit.

Location 28, which has the second highest proportion of speeding drivers, is positioned on the approach to a village shopping street, not long after the 30 mile/h limit starts, and is wide and also has good forward visibility. There is also not much frontage activity on this stretch.

The fourth ranked location (location 13) is along a major A road, and though it passes through a residential area there are no direct housing frontages at the sides of the road. This 538m section also includes a speed camera but despite this, it had 93 per cent of drivers exceeding the speed limit. Location 14 is a 38.7m long speed location which is positioned along the speed camera road markings within location 13. Although the mean speed and 85th percentile speeds measured for locations 13 and 14 are similar, there were found to be less speeding drivers (73 per cent, rank 11) within the immediate vicinity of the speed camera.

The other locations that were positioned in the immediate vicinity of speed cameras, along their road markings, were locations 8, 9 and 11. The proportions of speeding drivers at the speed camera locations are as follows:

- location 8: 86 per cent rank 5;
- location 9: 76 per cent rank 8; and
- location 11: 45 per cent rank 15.

Location 11 is the 30 mile/h location with the second lowest proportion of speeding drivers. From the rank of the other speed camera locations however, it would seem that there must be other factors that have resulted in a lower proportion of speeders here, other than the speed camera alone. These factors may include the pedestrian refuge, pelican crossing and side roads located near the speed camera at this location.

It would appear that there are just as many speeding drivers at the speed camera locations on the Watford route as there are for locations without speed cameras. The mean speeds and 85th percentile speeds are also no lower at the speed camera locations compared with other locations with no speed cameras. It could be that the speed cameras have encouraged lower vehicle speeds where they have been installed compared to the same location before they were installed, but there are still many speeding drivers. It could also be the case that the speed cameras have reduced the number of cases of extreme speeding, which our study method would be unlikely to detect because our drivers are unlikely to drive at extreme speeds whilst they are being observed.

The other 30 mile/h locations with speeding drivers include location 3 which, despite being a single carriageway and nearly always having a row of parked vehicles along its length, had 77 per cent (rank 7) of drivers exceeding the speed limit. Location 7 includes a narrow tunnel under a railway line, but 76 per cent (rank 9) of drivers still exceeded the speed limit, perhaps because the road within this stretch is otherwise wide, with little frontage activity. Location 20 had a smaller proportion of speeding drivers (53 per cent – rank 12). This is perhaps explained by the fact that the road is quite narrow and has a bend within the stretch as well as passing through a village centre with cross roads. There are also a number of 30 mile/h road marking roundels within the stretch. The location is also preceded by a 40 mile/h speed limit zone with bendy narrow roads enclosed by foliage which means the vehicles speeds on the approach to this location were not very high. However, much of the nearside consists only of a village green with no footpath or frontage activity. Location 4 perhaps has a lower proportion of speeders (53 per cent – rank 13)

because it is along a steep uphill gradient. Location 6 has the third lowest proportion of speeding drivers despite being on a downhill gradient, perhaps because it is located after a mini roundabout, and is within a residential area.

40 mile/h locations

There were a number of drivers found to be speeding on all three of the 40 mile/h locations. Of these, location 2 had the highest proportion of speeding drivers (25 per cent – rank 16) and this road is wide, has footways but has little frontage activity. Location 24 had 19 per cent (rank 18) of drivers speeding. This location starts from a 40 mile/h limit "gateway" consisting of signing, coloured surfacing and a 40 mile/h road marking roundel. It should be noted that the mean speed after the gateway was 6.7 mile/h less compared with the mean speed on the stretch before the gateway. Location 19 is a location consisting of a narrow rural road without footways and is bordered by foliage which, in combination with several bends, lowers the forward visibility. Perhaps because of this there is only a small proportion of speeding drivers on this stretch of road (11 per cent – rank 20).

60 mile/h locations

No drivers were found to be speeding on any of the six, 60 mile/h speed locations on the Watford route. On three of these locations (15, 16 and 17) it would be realistically impossible to speed due to the geometric characteristics of these locations.

70 mile/h locations

There were two 70 mile/h locations on the Watford route, on only one of which were any drivers found to be speeding. This was location 27, the motorway standard Kings Langley bypass where 20 per cent (rank 17) of drivers were found to be exceeding the speed limit.

2.2.4 Summary

- Most speeding takes place on 30 mile/h roads. The location with the most speeding drivers (98 per cent) on the Newcastle route was on the only 30 mile/h stretch with dual carriageway.
- The proportions of speeding drivers on 40 mile/h roads was generally lower, but was still high (more than 70 per cent) if the road was dual carriageway or four lane single carriageway.
- On the only 50 mile/h speed location, which was four lane single carriageway, only two per cent of drivers were found to be speeding.
- No drivers were recorded as speeding at any of the 60 mile/h speed locations. On some of these rural roads realistically it would be impossible to speed.
- Similar mean speeds and 85th percentile speeds were recorded on the 70 mile/h bypass sections on the Newcastle and Watford routes, though slightly more drivers were found to be speeding on the Watford section (20 per cent compared with 16 per cent).
- "Please drive carefully" signs and additional speed limit signs did not appear to have much effect on the proportions of speeding drivers compared with other locations without additional signs. It is possible that other factors were more likely to have an affect on the choice of speed at these locations.
- Fixed speed camera locations did not necessarily have many fewer speeding drivers compared with other locations. However it was not known whether the use of speed cameras had reduced speeds at these locations compared to prior to their installation.
- The sections of route that had the highest proportions of speeding drivers were typically wide, straight, with good forward visibility and had little frontage activity.

The driver interview data analysis which appears later provides further information on what the drivers' *said* affected their choice of speed.

2.3 Analysis by proportion of males and females above and below the mean speed, by location

2.3.1 Method

For each of the speed measurement locations the mean speed was calculated, apart from locations 4 and 8 on the Newcastle route where the mean time elapsed was calculated. Tables E4 and E5 show the numbers of males and females above and below the mean speed for each location on the Newcastle and Watford routes respectively.

It can be seen that in most cases there was a larger proportion of males travelling above the mean speed. The chi-squared test was used to calculate the probability that the actual and expected frequencies of males and females are similar by chance. Those locations where the differences were not very likely to have occurred by chance (P<5 per cent) are shaded grey in Tables 5.4 and 5.5.

2.3.2 Newcastle results

On the Newcastle route there are two sections of 70 mile/h road which consist of dual carriageway. At location 7 the dual carriageway section runs between two roundabouts and is relatively short. Therefore no drivers were recorded as breaking the speed limit. On the other, longer stretch of dual carriageway (location 26) 16 per cent of drivers exceeded the speed limit. At both of these locations there was a significantly larger proportion of male drivers above the mean speed. Of the locations where speeding occurred, location 26 was the only location on the Newcastle route where there was a significantly larger proportion of males.

The other locations on the Newcastle route where there was significantly larger proportions of male drivers above the mean speed were locations 19, 20, 21, and 22 all of which were 60 mile/h rural sections with no footways and little frontage activity, and with no drivers recorded as exceeding the speed limit. Locations 20 and 21 in particular are narrow roads with bends and limited forward visibility, whereas location 19 has limited forward visibility only at the end of the stretch. Location 22 in contrast is a wide, fast stretch of 60 mile/h road with good forward visibility.

2.3.3 Watford results

As with the Newcastle route, there were two, 70 mile/h sections of dual carriageway along which speeds were recorded on the Watford route, and where a significant proportion of male drivers were found to be above the mean speed. On one section (location 10) no drivers exceeded the speed limit, probably due to the fact that it is a relatively short section of dual carriageway ending at a traffic signal controlled junction. On the other longer section of bypass (location 27), 20 percent of drivers were found to be speeding.

A significantly larger proportion of male drivers were also found to be exceeding the mean speed at locations 4, 5 and 6. These locations are within a residential housing estate. Location 4 is along an uphill gradient with central bollards and locations 5 and 6 are along a downhill gradient where location 5 is positioned across a mini roundabout, and location 6 is positioned after the same mini-roundabout. There were only found to be a relatively small proportion of speeding drivers at each of these locations (ranked 13, 19, and 14 respectively).

Locations 15, 17, 18, 19 and 21 are rural roads on the Watford route where a significantly larger proportion of males were found to be travelling above the mean speed. These roads are all narrow with bends, and have foliage along the edges which reduces the forward visibility. Locations 18 and 19 were found to have a number of speeding drivers, with location 18 ranked 6 in this respect, and location 19 only ranked 20.

A further location with a significantly larger proportion of males exceeding the mean speed was location 23. This location is a single carriageway road on a down hill gradient with central hatching along a portion of its length and so is therefore quite wide. The national 60 mile/h limit applies. No drivers were found to be exceeding the speed limit on this stretch, but it has the fastest mean speed for any of the 60 mile/h locations on the Watford route.

2.3.4 Summary

At nearly all of the locations there was a larger proportion of male than female drivers exceeding the mean speed. The types of locations where the larger proportion of male drivers exceeding the mean speed was found to be significant were as follows:

- on the two stretches of 70 mile/h dual carriageway on each of the Newcastle and Watford routes;
- on the rural sections of route where there are narrow roads, bends and limited forward visibility on both the Newcastle and Watford routes;
- except for one location (location 18 on the Watford route), on roads that did not rank highly for the proportion of speeding drivers;
- on two sections of road within a housing estate, on the Watford route only;
- on the fastest section of 60 mile/h limit road on the Watford route where the road is wide and has good visibility; and
- on only one of three roads on the Newcastle route that had 60 mile/h limits and good forward visibility.

2.4 Analysis of the mean age and experience of the "fast drivers" compared with the mean of the "other drivers", by location

2.4.1 Method

For each of the speed measurement locations the mean age and the mean number of years since passing the Driving-test was calculated for those drivers travelling at, or exceeding the 85th percentile speed (the "fast drivers"), and also for those drivers travelling below the 85th percentile speed (the "other drivers"). Student's t-distribution was used to compare the mean age and experience for the "fast drivers" and "other drivers" at each location on the Newcastle and Watford routes. The results are shown by the charts in Figures E3 to E6 and those locations where a significant difference was found are highlighted in Tables E4 and E5.

As similar findings were made when using mean age and when using mean experience to compare the "fast drivers" and "other drivers", the two are discussed together below. It can be seen that in most cases the mean age and experience is lower for the "fast drivers" and a rank score has been allocated to those locations where the lower mean age and experience of the "fast drivers" was found to be most significant.

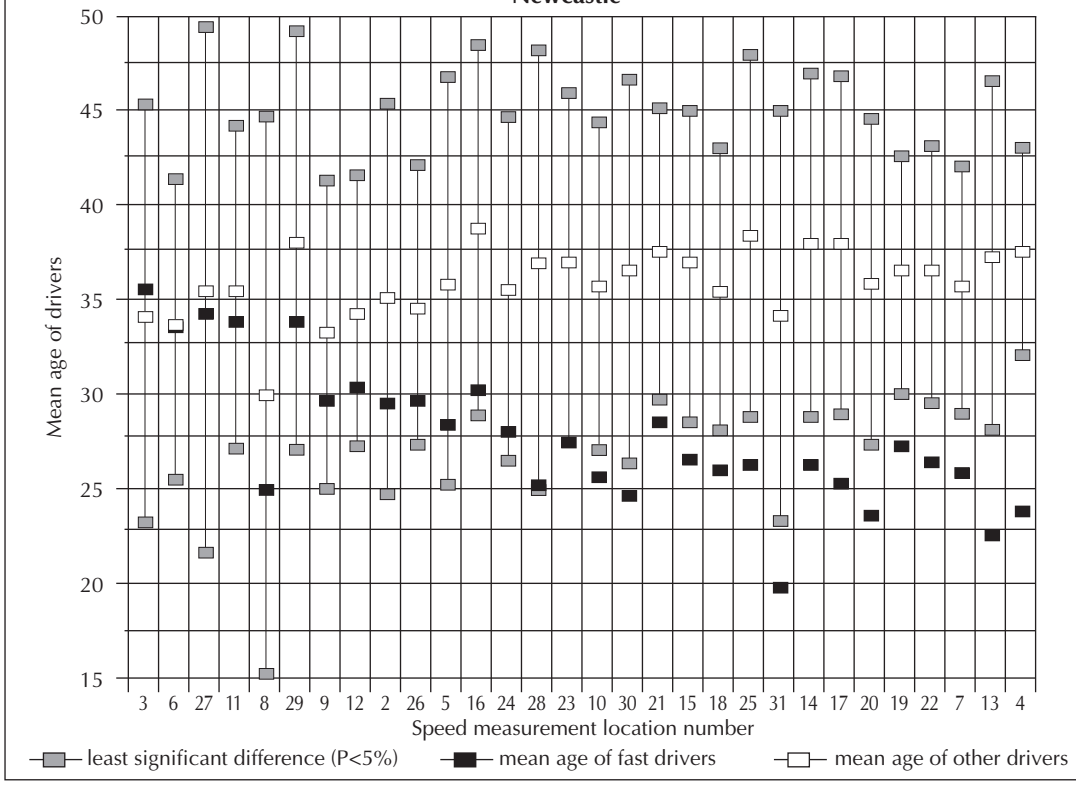
2.4.2 Newcastle results

There is a general tendency for younger drivers to drive faster and the location with the highest rank (location 4) for the significant difference found between the "fast drivers" and "other drivers" mean age and experience is on the approach to a large roundabout with poor deflection and a wide circulating width.

The second ranked location (13) for both age and experience is the only traffic calmed location within the route. Males were not found to be significantly over represented above the mean speed at this location. A small number of drivers exceeded the speed limit here (20 per cent).

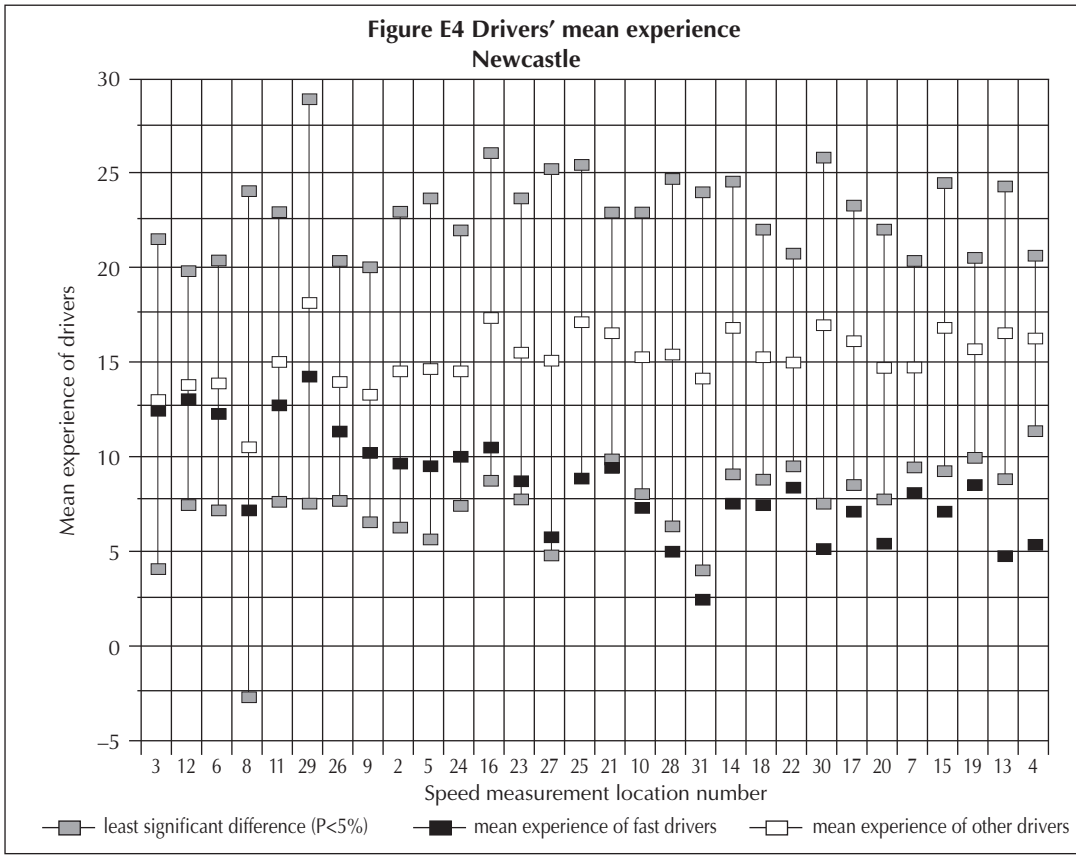
Location 7 was ranked 3 for the mean age of "fast drivers" being significantly lower, and was ranked 5 for the mean experience being significantly lower. This location consists of 70 mile/h dual carriageway between two roundabouts where there was a significant proportion of males above the mean speed, but no drivers exceeding the speed limit.

Figure E3 Drivers' mean age
Newcastle



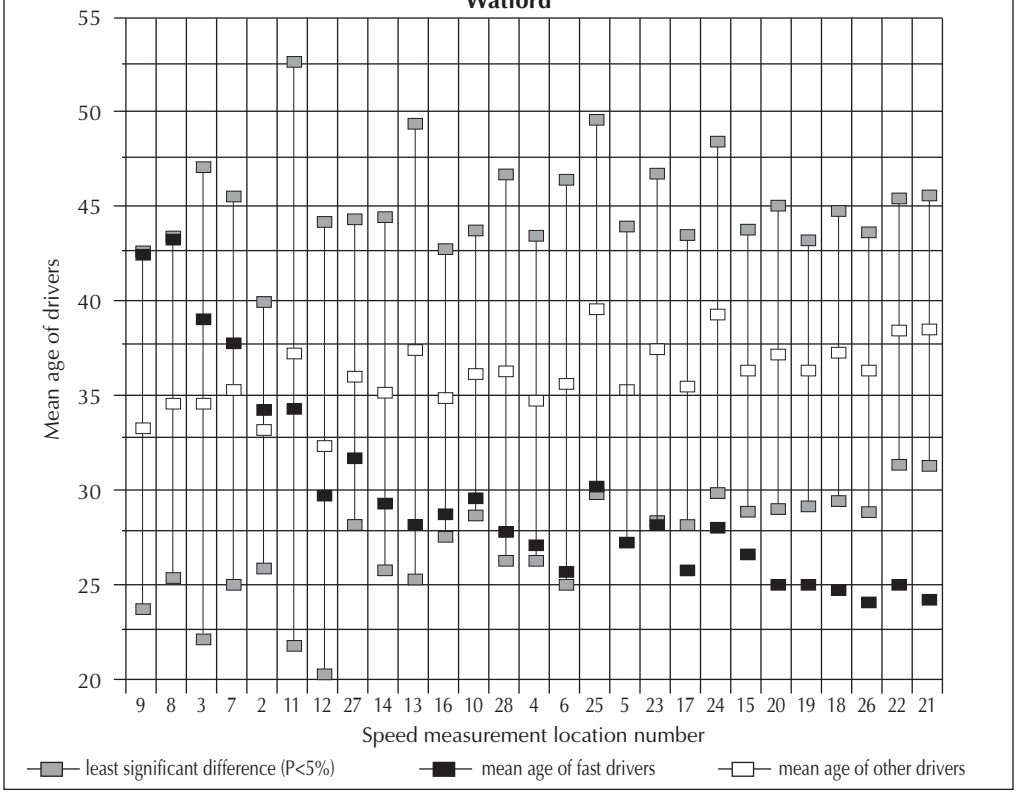
NB Location 1 was used as a record of the time to traverse the whole route.

Figure E4 Drivers' mean experience
Newcastle



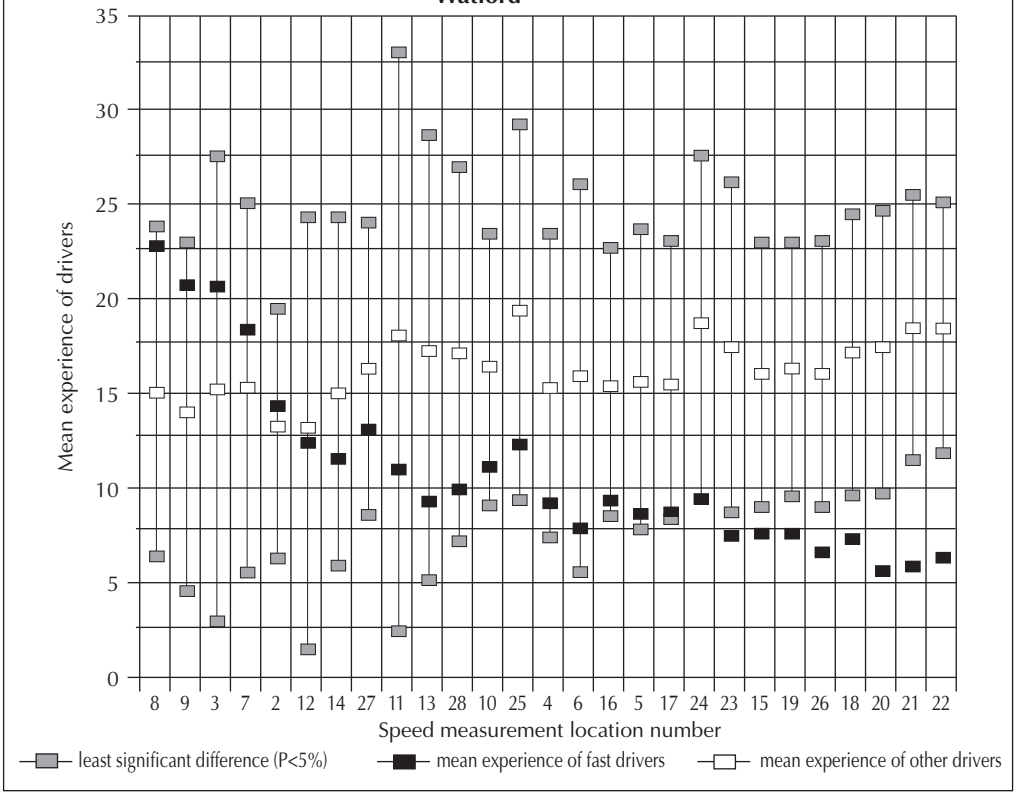
NB Location 1 was used as a record of the time to traverse the whole route.

Figure E5 Drivers' mean age
Watford



NB Location 1 was used as a record of the time to traverse the whole route.

Figure E6 Drivers' mean experience
Watford



NB Location 1 was used as a record of the time to traverse the whole route.

Locations 14, 15 and 16 are similar sections of 60 mile/h single carriageway on the Newcastle route. "Fast drivers" at locations 14 and 15 had a significantly lower age and experience. No drivers were found to be speeding at these locations, and males were not over represented in the drivers exceeding the mean speed. Location 22 also has similar characteristics and results, except that males were also found to be over-represented above the mean speed.

Locations 10 and 23 both have additional "please drive care-fully" 30 mile/h speed limit signs and were ranked for the "fast drivers" having a lower age but not very highly in this respect (15 and 16 respectively). Location 10 was also ranked for the "fast drivers" having a lower experience (14) and location 23, although not ranked, was approaching significance. Both locations had a proportion of speeding drivers, and did not have a significantly higher proportion of males exceeding the mean speed.

Two of the three 40 mile/h sections of Newcastle route were ranked for the "fast drivers" having a significantly lower age and experience (locations 17 and 18). These locations did not have a significant proportion of males exceeding the mean speed, but had 33 per cent and 71 per cent speeding drivers respectively.

Locations 19, 20 and 21 are all rural stretches with areas of poor visibility, no speeding drivers, and with a significantly larger proportion of male drivers exceeding the mean speed. Locations 20 and 21 in particular are narrow with bends. All these locations were ranked for the "fast drivers" having a significantly lower age and experience.

There were no speeding drivers or significantly large proportion of males above the mean speed at location 25 (a 60 mile/h bendy road through a village), but it was ranked 10 and 16 for the "fast drivers" having a significantly lower age and experience respectively.

Location 28 was one of only three, 30 mile/h residential locations (10 23 and 28, and not including the traffic calmed location 13) where a significantly lower mean age or experience was found for the "fast drivers". However, these locations were not ranked very highly in this respect.

Locations 30 and 31 were both ranked for the age and experience of "fast drivers" being lower. Both are on a section of 50 mile/h road with two lanes, and location 30 is on a stretch after a busy roundabout. No large proportion of males was found to be over the mean speed at either location.

In summary for the Newcastle route, the "fast drivers" were not found to have a significantly lower age or experience at locations that were obviously 30 mile/h residential areas, other than on the traffic calmed section. They did however have a lower mean age or experience on nearly all the 60 miles/h sections and on the rural sections that also had a larger proportion of males exceeding the mean speed. The "fast drivers" were not found to have a significantly lower age or experience on the fast dual carriageway section (location 26).

2.4.3 Watford results

The two locations with the highest ranking for the "fast drivers" having a significantly lower age and experience on the Watford route are locations 21 and 22. These are rural locations before and after 30 mile/h limit signing on the entry to a village. There was a significant proportion of male drivers above the mean speed on location 21 only. The stretch in location 22, although after the 30 mile/h signing, does not have many buildings close to the road, but there are more buildings nearer the centre of the village beyond location 22.

Location 21 discussed above was one of five 60 mile/h locations (locations 15, 17, 21, 23 and 26) out of a total of six on the Watford route where a rank was given for the "fast drivers" age and experience being lower, except location 17 which was not ranked for experience but was very close to significance.

Locations 18, 19 and 24 were also locations where a lower age and experience for the "fast drivers" was found to be significant. These locations were in rural areas with only occasional buildings along their length. Location 18 is a 30 mile/h location whereas locations 19 and 24 are 40 mile/h locations.

Of the sixteen 30 mile/h locations on the Watford route only five were ranked for the "fast drivers" having a lower mean age or experience (locations 5, 18, 20, 22 and 25). Of these, locations 5, 20 and 25 were the only ones that were obviously located within a residential area with buildings close to the road and locations 5 and 25 were only ranked for age and not very highly.

Locations 8 and 9, (both speed camera locations) are of particular interest on the Watford route. They were the only locations for both routes where the "fast drivers" mean age and experience was approaching a level significantly higher than for the "other drivers". The other speed camera location (11) did not show this trend, but was found to have lower speeds anyway.

The fast dual carriageway section (location 27) did not have a significantly lower age or experience associated with the drivers travelling "fast" on this section.

2.4.4 Summary

The following types of location were ones where the "fast drivers" were found to have a significantly lower age and experience than the "other drivers":

- 60 mile/h sections of road and rural sections of road that did not have very many buildings positioned alongside the road; and
- the only location that was traffic calmed by pinch points and speed cushions.

There were two speed camera locations on 30 mile/h limit sections of route where it was found that the mean age and experience of the "fast drivers" was very nearly significantly higher than for the "other drivers".

2.5 Analysis of the mean mileage and mean car engine size of the "fast drivers" compared with the means of the "other drivers", by location

2.5.1 Method

As with the analysis of the mean age and experience of "fast drivers" and "other drivers" described above, Student's t-distribution was also used to compare the mean estimated annual mileage and mean car engine size for the "fast drivers" and "other drivers" at each location on the Newcastle and Watford routes. The results are shown by the charts in Figures E7 to E10 and those locations where a significant difference was found are highlighted in Tables E4 and E5.

2.5.2 Newcastle and Watford results

It can be seen that the mean estimated annual mileage of the "fast drivers" was not found to be significantly different at any of the locations on the Newcastle route. There were 4 locations (locations 4, 7, 15 and 17) where the mileage was significantly higher for the "fast drivers" on the Watford route. Three of these locations (7, 15 and 17) are characterised by bends with poor forward visibility, the other is on an uphill gradient in a residential area.

There was only one location on each of the two routes where mean car engine size was significantly higher for the "fast drivers".

2.5.3 Summary

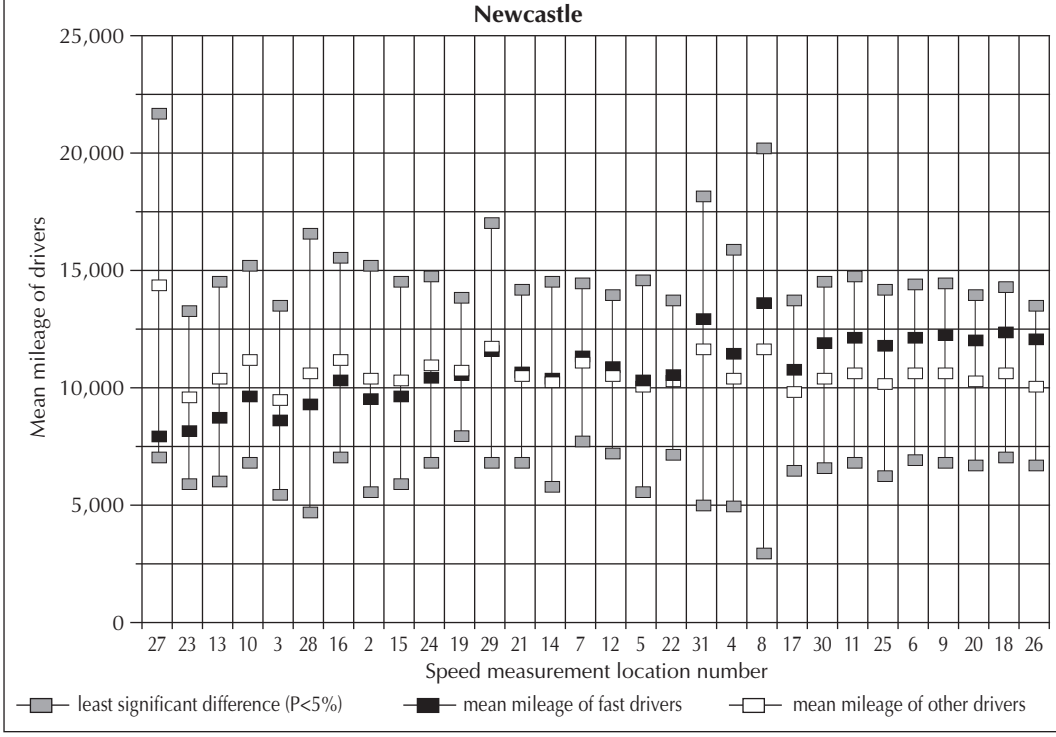
There is no evidence of the mean car engine size of "fast" drivers being significantly different to that of the "other drivers" for any particular type of location.

3 Analysis of actual speed data, by driver

3.1 Method

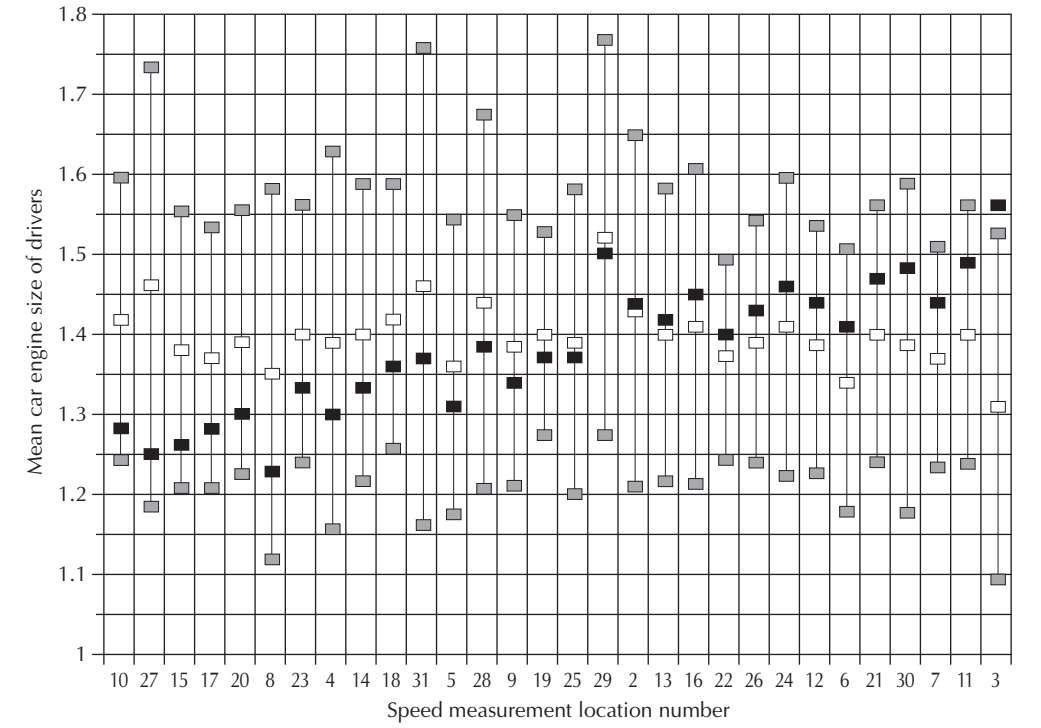
As well as considering each of the speed measurements locations on the two routes in turn, it was also possible to consider the overall performance of each driver. For example, during each journey along the Newcastle route the subject vehicle will have passed a total of 30 speed measurement locations. For a proportion of these, the driver will have had a "free choice of speed" as defined previously, and a speed measurement will have been made. The drivers could then be categorised into "consistently fast" groups depending on the proportion of times that they exceeded the 90th, 85th and 75th percentile speeds out of all the times that they had a "free choice of speed". The drivers could also be categorised into "consistently slow" groups if they never exceeded the same percentile speeds. These percentile speeds were chosen as thresholds to allow a range of varying sizes of "consistently fast" or "consistently slow" driver groups. A precise definition of the categories used is provided below:

Figure E7 Drivers' mean mileage, Newcastle



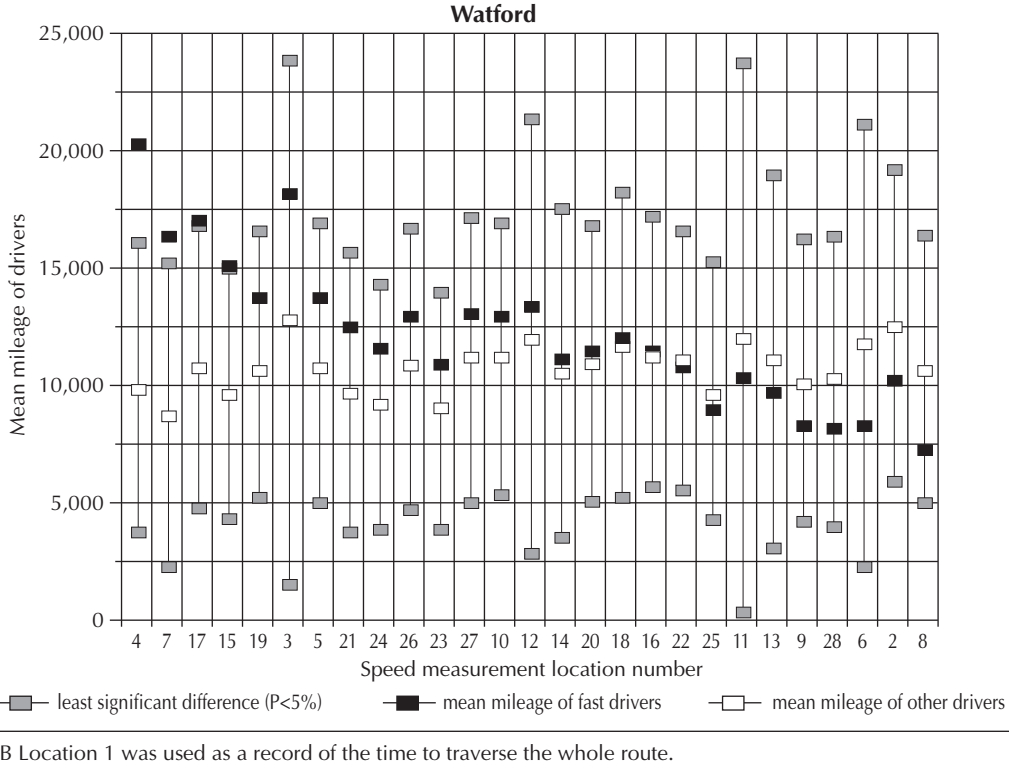
NB Location 1 was used as a record of the time to traverse the whole route.

Figure E8 Drivers' car mean engine size, Newcastle



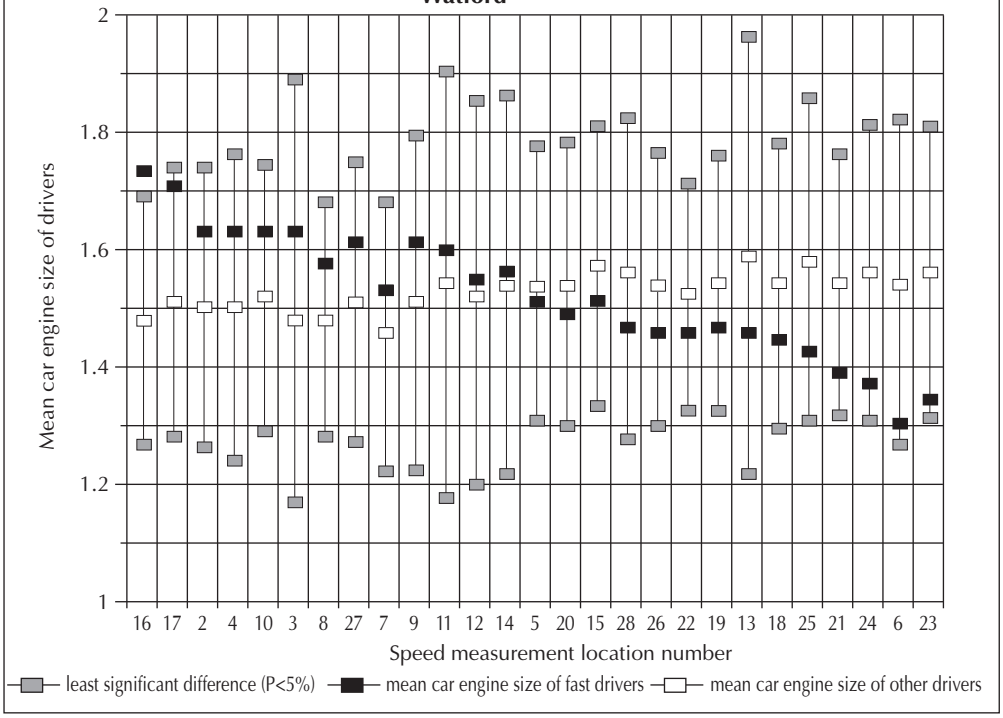
NB Location 1 was used as a record of the time to traverse the whole route.

Figure E9 Drivers' car mean mileage, Watford



NB Location 1 was used as a record of the time to traverse the whole route.

Figure E10 Drivers' mean engine size
Watford



NB Location 1 was used as a record of the time to traverse the whole route.

- Very fast: Driver exceeded the 90th percentile speed along at least half of the locations where he/she had a "free choice of speed"
- Fast: Driver exceeded the 85th percentile speed along at least half of the locations where he/she had a "free choice of speed"
- Quite fast: Driver exceeded the 75th percentile speed along at least half of the locations where he/she had a "free choice of speed"
- Quite slow: Driver never exceeded the 90th percentile speed
- Slow: Driver never exceeded the 85th percentile speed
- Very slow: Driver never exceeded the 75th percentile speed

The characteristics of these driver groups were then analysed. One of the characteristics that was investigated was a subjective rating given to each driver at the end of each drive by the drive observer. The subjective rating was made on a 5 point scale with 1 being the most cautious, 3 average and 5 aggressive. The rating was made by the observer based on the following factors for the whole of the drive:

- hard acceleration/ deceleration
- courtesy to other road users
- compliance with traffic regulations
- gap acceptance
- excessive speed
- attitude

3.2 Results

Table E6 shows the numbers of drivers in each of the "consistently fast" and "consistently slow" driver groups as well as the mean age, mean number of years as a driver, mean annual mileage, mean car engine size and the mean observer rating for the drivers within each group.

Males and females

There are more males in nearly all the "consistently fast" groups of drivers in both samples, and the proportion of males in the Watford groups is higher than that for Newcastle. (There is only one female in the "very fast" and "fast" groups in the Watford sample). There is an exception, however, in the Newcastle sample where the number of males and females in the "very fast" group of drivers is similar (6 males and 7 females).

There are more females in the "consistently slow" driver groups for both samples and the proportion of females in the Watford sample is greater than that for Newcastle.

Age and experience

It can be seen that for the Newcastle drivers, the mean age and experience for the "very fast" group of drivers is the lowest (24.08 years old and 6.38 years experience), and that the age and experience increases for the "consistently slow" groups. (The "very slow" group has a mean age of 50.81 years and a mean experience of 27.31 years since passing the Driving-test.)

Table E6 Charateristics of "consistently fast" and "consistently slow" drivers

Category (driver group)	Number of Males	Number of Females	Total	Mean Age	Mean Number of Years as a Driver	Mean Annual Mileage	Mean Car Engine Size	Mean Observer Rating of Driver†
Newcastle								
Very Fast	6	7	13	24.08	6.38	10,957	1.41	4.31
Fast	14	9	23	24.65	7.13	11,393	1.38	3.87
Quite fast	32	16	48	26.92	7.19	10,303	1.39	3.53
Quite slow	23	29	52	38.48	17.52	10,465	1.37	2.06
Slow	13	22	35	41	19.23	9,726	1.36	2
Very slow	6	10	16	50.81	27.31	9,615	1.37	1.67
Watford								
Very Fast	10	1	11	23.36	5.73	13,038	1.7	4.11
Fast	12	1	13	25	6.69	12,598	1.64	4.27
Quite fast	22	9	31	25.16	6.94	12,226	1.49	3.84
Quite slow	13	23	36	37.81	17.89	10,584	1.51	2.82
Slow	8	18	26	37.2	17.12	9,898	1.53	2.69
Very slow	5	10	15	35.67	16.07	9,168	1.5	2.73

†Overal mean observer rating: Newcastle = 2.66; Watford = 3.2

Similarly in the Watford sample the mean age and experience of the "very fast" group is the lowest (23.36 years old and 5.73 years experience) and increases slightly for the "fast" and "quite fast" groups. The "consistently slow" groups have a much larger mean age and experience than the "consistently fast" groups but unlike the Newcastle sample the mean age and experience does not increase for the "slow" and "very slow" groups compared with the "quite slow" group.

Observers' subjective driver rating

The mean subjective rating given by the drive observers for the "very fast" group in the Newcastle sample is the highest at 4.11 and decreases to just 1.67 for the "very slow" group. The highest mean rating on the Watford sample was found to be for the "fast" group at 4.27 which was higher than for the "very fast" group at 4.11. The lowest rating was

found to be for the "slow" group (2.69). For both samples the "consistently fast" driver group ratings were all found to be higher than those for the "consistently slow" drivers.

It should be noted that the rating given to each driver by the observer was purely subjective and that consequently the ratings between the six different observers employed during the study are not necessarily consistent. The higher mean rating for the Watford sample compared to the Newcastle sample does not necessarily suggest that the Watford drivers are more aggressive.

3.3 Summary

The analysis by categorising drivers into "consistently fast" or "consistently slow" groups has revealed the following:

- Overall, there are more males in the "consistently fast" groups of driver in both samples, and a greater proportion of males to females in the Watford sample than is the case in the Newcastle sample.
- The "very fast" group, in the Newcastle sample only, consist of similar numbers of males and females.
- There are more females in the "consistently slow" driver groups in both samples and a greater proportion of females to males in the Watford sample than is the case in the Newcastle sample.
- The mean age and experience of the "consistently fast" groups of drivers is considerably less than that of the "consistently slow" groups and decreases for the faster groups.
- The mean age and experience of the increasingly slower groups increases for the Newcastle sample but remains similar for the Watford sample.
- The subjective ratings given by the drive observers suggest that the "consistently fast" drivers also drive more aggressively in general.

4 Analysis of factors mentioned by drivers during the interviews as affecting the way they decided to drive

4.1 Method

The analysis described previously has been based largely on the objective speed data as measured from the video recording of each drive. Subjective data was also assembled during the interview sessions on the factors that the drivers mentioned as affecting the way they decided to drive. This was achieved by noting the responses to questions 1 and 2 during the interview (shown below).

Q1: What factors affected the way you decided to drive during the clip just shown?

Q2: What effects did these factors have on the way you decided to drive?

Where possible, the causes given in response to question 1 were linked with the effects attributable to each cause given in response to question 2. A matrix of causes and effects could then be constructed by various categories of driver and by location. It was not always possible to record exactly the link between cause and effect because the drivers were not always sure why they decided to drive as they did, or were not sure what some factors had caused them to do exactly, though factors were still recorded when no link was apparent. A list of the categories of factors which was used for analysis was compiled as the test drives progressed and the most commonly mentioned categories became apparent. This list is shown as Table E7.

4.2 Results

Tables have been compiled to summarise the most frequently mentioned factors for Newcastle and Watford, and to highlight the main differences between male and female drivers and "consistently fast" and "consistently slow" groups of drivers in the proportions of factors mentioned, based on the chi-squared test.

Table E7 Categories of factors mentioned by drivers as affecting the way they decided to drive	
Vehicle ahead (in same direction)	Dual carriageway
Oncoming vehicle	Little/no traffic/clear road
Parked vehicle	Few/no road signs/markings
Any potential vehicle	Police cars/camera
Other vehicle (eg on roundabout or side road)	Rain/frost/leaves/mud/weather causing wet or slippy roads
Vehicle behind	Animals
Good visibility	Unfamiliarity
Bad visibility	Occasional house/farm buildings with concealed entrances/driveways
Speed limit from road signs or markings (eg roundels)	Junctions/side roads/turn offs
Slow road marking	Lane markings/lanes/double white lines
Give way/priority signing	Learner drivers
Other road signs or road markings	Village
Layout: bus lane/bus stop	Road works/construction/cones
Layout: merge/slip road	Fast/wide/open/straight road
Twisty road/bend/corner	Congested/busy/lots of traffic
Narrow road	Cycle lane
Roundabout	Road surroundings other
Road surroundings (built up)	Bushes/hedges/trees
Road surroundings (country side)	Bright sunlight/glare/sunshine/dappled/shade
Pedestrian	Islands/refuges/bollards
Cyclist	Tunnel
Traffic calming	Pub/pub car park/car park
Traffic signals	Hump back bridge
Pelican crossing	Gradient/hill
Familiarity, knowledge of road	Layby
Poor road surface	Balls/cricket/golf
Road layout other	Dazzling eadlights/headlights/nightfall/twilight/ darkness
Children and/or schools	Garage (car sales forecourt)

4.2.1 All factors mentioned by drivers as affecting the way they decided to drive, whether linked to a particular effect or not

Table E8 Factors mentioned most frequently by drivers as affecting the way they decided to drive, whether linked to a particular effect or not (making up 75 per cent of all factors mentioned)

Newcastle		Watford	
1: vehicle ahead	10: pedestrian	1: vehicle ahead	12: good visibility
2: roundabout	11: traffic signals	2: other road signs or road markings	13: road surrounds (other)
3: other road signs or road markings	12: lane markings/lanes/ double white lines	3: parked vehicles	14: junctions/side roads/ turn offs
4: bad visibility	13: good visibility	4: bad visibility	15: vehicle behind
5: speed limits from signs or markings	14: oncoming vehicles	5: twisty road/bend/ corners	16: other vehicles (eg on roundabout or side road)
6: other road vehicles (eg on roundabout or side road)	15: road layout (other)	6: oncoming vehicles	17: pelican crossing
7: road surroundings (built up)	16: parked vehicles	7: road surroundings (built up)	18: roundabout
8: vehicle behind	17: layout (merge)	8: narrow road	19: police cars/cameras
9: twisty road/bend/ corners	18: traffic calming	9: road layout (other)	20: fast/wide/open/ straight road
	19: narrow road	10: speed limit from road signs or markings	21: hump back bridge
	20: poor road surface	11: pedestrian	

As was mentioned above, some factors could be linked to the particular effect that they had, others could not. Table E8 summarises the most frequently mentioned factors, irrespective of their effects, for Newcastle and Watford. It can be seen that there are a number of differences which are likely to be because of the differences between the two routes. For example the factor *roundabout* is mentioned the second most frequently for the Newcastle route and is ranked only 18th for the Watford route (there are 6 roundabouts encountered within interview locations on the Newcastle route, and only 2 on the Watford route). There are some notable similarities, however. For example the following factors (in rank order) all appear in the 10 most frequently mentioned factors for both routes:

- *vehicle ahead;*
- *other signs or road markings;*
- *bad visibility;*
- *speed limit from road signs or markings;*
- *twisty road/bend/corners;* and
- *road surroundings (built up).*

When considering the factors mentioned more times by males or females than would be expected for those factors mentioned, irrespective of their effects, it can be seen from Table E9 below that there are again a number of differences between the Newcastle and Watford samples. The only similarities are that the following factors are mentioned more times by females on both routes:

- *unfamiliarity* (and *familiarity* on the Watford route);

Two factors relating to road signs and another two factors relating to road surroundings are also mentioned by females more times than would be expected:

- *other road signs or markings* and *few/no road signs/markings;* and
- *road surroundings (other),* and *road surroundings (countryside).*

Table E9 Main differences between male and female drivers in the proportions of factors mentioned, whether linked to individual effects or not, based on chi-squared test

	Newcastle	Watford
Factors mentioned more times by males and less times by females than would be expected	6: road layout (other) 7: cyclist 8: junctions/side roads/turn offs 10: rain/frost/leaves/mud/slippy road 11: vehicle behind	5: village 8: dual carriageway 9: narrow road 10: rain/frost/leaves/mud/slippy road
Factors mentioned more times by females and less times by males than would be expected	1: unfamiliarity 2: few/no road signs/markings 3: congested 4: road surroundings (countryside) 5: little/no traffic 9: oncoming traffic	1: road layout (other) 2: other road signs or markings 3: road surroundings (other) 4: unfamiliarity 6: bad visibility 7: familiarity

NB The numbering within the table ranks the factors in order of the most significant difference between males and females within the Newcastle and Watford samples.

The only similarity between the males for the two samples is the mention of *rain/frost/leaves/mud/slippy* road more times than would be expected.

Table E10 below compares all the factors mentioned by the "consistently fast" and "consistently slow" groups of drivers. The only similarity between the "consistently fast" Newcastle and Watford groups is the mention of *vehicle ahead* more times than would be expected. Similarities between the "consistently slow" groups for both samples include the mention of the following factors more times than would be expected:

- *rain/frost/leaves/mud/slippy road;* and
- *unfamiliarity*

Table E10 Main differences between "consistently fast" and "consistently slow" drivers in the proportions of factors mentioned, whether linked to individual effects or not, based on chi-squared test

	Newcastle	Watford
Factors mentioned more times by consistently fast drivers and less times by slow drivers than would be expected	1: vehicle ahead 4: junctions/side roads/turn offs 8: familiarity	1: vehicle ahead 2: dual carriageway 4: traffic signals 5: village
Factors mentioned more times by consistently slow drivers and less times by fast drivers than would be expected	2: rain/frost/leaves/mud/slippy road 3: poor road surface 5: unfamiliarity 6: speed limit from road signs or markings 7: lane markings/lanes/double white lines	3: road surroundings (other) 6: rain/frost/leaves/mud/slippy road 7: unfamiliarity 8: familiarity 9: other road signs or road markings

NB The numbering within the table ranks the factors in order of the most significant difference between males and females within the Newcastle and Watford routes.

4.2.2 Factors specifically mentioned by drivers as causing them to slow down

The following Table E11 shows the factors that were specifically mentioned by the drivers as causing them to slow down.

Table E11 Factors mentioned most frequently by drivers as causing them to slow down (making up 75 per cent of all factors mentioned)

Newcastle		Watford	
1: vehicle ahead	9: narrow road	1: vehicle ahead	8: road surroundings (built up)
2: roundabout	10: poor road surface	2: twisty road/bend/ corners	9: bad visibility
3: twisty road/bend/ corners	11: oncoming vehicles	3: parked vehicles	10: roundabout
4: bad visibility	12: ltraffic signals	4: narrow road	11: hump back bridge
5: speed limit from signs or markings	13: other vehicles	5: other road signs or road markings	12: police cars/cameras
6: other road signs or markings	14: layout: merge	6: speed limit from road signs or markings	13: tunnel
7: traffic calming	15: pedestrian	7: oncoming vehicle	14: rain/frost/leaves/ slippy roads
8: road surroundings (built up)	16: parked vehicle		15: pedestrian

There are a number of differences between the most frequently mentioned factors for Newcastle and Watford due largely to the differences between the two routes. For example, there is a larger number of roundabouts encountered on the Newcastle route as well as an obvious section of traffic calming. The following factors however (placed in rank order) all appeared as one of the most frequently mentioned factors causing drivers to slow down on both routes:

- *vehicle ahead;*
- *twisty road/ bend/corners;*
- *speed limit from road signs or markings;*
- *other road signs or road markings;*
- *bad visibility;*
- *narrow road;*
- *parked vehicles;*
- *road surroundings (built up);* and
- *oncoming vehicle.*

The following Table E12 compares the proportions of factors mentioned more times by males and females as causing them to slow down for the Newcastle and Watford samples. There is only one similarity between the two samples and that is the mention of *oncoming vehicles* by females more times than would be expected. One notable difference is the mention of *twisty road/bend/corners* more times by males on the Newcastle route but conversely more times by females on the Watford route.

There was found to be no significant difference in the proportions of factors mentioned as causing the drivers to slow between the “consistently fast” and “consistently slow” groups of drivers for either of the Newcastle or Watford samples.

Table E12 Main differences between male and female drivers in the proportions of factors mentioned as causing them to slow down, based on chi-squared test		
	Newcastle	**Watford**
Factors mentioned more times by males and less times by females than would be expected	2: road layout (other) 3: twisty road/bend/corners 4: slow road marking	5: junctions/side roads/turn offs
Factors mentioned more times by females and less times by males than would be expected	1: unfamiliarity 5: pedestrian 6: oncoming vehicles	1: traffic signals 2: tunnel 3: other vehicles 4: oncoming vehicles 6: twisty road/bend/corners

NB The numbering within the table ranks the factors in order of the most significant difference between males and females within the Newcastle and Watford samples.

4.2.3 Factors causing drivers to speed up

The Table E13 below summarises the factors mentioned most frequently as causing the drivers to speed up.

Table E13 Factors mentioned most frequently by drivers as causing them to speed up (making up 75 per cent of all factors mentioned)			
Newcastle		**Watford**	
1: vehicle ahead 2: dual carriageway 3: good visibility 4: roundabout 5: speed limit from road signs or markings	6: fast/wide/open/ straight road 7: little/no traffic/clear road 8: layout (merge) 9: vehicle behind	1: dual carriageway 2: fast/wide/open/ straight road 3: good visibility 4: little/no traffic/clear road	5: vehicle ahead 6: speed limit from road signs or markings 7: road layout (other)

The following factors (in rank order) are those that were identified as common to both routes as the most frequently mentioned by the drivers for causing them to speed up:

- *dual carriageway;*
- *good visibility;*
- *vehicle ahead;*
- *fast/ wide/open/straight road;*
- *little/no traffic/clear road;* and
- *speed limit from road signs or markings.*

Table E14 below shows that no significant difference was found between the proportion of times factors were mentioned by males or females as causing them to speed up for the Newcastle sample. However *dual carriageway* was mentioned more times by Watford males, and *vehicle ahead* was mentioned more times by Watford females than would be expected.

No significant difference was found between the "consistently fast" and "consistently slow" groups of drivers on either route in the proportions of factors mentioned as causing them to speed up.

Table E14 Main differences between male and female drivers in the proportions of factors mentioned as causing them to speed up, based on chi-squared test		
	Newcastle	**Watford**
Factors mentioned more times by males and less times by females than would be expected	no significant difference	1: dual carriageway
Factors mentioned more times by females and less times by males than would be expected	no significant difference	2: vehicle ahead

NB The numbering within the table ranks the factors in order of the most significant difference between males and females within the Newcastle and Watford routes.

4.3 Summary

The results of the analysis of all the factors mentioned by drivers as affecting the way they decided to drive has shown the following:

- The only major differences in the most frequently mentioned factors overall between the two samples is likely to be because of the differences between the two routes.
- A number of factors appeared as the most frequently mentioned by both samples. These were the following (in rank order):
  - *vehicle ahead;*
  - *other signs or road markings;*
  - *bad visibility*
  - *speed limit from road signs or markings;*
  - *twisty road/ bend/ corners;* and
  - *road surroundings (built up).*
- There were a number of differences found between the two samples when assessing the factors mentioned more times by males or females and by "consistently fast" or "consistently slow" groups of drivers.
- Females mentioned *unfamiliarity* and factors relating to road signs and road surroundings more times than would be expected on both routes.
- mentioned *rain/frost/leaves/mud/slippy road* more times than would be expected on both routes.
- "Consistently fast" groups of drivers mentioned *vehicle ahead* more times than would be expected on both routes.
- "Consistently slow" groups of drivers mentioned *rain/frost/leaves/mud/slippy road* and *unfamiliarity* more times than would be expected.

Analysis of the factors most frequently mentioned as causing the drivers to slow down has shown the following:

- There are a number of differences in the most frequently mentioned factors between the two samples due to the differences in the routes, but the following factors appeared as the most frequently mentioned by both samples (in rank order):
  - *vehicle ahead;*
  - *twisty road/bend/corners;*
  - *speed limit from road signs or markings;*
  - *other road signs or road markings;*

  - *bad visibility;*
  - *narrow road;*
  - *parked vehicles;*
  - *road surroundings (built up); and*
  - *oncoming vehicles.*

- There was only one similarity between the two samples when assessing the factors mentioned more times by males or females, and that was the mention of *oncoming vehicles* by females more times than would be expected for both routes.
- There was found to be no significant difference in the proportions of factors mentioned between "consistently fast" and "consistently slow" groups of drivers for either route sample.

Analysis of the factors most frequently mentioned as causing the drivers to speed up has shown:

- The following factors (in rank order) are those that were identified as common to both routes as the most frequently mentioned by the drivers for causing them to speed up:
  - *dual carriageway;*
  - *good visibility;*
  - *vehicle ahead;*
  - *fast/wide/open/straight road;*
  - *little/no traffic/clear road;* and
  - *speed limit from road signs or markings.*
- Watford males mentioned *dual carriageway* and Watford females mentioned *vehicle ahead* as causing them to speed up more times than would be expected. There was no significant difference between the Newcastle males and females.
- There was found to be no significant difference in the proportions of factors mentioned between "consistently fast" and "consistently slow" groups of drivers for either route sample.

5 Analysis of actual speeds and drivers self reported familiarity with a location

5.1 Method

It was discovered in the analysis of the factors mentioned by drivers as affecting the way they decided to drive that *unfamiliarity* was mentioned more times than would be expected by the consistently slow drivers. Analysis was therefore completed to combine the drivers' self-reported familiarity with a location during the interviews, with their actual speeds measured from the video clips. During the interview each driver was asked to rate their familiarity with a location after viewing the video clip, using a four point scale as follows:

- 1: Very familiar (know it very well)
- 2: Quite familiar (know the road)
- 3: Slightly familiar (been there before)
- 4: Not familiar (never been there)

For those interview locations that coincided with the speed measurement locations the mean familiarity rating for the fast drivers (those exceeding the 85th percentile speed) at that location was compared with the mean familiarity rating of the other drivers whose speed did not exceed the 85th percentile.

5.2 Results

The following Tables E15 and E16 show the mean familiarity rating for the "fast drivers" and "other drivers" for each of the instances where the interview locations and speed measurement locations coincide. Those instances where the "fast drivers" have a lower mean familiarity rating (more familiar) have been shaded in grey.

5.2.1 Newcastle

Table E15 Mean familiarity rating of "fast drivers" compared with "other drivers" for the Newcastle route

Interview location number	Speed measurement location number	Mean familiarity rating of fast drivers	Number of fast drivers	Mean familiarity rating of other drivers	Number of other drivers
3	**4**	2.09	11	2.70	50
	5	2.50	12	2.62	58
	6	1.83	18	2.85	93
4	**8**	2.33	6	3.44	29
	9	3.00	18	3.06	83
	10	2.67	15	3.03	80
5	**12**	3.62	21	3.58	100
8	**16**	2.47	17	2.93	42
9	**17**	1.8	15	2.14	72
	18	1.69	16	2.11	87
10	**19**	3.52	31	3.5	96
	20	3.5	16	3.47	85
11	**21**	3.32	22	3.57	63
12	**23**	2.81	16	3.33	66
13	**25**	3.00	14	3.43	74
14	**26**	1.95	19	2.45	103
15	**27**	2.57	7	2.25	20
17	**30**	1.64	11	1.57	61
		2.68	285	2.92	1,262
Overall mean familiarity rating = 2.88					

It can be seen from the above table that in 15 out of the 18 instances where the familiarity rating could be combined with the actual speed data on the Newcastle route, the "fast drivers" were more familiar with the location in question. The mean familiarity ratings for all the instances combined indicated that overall, the locations were more familiar to the "fast drivers". The only locations where the "other drivers" were more familiar included interview locations 5 and 10 which are two of the most unfamiliar locations to all the drivers on the Newcastle route. Interview location 17 which was also more familiar to the "other drivers", was the most familiar location to all the drivers out of all the locations on the Newcastle route.

5.2.2 Watford

Table E16 Mean familiarity rating of "fast drivers" compared with "other drivers" for the Watford route					
Interview location number	**Speed measurement location number**	**Mean familiarity rating of fast drivers**	**Number of fast drivers**	**Mean familiarity rating of other drivers**	**Number of other drivers**
12	**14**	3.82	11	3.73	63
14	**7**	3.25	12	3.14	37
	8	3.15	13	3.09	57
15	**10**	2.24	17	2.09	74
2	**13**	2.63	8	1.58	36
	14	1.91	11	1.76	41
3	**15**	2.28	18	2.92	59
4	**16**	2.31	16	3	85
5	**18**	3.06	16	3.19	69
6	**19**	3.06	18	3	75
	20	3.07	15	2.94	65
8	**23**	2.58	12	3.12	57
	24	2.75	12	3.26	50
9	**26**	3.06	16	3.01	76
10	**27**	2	14	2.43	76
		2.73	209	2.86	920
Overall mean familiarity rating = 2.83					

There were 15 instances where the interview locations coincided with the speed measurement locations on the Watford route. Of these there were 6 where the "fast drivers" were more familiar with the location than the "other drivers". As with the Newcastle route, the "fast drivers" were overall, more familiar with the locations than the "other drivers". Again it was found that for the interview locations that were the most familiar and least familiar to all the drivers, that they were, less familiar to the "fast drivers". For the locations analysed here, it can be seen that the Watford drivers were more familiar with the locations they encountered on their route than the Newcastle drivers were with the locations that they encountered on their route.

5.3 Summary

The analysis has revealed the following:

- Overall, the Watford drivers were more familiar with the locations analysed on their route than the Newcastle drivers were with their locations.
- Overall the "fast drivers" were more familiar with the locations than the "other drivers" on both the Newcastle and Watford routes.
- The difference between the mean familiarity rating between the "fast drivers" and "other drivers" was greater for the Newcastle sample.
- The "fast drivers" were less familiar with the locations that were found to be the most familiar or most unfamiliar with the "other drivers".

6 Analysis of the drivers' knowledge of the speed limit and how they judged their speed

6.1 Method

During the interview session the drivers were asked two questions after each clip of their drive to determine their knowledge of the speed limit along the stretch of road within the clip:

Q3: What was the fastest speed your car was travelling on this stretch?

Q4: Was it within the speed limit? *Yes No Not sure*

The answers provided by the drivers were categorised into those who provided an estimate of their speed that was above or below the speed limit for that location, and also whether they knew whether their estimate was within the speed limit or not. A further question inquired as to how they knew their speed at the time:

Q5: How did you know your speed at the time?

A number of example responses were provided on the driver's question sheet for this question and the driver could respond with one or more of these answers, or could offer a different answer if they so desired.

6.2 Results

Table E17 shows the data collected for questions 3 and 4 from male and female drivers, the "consistently fast" groups of drivers and "consistently slow" groups of drivers, and by drivers divided into three experience groups of roughly equal numbers of drivers.

Table E17 Drivers' knowledge of speed limits

	Drivers gave an estimate that was below the speed limit and correctly guessed that it was below the speed limit				Driver gave an estimate that was above the speed limit and correctly admitted that it exceeded the speed limit				Driver's knowledge of speed limit was accurate				Driver gave an estimate that was below the speed limit but thought that it was above the speed limit				Drive gave an estimate that was above the speed limit but thought that it was below the speed limit				Driver's knowledge of speed limit was inaccurate				Driver could not given an estimate of their speed or did not know if it was within the speed limit or not				No data			
	Newcastle		Watford		Newcastle		Watford		Newcastle		Watford		Newcastle		Watford		Newcastle		Watford		Newcastle		Watford		Newcastle		Watford		Newcastle		Watford	
	no	%	no	%	no	%	no	%	no	%	no	%	no	%	no	%	no	%	no	%	no	%	no	%	no	%	no	%	no	%	no	%
Males	704	63	470	63	197	18	138	19	901	81	608	82	20	2	23	3	57	5	41	6	77	7	64	9	131	12	64	7	16	1	6	1
Females	633	68	483	65	63	7	99	13	696	75	582	78	13	1	10	1	56	6	34	5	69	7	44	6	149	16	105	14	16	2	11	1
Consistently fast	196	57	95	52	74	21	44	24	270	78	139	76	8	2	7	4	16	5	13	7	24	7	20	11	38	11	23	13	13	4	0	0
Consistently slow	391	74	278	76	24	5	31	9	415	79	309	85	8	2	4	1	37	7	16	3	45	9	20	4	58	12	38	10	7	1	4	1
Experience 0–5 years	474	59	288	59	150	19	108	22	624	78	396	81	7	1	11	2	41	5	20	4	48	6	31	6	125	15	63	13	13	2	0	0
Experience 6–16 years	395	64	288	59	68	11	94	19	463	75	382	78	16	3	11	2	34	6	30	6	50	9	41	8	91	15	54	11	11	2	13	3
Experience 17+ years	468	74	377	75	42	7	35	7	510	81	412	82	10	2	11	2	38	6	25	5	48	8	36	7	64	10	52	10	8	1	4	1
All drivers	1,377	65	953	64	260	13	237	16	1,597	78	1,190	80	33	2	33	2	113	5	75	5	146	7	108	11	280	13	169	11	32	2	17	1

NB Due to rounding percentages do not always sum to 100.

It can be seen that there are some differences between the groups, some of which would be expected. For example there is a larger proportion of "consistently fast" drivers who gave an estimate of their speed which was higher than the speed limit (these drivers are obviously more likely to be travelling faster than the speed limit). The chi-squared test was therefore used to investigate whether there were any significant differences (P<5 per cent) between the different driver groups in the proportions of drivers whose knowledge of the speed limit was:

- accurate;
- inaccurate; and
- could not estimate their speed or did not know whether it was within the speed limit (could not answer).

It was found that the females from both samples could not answer more times than would be expected compared with the males in each sample. The "consistently fast" drivers from the Watford sample were found to be inaccurate about the speed limit more times than would be expected compared with the "consistently slow" drivers. The most experienced driver group from the Newcastle sample were more likely to be able to give an answer compared with the other less experienced driver groups, though the answers given were not any more accurate or inaccurate.

The results of the responses given by drivers to question 5 for the Watford and Newcastle samples combined are summarised by Table E18 below.

Table E18 Answers given by drivers to Q5: How did you know your speed at the time?

Category	Consistently fast		Consistently slow		Males		Females		All	
	No	%	No	%	No	%	No	%	No	%
Car speedometer	289	47	560	53	1,119	49	979	51	2,098	50
Sensing speed from the surroundings	165	27	232	22	637	28	412	22	1,049	25
Sound of the engine/ gear I was in	61	10	152	14	223	10	223	12	446	11
Speed of other vehicles	63	10	34	3	170	7	88	5	258	6
Didn't know	15	2	32	3	61	3	86	5	147	4
Just guessing	9	1	12	1	30	1	49	3	79	2
Feel of the car	1	0	22	2	33	1	33	2	66	2
Experience	6	1	17	2	20	1	18	1	38	1
I was stopping and starting	1	0	3	0	0	0	12	1	12	0
Foot control	0	0	0	0	0	0	1	0	1	0
Total	610	100	1,064	100	2,293	100	1,901	100	4,194	100

It can be seen that drivers claimed to have used their speedometer to assess their speed as 50 percent of all responses. The other main categories mentioned include *sensing speed from the surroundings* and *sound of the engine/gear I was in.* Chi-squared analysis was used to investigate any significant differences between the males and females and between the "consistently fast" drivers and "consistently slow" drivers. It was found that males mentioned *sensing speed from the surroundings* and *speed of other vehicles* more times than would be expected, and females mentioned *didn't know speed* more times than would be expected. The main differences between the "consistently fast" and "consistently slow" drivers were found to be the mention of *speed of other vehicles* more times than would be expected by the "consistently fast" drivers, and mention of *feel of the car* more times than would be expected by the "consistently slow" drivers.

6.3 Summary

The analysis has revealed the following main findings:

- When asked what speed they were travelling and whether they thought that it was within the speed limit the females from both samples were more likely not to be able to give an answer. When an answer was given however, similar proportions of males and females gave accurate or inaccurate answers with respect to their knowledge of the speed limit.
- The "consistently fast" drivers from the Watford sample were found to be inaccurate more times than the "consistently slow" drivers when stating whether their estimate was within the speed limit or not.

  When drivers were asked how they knew their speed the most frequently mentioned factors were:

  – car speedometer
  – sensing speed from the surroundings
  – sound of the engine/gear I was in

- The males mentioned *sensing speed from the surroundings* and *speed of other vehicles* more times than the females when asked how they knew their speed.
- The "consistently fast" drivers mentioned *speed of other vehicles,* and the "consistently slow" drivers mentioned *feel of the car* more times than would be expected when asked how they knew their speed.