THE ROYAL SOCIETY FOR THE PREVENTION OF ACCIDENTS
RoSPA

HELPING DRIVERS NOT TO SPEED

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INTRODUCTION

Driving too fast for the conditions is a major cause of crashes.[1] Excessive speed contributes to 12% of all injury collisions, 18% of crashes resulting in a serious injury and 28% of all collisions which result in a fatality. This means that around 1,000 people are killed each year on Britain's roads because drivers and riders travel too fast, and over 6,000 are seriously injured.[2]

Many methods have, and are, employed to persuade drivers to drive within speed limits, and below the limit when appropriate. Most public and media attention in recent years has focussed on the role of safety cameras and of traffic calming - especially speed humps. However, the speed management strategy includes a much wider range of 'tools':

- Safety Cameras
- Traffic Calming
- Speed Awareness Courses
- Publicity Campaigns
- Road Design
- Speed Limit Signing
- 20 mph zones
- Home Zones and Quiet Lanes
- Police (non-camera) Enforcement
- Variable speed limits
- Variable Message Signs (VMS)
- Stronger Sentencing Options for Offenders
- Research into Why Drivers Speed

Despite this, speeding is still an endemic problem. Around 1.7 million speeding prosecutions[3] and tens of thousands of speed related casualties continue to occur each year.

It needs to be much, much easier for drivers to choose to drive at safe speeds. This requires education, training and publicity, better and more consistent roadside information about the posted speed limits and improved vehicle design so that drivers are more aware of the speed at which they are travelling.

This paper aims to explore what more can be done, in addition to the above list, to help drivers avoid inadvertently speeding, either by creeping above the limit or by driving within the limit but too fast for the prevailing conditions.

Broadly speaking, the paper focuses on suggestions for helping drivers not to speed by taking action outside the vehicle, on the roadside, and inside the vehicle through car design.

The paper does not aim to discuss the effectiveness of current activities, such as safety cameras, but to open discussion on future issues.

BACKGROUND DATA

Drivers travelling at higher speeds have less time to identify and react to what is happening around them. It takes longer for the vehicle to stop. Any resulting crash is more severe, causing greater injury to the occupants and to any pedestrian or rider hit by the vehicle.[1]

Driving too fast for the conditions is a major cause of crashes. Excessive speed contributes to 12% of all injury collisions, 18% of crashes resulting in a serious injury and 28% of all collisions which result in a fatality. This means that around 1,000 people are killed each year on Britain's roads because drivers and riders travel too fast.[2]

Approximately two-thirds of all crashes in which people are killed or injured happen on roads with a speed limit of 30 mph or less. At 30 mph vehicles are travelling at 44 feet (about 3 car lengths) each second. One blink and the driver may fail to see the early warning brake lights; one short glance away and the tell-tale movement of a child behind a parked car will be missed.

Even in good conditions, the difference in stopping distance between 30 mph and 35 mph is an extra 21 feet, more than 2 car lengths. At 35 mph a driver is twice as likely to kill someone as they are at 30 mph.[1]

- Hit by a car at 40 mph, 9 out of 10 pedestrians will be killed
- Hit by a car at 30 mph, about half of pedestrians will live.
- Hit by a car at 20 mph, only 1 out of 10 pedestrian will be killed.

Unfortunately, most drivers exceed the speed limit at some time. Over half (53%) of car drivers, 48% of motorcyclists and 49% of HGV drivers exceed the 30mph speed limit in urban areas. On 40mph roads, over one quarter (27%) of car drivers and 36% of motorcyclists exceed the 40mph speed limit.[4]

Around 45% of fatal and serious road casualties, and 54% of fatalities, occur on rural roads. The reduction of casualties on these types of road has been much slower than on urban roads.

Reducing the average running speed of vehicles by just 1 mph would reduce the number of accidents by 5%. The reduction varies according to road type:

- 6% for urban main roads and residential roads with low average speeds;
- 4% for medium speed urban roads and lower speed rural main roads; and
- 3% for the higher speed urban roads and rural single carriageway main roads.[1]

The greatest benefit would come from reducing the speeds of the faster drivers:

- if the proportion of speeders doubles, accidents go up by 10%;
- if their average speed goes up by 1mph, and all else is held constant, accidents go up by 19%; and
- if an individual drives more than 10 - 15% above the average speed of the traffic around them, they are much more likely to be involved in an accident.[1]

Research also shows that drivers who exceed speed limits are more likely to be involved in crashes. They are also more likely to commit other road traffic offences such as close following, red-light running, and drinking and driving.

WHAT MORE CAN BE DONE ON THE ROADSIDE

Speed Limits

Drivers' choice of speed is partly dependent on the characteristics of the road on which they are driving, and drivers' perception of what is a safe speed on a particular road will often differ to that of other road users, such as pedestrians, pedal cyclists and horse riders. Therefore, it is important that road design gives drivers the right messages about the maximum safe speed.

Speed limits need to be appropriate for the road on which they are posted, otherwise drivers are less likely to respect them and it may reinforce the argument used by some motorists that they are unfairly penalised. However, the reasons for a particular speed limit may not be apparent to motorists and consideration needs to be given to ways of making the reasons for speed limits on particular roads, especially roads which have a speeding problem, more obvious to the road users. This could be by providing information at the roadside or through local publicity campaigns.

Speed Limit Signing

The over-riding principle of speed limit signing should be to ensure that the limit is always as clear and obvious as possible. Drivers should not be expected to work out what the speed limit is.

Speed limit signing is not always consistent. Motorists often claim that it is difficult to know what the speed limit is on a particular stretch of road. Sometimes this is because they have not noticed the speed limit signs, but sometimes the signs are not present.

Most drivers will have had the experience of driving on a stretch of road and not being sure of the limit. Speed limit signs tend to be placed at junctions because this is often the point at which the limit changes. However, junctions are also where drivers need to absorb a wide range of different information and it is easy to miss a speed limit sign when concentrating on one or more other things (e.g., which way am I going, is that driver going to pull out, etc).

Drivers who claim they do not know the limit may be genuinely unsure, or may be making excuses. When they are genuinely unsure of the limit, this may be because they are not paying sufficient attention or it may be that the limit has not been adequately shown. In some ways, it is irrelevant whether they have a genuine complaint or are making an excuse for their poor observation. Making the limit obvious would help those drivers who are genuinely unclear, and would remove the excuse from those drivers who really did know the limit but exceeded it anyway.

In many cases, the nature of the road does not indicate the speed limit. In urban areas, for example, dual carriageways can have limits of 30 mph, 40 mph, 50 mph, 60 mph or 70 mph.

Repeater signs help to solve this problem, but only if they are in place and at regular intervals. This is not always the case, and when repeater signs are present, the first one may be some considerable distance from the junction or the point at which the limit changed.

Drivers can also be made aware of a change in speed limit by more marked changes on the road and roadside. Strips of coloured tarmac and a roundel painted on the road would emphasise the change and alert drivers to the new speed limit.

In rural areas, the use of 'Gateways' to mark the start of a lower speed limit in a village are particularly useful.

Speed limits should always be clearly and consistently marked, and this requires greater use of speed limit repeater signs and speed limit road markings.

Speed Limit Signs and Cameras
A common complaint from car drivers about cameras is linked to the perception that speed limits at camera sites are not always made obvious. One way of removing this complaint would be to show the speed limit sign with camera signs and perhaps with the cameras themselves. This could be achieved by using speed limit signs and/or speed limit roundels painted on the road. Where there is a speeding problem involving vehicles with a different speed limit to cars, signs could show limits for the different types of vehicles. This has the added benefit of reminding drivers that other vehicles, such as HGVs, have lower limits. It would probably only be practical to show the speed limit with signs that are close to the actual camera. Advanced camera signs that are some distance from the camera itself may cover roads with different speed limits and therefore could not show a single limit.

30 mph Speed Limit Repeater Signs
30 mph speed limit repeater signs are prohibited on 30 mph roads which have street lamps. Even if a local authority wished to place 30 mph repeater signs on these roads to address a speeding or accident problem it is not able to do so.

Paragraph 103 of the Highway Code tells drivers *"Street lights usually mean that there is a 30 mph speed limit unless there are signs showing another limit".*

This requires drivers to work out what the limit is. It is worth repeating that approximately two-thirds of all crashes in which people are killed or injured happen on roads with a speed limit of 30 mph or less. Therefore, doing everything possible to make the speed limit as clear and obvious as possible would be a logical step.

It is not feasible to put repeater signs or roundels on the road on all 30 mph roads, because it would lead to a massive proliferation of signs and create considerable resource problems. However, Highway Authorities should have the ability to do so. This would enable them to place repeater signs or markings on roads which speed surveys showed there is a speeding problem, or accident data showed a speed-related crash problem.

A trial should be conducted to examine the effectiveness of 30mph repeater signs on driver speed. If it found that such signs are effective, then the prohibition against repeater signs in 30 mph zones should be rescinded.

Speed education campaigns should also aim to reinforce paragraph 103 of the Highway Code (*"Street lights usually mean that there is a 30 mph speed limit unless there are signs showing another limit")* to help remind drivers that such roads have a 30 mph limit even if there are no signs to say so. Keeping the issue fresh in the minds of all drivers would help to reduce the amount of thought that a driver has to undertake to work out the speed limit of the road.

An alternative approach may be to ensure that all 40 mph roads have frequent repeater signs with the aim of encouraging drivers to assume that if there are no repeater signs, the limit must be 30 mph.

Repeater signs are not the only way of informing drivers of the prevailing speed limit. Wider use of speed limit markings on the road surface can also be employed, although care must be taken to ensure that this does not adversely affect two-wheelers, especially in wet road conditions.

It has also been suggested that lamp posts or the road surface could be marked or painted in certain colours to show the speed limit. There would be difficulties with this approach in that road users would need to be educated in the meaning of the markings or colours and there may be many places where it would be unsuitable for environmental reasons.

National Speed Limit Sign
Some drivers are confused about the meaning of the national speed limit sign (white circle with diagonal black bar) which means different speed limits on different types of road and for different vehicles. The Transport Select Committee in its report, "Road Traffic Speed", recommended that "The 'derestricted' sign should be replaced by a sign indicating what the speed limit is". However, the Government disagreed, explaining in its response, published in October 2002, that

"The national speed limit or 'derestricted' sign makes for simplicity of signing and avoids sign proliferation particularly in rural areas. However there is concern that its meaning may not be properly understood by some drivers. The national speed limit sign indicates that no vehicle may exceed 60mph on single carriageway roads and 70mph on dual carriageways. The difficulty with numerical signing is that lower speed limits apply to different vehicles which would make signing difficult and confusing; for example; HGV's over 7.5 tonnes may not exceed 40mph on single carriageway roads."

RoSPA's view is that speed limit signs that show the numerical limit are clearer. Drivers of vehicles, such as HGVs, to which lower limits apply are professionally trained and qualified and should be expected to know the limits that apply to their vehicles. Where there is a problem with such vehicles exceeding their speed limits, additional signs specifically showing the lower limits for certain types of vehicle should be considered. RoSPA believes that the national speed limit sign should be phased out during the course of normal road and sign maintenance and replaced with numerical signs.

Sign Visibility
Road signs are only useful if drivers can see them. It is important that Highway Authorities ensure that signs are kept visible, and in particular, that hedges, trees and vegetation do not obscure them.

Vehicle Activated Signs (VAS)

Vehicle activated signs are a way of drawing a driver's attention to the road environment. One type of VAS are Speed Indicator Devices (SID), which detect the speed of oncoming vehicles and, if above the speed limit, flashes the speed the driver is doing or the speed limit of the road, sometimes with warning messages such 'slow down'. They can also display junction or bend warning signs or the safety camera sign, and are also particularly effective on approaches to isolated hazards, such as junctions and bends in rural areas.

A large-scale evaluation was conducted into the effectiveness of VAS by TRL in 2002[5]. It found that junction and bend warning signs reduced the mean speed by up to 7mph. Safety camera repeater signs, used in conjunction with enforcement, reduced the mean speed by up to 4mph, and their use with cameras reduced accidents more than cameras alone.

The evaluation also measured public opinion and found that there was "overwhelming approval" of the signs.

Importantly, there was very little indication that the signs only had a novelty effect, and their influence on speed reduction was sustained over a long period.

Psychological Traffic Calming

The road environment can be engineered to affect driver behaviour. An obvious example is traffic calming, which is designed to make drivers slow down, usually by physical measures such as speed humps. However, the potential benefits of 'psychological traffic calming' are being investigated to assess whether speed reductions can be achieved without using speed humps.

Changes in the road environment have been studied to see how they affect driver behaviour[6]. In general, more complex road environments create a greater cognitive load on drivers, which induces them to slow down to give themselves time to understand the surroundings. It is likely that psychological traffic calming may be more acceptable to drivers who are concerned about the potential of speed humps to damage vehicles and cause discomfort or injury to disabled or elderly drivers and passengers.

There are several ways by which the road can be modified to ensure that drivers do not drive at an inappropriate speed. The road width, or perceived road width, can be reduced in order to create the effect of narrowing the road and increase the perceived risk. This effect can be increased by the removal of the central white line.

A photomontage and simulated road environment was tested on drivers to see the effects that different schemes would have on their speed[7]. The most successful measures were those which built out into the road, such as red brick narrowing and tree build outs, and a sustained combination of psychological traffic calming measures were found to maintain speed reductions over a stretch of road. Interestingly and importantly, the results found that psychological traffic calming slowed faster drivers the most – as the increase in perceived risk diminishes any "thrill factor" which a small percentage of the driving population senses from speeding.

Red brick narrowing, whereby a surface of red brick is added to the sides of the road creates uncertainty in the footway width and defines a distinctly narrower edge to the road. Tree build outs are also an effective measure in reducing speed, again these physically narrow the road but a red strip can be added to the surrounding to further reduce the perceived width. The presence of built up vertical structures by the side of the road – such as the trees used in this method – can also encourage drivers to reduce their speed.

To date, one psychological traffic-calming scheme has been implemented in the UK, and the results have been evaluated to study the effects of psychological traffic calming in a real world situation, and to confirm the prior literature and simulator studies. The village of Latton in Wiltshire was chosen which is just off a main, dual carriageway, A-road. The scheme had several main elements throughout the length of the village and was intended to reinforce a speed limit change from 40 to 30 miles per hour.

Stone gateways were constructed to create a well-defined entrance to the village and speed limit signs were mounted upon them, the gateways were built out by one metre into the road to reduce its width.

Throughout the village itself, the central white line was removed, and build-outs with parking bays were used to reduce the width of the road. A buff surfacing was used in once part of the village to create a difference in road texture and the lighting columns were reduced in height – as a tall light suggests to the driver that the road has a high speed limit.

Speeds were measured before and after the scheme. The percentage of drivers exceeding 30mph dropped from around 85% to 50% and the percentage of drivers exceeding 40mph dropped from 50% to around 10%.

The mean speeds measured at the north gateway of the village fell from 44.2mph to 36.7mph, likewise at the south gateway it fell from 40.9mph to 36.9mph, and in the village centre it fell from 39.4mph to 30.8mph. The mean speeds of both north and southbound traffic fell. The speeds were measured 7 months after the scheme was implemented which suggests that the effects were not due to a transient novelty effect.

A public attitude survey was conducted to measure the acceptance of the scheme. Of the local people questioned, 75% supported the measures as a whole and 75% also liked the appearance of the scheme. Two-thirds (67%) of questioned residents thought that the speeds through the village had reduced, and half of the respondents thought that it was safer to cross the road than before. Opinion was divided over the removal of the central white line, however, which may have been because many people felt that removing the centre line would make driving more dangerous, even though the results of the trial showed otherwise.

Early results suggest that psychological traffic calming can be effective in reducing speed, without the need for the more intrusive physical measures of speed humps. However, they may produce smaller speed reductions than physical measures.[6] Therefore, it is likely to be a useful speed management tool in the right locations. However, these types of scheme may be more expensive than traditional traffic calming and their cost-effectiveness must also be considered.

WHAT MORE CAN BE DONE – IN THE VEHICLE

Motor manufacturers can consider how they design cars to give drivers more awareness and better information about their actual speed.

Intelligent Speed Adaptation (ISA)

Intelligent Speed Adaptation has the potential to significantly decrease the number of road casualties. The European Commission identified this as a key issue and in a resolution in June 2000 recommended *"the use of advanced assisted driving technology which has considerable potential for improving road safety".* It called for research in *"technology relating to speed limitation devices and to identify any technical, organisational, administrative and legal difficulties in introducing them"*

The Project for Research On Speed Adaptation Policies on European Roads (PROSPER), set up by the European Commission, aims to help promote international co-operation in order to overcome the barriers (for example, legal or technical issues) to implementing such systems. Although trials are being conducted in several countries, the two most widespread have been in the UK and Sweden.

Sweden: Trials in Borlänge, Lidköping, Lund and Umeå

A wide scale trial was conducted in Sweden using the ISA technology in four different cities between 1999 and 2002[8]. It identified the primary application of ISA to be in towns and urban areas where speed humps are currently used to slow down traffic speeds.

Borlänge

In Borlänge, 400 vehicles were fitted with a system which monitored the driver's position using GPS and then matched it to a map of the speed limits. If a speed limit was exceeded, a tone sounded in the vehicle, which repeated if the offence continued. This type of system that constantly gives the driver information of their speed is referred to as an 'informative display system'.

Lidköping

In Lidköping 150 vehicles were fitted with the informative system, and 130 of those were also fitted with active accelerator (described below). A speed sensor monitored the vehicle's speed and again map matching was used to determine if the vehicle was exceeding the speed limit. The trial compared the differences in attitudes of drivers using the two systems in the same environment.

Lund

In Lund, 290 vehicles were fitted with active accelerator pedals which interfaced with the driver by exerting a counterforce to the pressure applied by the driver when depressing the pedal, but only when the vehicle exceeded the speed limit. If the driver exceeded the limit, s/he needed to exert three to five times the force usually required to depress the pedal. The idea being that when a driver feels a mildly uncomfortable sensation through their leg, the instinct will be to lift the foot off the pedal, which will slow the vehicle back below the speed limit. It also removes the need for an audible tone to alert the driver. The drivers were constantly reminded of their speed by a display in the car and GPS monitored the vehicles' speed and position.

Umeå
4,000 cars (representing approximately 10% of the vehicle kilometres travelled in the municipality) participated in the Umeå trial which allowed the effects of ISA on overall traffic flow to be assessed. The main difference with the other trials was that the speed limit was not constantly displayed inside the vehicle. Transmitters mounted on lampposts let the vehicle know the speed limit and if the driver exceeded it, an audio and visual signal was activated inside the vehicle. This system is an example of a warning ISA system. This trial also compared the effects of the warning system with the informative system.

Results
ISA had a clear effect on the average speed of the vehicles during the trial although it was relatively small, partly because vehicle speed is dependent on traffic flow, congestion and road design as well as the speed to which a vehicle is limited.

The number of speed violations fell sharply with the use of ISA and drivers returning to non-regulated vehicles were found to be less likely to exceed the speed limit. The percentage of drivers exceeding the speed limit increased again after a short period of time.

The widespread trials in Umeå found a slight, but noticeable, drop in the average speeds and the number of vehicles travelling above the 85th percentile. This suggests that if only 10% of vehicles in an area are ISA equipped, it still leads to an overall drop in speeds.

The active accelerator pedal in the Lund trial led to an initial decrease of speeds (possibly due to the drivers not being used to the resistance force of the pedal) followed by an increase in speeds as they became more familiar with the system. However, the increase was only between 5 and 50% of the initial decrease, so there was a net reduction in mean vehicle speeds on different types of roads. The largest reductions were found on the 70 mph and 50 mph roads.

UK: The University of Leeds and the Motor Industry Research Association

External Vehicle Speed Control (EVSC)
The forerunner to the current study at the University of Leeds was carried out with the help of the then Department of Environment, Transport and the Regions (DETR) and the Motor Industry Research Association (MIRA). Trials were performed in simulators and on the road, and in both the speed limit of the current zone and the limit that the vehicle was restricted to was shown on a dashboard-mounted display.

The effects of three different types were assessed[9]. *Advisory*, which displays the speed limit and reminds the driver when it is breached (this is roughly equivalent to some commercial systems on sale today). *Voluntary*, which allows the driver to switch the limiter on and off. *Mandatory*, which limits the speed of the vehicle at all times.

The speed to which the vehicle was limited were divided into three categories. *Fixed*, the vehicle is restricted only to the speed limit of the road but may still be able to drive at inappropriate speeds. *Variable,* where the vehicle is also informed of the locations of hazards (e.g. pedestrian crossings or schools) and suggests a more appropriate speed for the situation. *Dynamic*, where additional speed restrictions based on the current circumstances (e.g. bad weather, congestion) are communicated to the vehicle.

The voluntary system, known in the trials as "Driver Select", offered the driver the option to engage or disengage the system every time the speed limit changed; the driver could also override the system at any time. Red and green buttons on the steering wheel were used to switch the system on and off. The system also switched off if the audio warning signal was ignored for over 4 seconds.

The mandatory system was designed to restrict the driver to the speed limits. It worked by retarding the ignition and then reducing the fuel injected into the engine to decrease the power and therefore decrease the speed. If this was not enough to limit the vehicle, the brakes were gently applied. The vehicle was slowed down on approach to lower speed limit zones so that the limit would not be exceeded.

The results were positive, and there was no negative compensatory behaviour such as tailgating in the real world trials, possibly because traffic in front of the vehicle was able to travel at a faster speed. Driver behaviour improved and braking was less abrupt.

Drivers preferred the voluntary system because they felt vulnerable when moving slower than other traffic and being overtaken approximately twice as many times when constantly limited to the speed. (If a high percentage of drivers were using ISA, it is reasonable to suggest that this feeling of vulnerability and frustration would decrease). The report, therefore, concluded that it would be unwise to make the system mandatory until a significant number of vehicles on the road were equipped with it.

A disadvantage with the voluntary system was that drivers tended to disengage it in areas where speeding was the norm, so it was only half as effective as the mandatory one. The table[10] below indicates that the cost benefit ratio is not as high when voluntary systems are used, because it is not in constant use.

System	Speed Limit Type	Best Estimate of Injury Accident reduction	Best Estimate of Fatal and Serious Accident Reduction	Best Estimate of Fatal Accident Reduction	Cost to Benefit Ratio (low GDP)	Cost to Benefit Ratio (high GDP)
Advisory	Fixed	10%	14%	18%	5.0	6.9
	Variable	10%	14%	19%	5.3	7.2
	Dynamic	13%	18%	24%	7.0	9.6
Voluntary	Fixed	10%	15%	19%	3.7	5.0
	Variable	11%	16%	20%	4.0	5.4
	Dynamic	18%	26%	32%	6.1	8.3
Mandatory	Fixed	20%	29%	37%	7.4	10.0
	Variable	22%	31%	39%	8.0	10.9
	Dynamic	36%	48%	**59%**	12.2	16.7

The ISA Project

The second trial is being conducted with MIRA using DfT funding in which ISA has been fitted to twenty cars with a mix of male, female, young and old drivers in the Leeds area.

The first six-month trial (due for completion in December 2004) is monitoring their driving behaviour for one month before using the ISA system, with the system fitted for four months, and then without the system after using it. The speed of the vehicles in this trial is controlled by GPS based navigation, which compares the vehicles' position with the speed limit of the roads in and around Leeds.

A Review of Locally Implementing the Scheme

A review[11] of how a locally implemented system would reduce casualty numbers found that a scheme in which all vehicles registered within a 5 km radius were fitted with ISA would be 63% as effective in that area as a nationally implemented ISA. A scheme of 10km radius would be 73% as effective and 15km radius would be 84% as effective. These results are especially relevant in estimating the effectiveness of the system if it were to be introduced into city centres.

Conclusion

Technologically, the ISA system is entirely feasible (The only unresolved technological issue is the creation of a permanent satellite network to control the systems) and this is under development.

ISA offers considerable potential in reducing the casualty rates; the trials indicate that it is effective in reducing speeds on both urban and rural road networks. The trials are still at an early stage and there are many areas that need to be researched and developed with the manufacturers so that ISA is part of the production process and is built into the cars' systems.

Public perception of this new technology will be crucial; drivers will need to clearly understand what it does and does not do. And the transition period during which both ISA and non-ISA cars share the road will present challenges.

Commercially Available Speed Management Systems

Several devices, known as Speed Management Systems, are already commercially available. They are retrofitted to the vehicle and can either warn a driver when they exceed the speed limit, or limit the top speed of the vehicle in the same way as ISA.

These devices will help to introduce the concept of Intelligent Speed Adaptation to the general public. They may also be a good way of helping some drivers adhere to speed limits and may become popular amongst some sections of consumers.

However, they do not provide the same benefits as the fixed ISA systems for several reasons:

- As the speed limit is not automatically communicated to the vehicle via an external system they depend on a driver (or passenger) pressing a button to switch on a pre-set limit and then changing this as the vehicle travels on different roads.

- The device depends upon the driver being aware of the speed limit in order to input it correctly. This is in turn reliant on drivers making correct observations and does not address the problem that sometimes the drivers are unaware of the speed limit; the driver is only informed of what he or she has just told the system.

- The potential exists for drivers to set it at a speed higher than the speed limit.

Commercially Available Warning Systems
As well as being able to purchase speed limiters, drivers can also purchase warning units which are sold on the basis that they warn against accident black spots and also inform drivers of other dangers such as school zones.

They work by using GPS satellites to track a car's position in the same way that ISA systems do. The difference is that the car's location is cross-referenced with zones that show accident black spots and speed camera sites. If a car's co-ordinates lie within that zone then the unit displays an alert. Several of these units also display the speed of the vehicle and again their use is a step towards the acceptance of ISA.

Although these systems could be useful in alerting drivers to dangerous stretches of road where lower speed is appropriate, they have the potential to be used by drivers as a warning device to the presence of speed cameras. This would certainly remove most, if not all, of the safety benefits which could potentially be gained from their use.

Another shortcoming of these warning systems is that they only highlight the location of the cameras rather than the reason that they exist. The websites of the safety camera partnerships display the locations of the cameras along with further road safety messages to help drivers understand the issues surrounding speeding.

Vehicle Monitoring Devices (VMD)
There are systems available and being trialed[12], which can collect data from a vehicle's journey. Recording the data allows fleet managers to review a driver's speeds and, if speeding is a problem, they can then decide that the driver needs further training or warnings about the speeds used. These systems can also give real time feedback to a driver using the vehicle to warn of excessive speeds.

As the device does not communicate with sources outside of the vehicle it would not know the speed limit of the road, and although the speed of the car and the road can be compared after the journey, this means its applications are currently limited in this respect. However, It does have further potential in other areas of driver improvement.

RoSPA has published guidance for employers on how to develop and implement safer speed policies for their staff who drive for work. "Driving for Work: Safer Speeds Policy" is available at www.rospa.com/roadsafety/info/workspeed.pdf.

Speedometer Design

In order to keep a vehicle under a certain limit, the driver needs to be informed of the vehicle's speed. This is the function of speedometers.

EU legislation[13] broadly states that the speedometer must be:

- positioned within the driver's field of vision
- legible by day and night
- graduated in sets of 1, 2, 5 or 10 mph and k/mph.

Although the ergonomics of the best place to locate a speedometer on the dashboard are not discussed here, the advantages and disadvantages of locations of speedometer are discussed along with examples of speedometer and future technology that may have implications about the position of speedometer.

Current Designs

The current convention in car design is to place the speedometer on the dashboard behind the steering wheel; the driver then only has to glance down to read the current speed. In recent years, however, the introduction of driver's airbags in the steering wheel has meant that the steering wheel has got 'chunkier' and the speedometer can be obscured, especially as the steering wheel is being turned when performing manoeuvres.

Several current speedometer designs may also be hard to read at a quick glance due to only a small arc being between each mark indicating an increased graduation in speed. This is due to speedometers displaying top speeds that cars can't travel at – a problem that could be more common in smaller engine cars when the same dial layout is used for faster cars in the range.

Potentially, there are other, relatively inexpensive, ways of making a driver aware of the vehicle's speed. Speedometers tend to only show numbers in units of 20 mph (i.e. 20, 40, 60 mph) which means that other speeds such as 30 or 70 mph are harder to pick out – making drivers less aware of these speeds.

If 30 mph was marked at or near the top of the dial, this implies to drivers that they are travelling at a significant speed by the time they reach 30 mph. Other examples of communicating speed may be provided by colour changes on the dashboard display, for example the speedometer display could turn yellow (amber) over 30 mph and red over 70 mph – one manufacturer has already employed a similar colour change to inform the driver when the rev counter is too high. An audio signal could also be used to alert the driver that a common speed limit has been exceeded.

Some manufacturers have tried to improve speedometer design, most noticeably by using digital displays. These have the advantages that large numbers can be displayed and also set against a lit background, making it an easier to read in darkness.

One type of car has the dial of the speedometer displayed around the circumference at the top of the steering column. This means that as the circumference of the dial is larger, a greater distance exists between the graduations of the speeds displayed making it easier to read at a glance.

WHAT MORE CAN BE DONE TO INFLUENCE DRIVER BEHAVIOUR

During The Test

Greater emphasis could be placed on speed and its effects during both the theory and practical test.

In the theory test, more questions could be set on speed and its effects to highlight the number of deaths and injury that it causes. These questions would help new drivers develop their risk perception of the dangers of speed.

One of the reasons why drivers fail their practical test is not driving at appropriate speed. The terminology could be misinterpreted by the learner driver to mean that they did not drive fast enough.

Speed Awareness Courses

One of the problems with only issuing fines and penalty points to drivers who break speed limits is that whilst they are used as a punishment for a crime, they do not seek to explain the reason why they have been awarded. If the recipient believes that there is a disparity between the crime and punishment, then the educational message of a punishment may be missed.

Speed Awareness Courses[14] address this perceived unfairness by weaving the educational message into the punishment. Individual police forces may divert offenders to a Speed Awareness Course rather than issue them with a fixed penalty notice. This follows the model of the successful National Driver Improvement Scheme (whereby drivers committing careless driving offences may be offered a course of driver instruction rather than prosecution).

Currently, Eight police forces are operating some form of speed awareness scheme. However, the content and criteria for allocation vary and it is not yet possible for police forces easily check whether a driver has already taken such a course in the preceding three years. ACPO are developing guidance for a national scheme which will outline a draft course specification, criteria for when the offer of a course is and is not appropriate and a database for attendance records to ensure that individual drivers cannot continually avoid prosecution by attending several courses.

The DfT will commission research to assess the most effective course specification and by April 2006 be in a position to offer this to the police service who it is expected will adopt this as the national specification.

It is hoped that by drivers who undertake a speed awareness course will appreciate the reasons why speed limits are important and why it is unacceptable to exceed them or to drive too fast for the conditions. This change in knowledge and attitudes should then lead to a change in their driving behaviour, which should apply whenever and wherever they drive.

An assessment of one type of speed awareness course was able to quantify the effects that it had upon the attendees[15]. The results were split into two categories, those who had been prosecuted for travelling slightly over the speed limit – described as "low speed participants", and those who had been prosecuted for a major speeding violation who in turn are described as "high speed participants".

The course examined comprised a computerised assessment of the attendees, which included topics such as demographic, speed choices, and driving experiences – amongst others – before providing them with an analysis of their attitudes, and personally tailored safety messages. The second session was a discussion with a trainer where topics around speeding were discussed, such as enforcement, revenue and the link between speed and accidents – which was related back to the participant's speed choices from the first session.

Of the low speed participants, just under 30% declared their intentions to travel 'much slower' in future and around 65% declared their intention to travel 'slower', the rest indicated that there would be no chance in their choice of speed, or that they would travel faster or much faster.

A greater proportion of high-speed participants – around 45% – declared their intention to travel 'much slower' after the course and 53% had aims to travel 'slower'. Again there was a small number of attendees who were not going to change their driving habits or became more determined to break the law.

Other characteristics, and how they affected a driver's mindset after a course, were also examined. Younger drivers were more likely to declare intentions to travel slower after the course, as were female drivers. The course attendees who rated either of the two sessions positively also responded in a similar manner.

Speed awareness courses are a useful tool in promoting a strong educational message, both to drivers who deliberately break the limit regularly, and those who have mistakenly travelled at an illegal speed. Future research will be focussing on the long-term effects of the speed awareness course on a driver's choice of speed.

CONCLUSION

Driving too fast for the conditions (including exceeding the speed limit) causes enormous harm and grief. Britain's road safety strategy rightly sets speed management as one of the main priorities for preventing crashes and reducing road casualties.

Many different approaches are being employed to persuade drivers to drive within speed limits, and below the limit when appropriate. Measures such as traffic calming, speed education campaigns and safety cameras have been particularly effective and should continue to be supported. However, there are other approaches that could also be adopted.

The over-riding principle of speed limit signing should be to ensure that the limit is always as clear and obvious as possible. Drivers should not be expected to work out what the speed limit is.

In addition to normal road safety engineering measures, roadside changes such as psychological traffic calming may well prove useful in reducing speeds in areas by creating a perceived risk, it must be ensured that actual risk is not effected by the changes in any way however.

Engineering changes to the vehicle will help the driver to know the speed limit, and the availability and feasibility of computer based in-vehicle devices is increasing rapidly. Ultimately the mapping of the UK's road network – in terms of the speed limit – will make it possible to display the speed limit of every road, within the car, so that a driver can constantly be reminded of this. Ultimately this also leads to the vehicle limiting the speed of the driver dependent on the safety of current conditions.

Speed awareness courses provide a good opportunity to educate drivers who have committed speeding offences.

It needs to be much, much easier for drivers to choose to drive at safe speeds. This requires education, training and publicity, better and more consistent roadside information about the posted speed limits and improving vehicle design so that drivers are more aware of the speed at which they are travelling.

RECOMMENDATIONS

Road Design
Consideration should be given to ways of making the reasons for speed limits on particular roads, especially roads which have a speeding problem, more obvious to the road users. This could be by providing information at the roadside or through local publicity campaigns.

Speed Limits
Speed limits should always be clearly and consistently marked. This requires greater use of speed limit repeater signs and speed limit road markings.

Where there is a speeding problem involving vehicles with a different speed limit to cars, the benefits of showing the limits for the different types of vehicles should be investigated. This may have the added benefit of reminding car drivers that other vehicles on the road, such as HGVs, have lower limits.

Speed Limit Signs and Cameras
Wherever possible, the speed limit should be shown with safety camera signs and perhaps with the cameras themselves. (Advanced camera signs that are some distance from the camera itself may cover roads with different speed limits and therefore could not show a single limit).

30 mph Repeater Signs
A trial of the effects of using 30mph repeater signs should be conducted. If this was effective in reducing speeding, the prohibition on using repeater sign on 30 mph roads with street lamps should be rescinded to enable Highway Authorities to put repeater signs or roundels on roads which have a speeding problem, or where accident data showed a speed-related crash problem.

Repeater signs are not the only way of informing drivers of the prevailing speed limit. Other methods should be developed.

National Speed Limit Sign
The national speed limit sign should be phased out over time (during the course of normal road and sign maintenance) and replaced with numerical speed limit signs.

Vehicle-Activated Signs
Vehicle-activated signs are a way of making drivers aware of their speed and upcoming dangers on the road. They are popular among drivers and effective in reducing mean speed. Their use should be considered on a more widespread basis.

Psychological Traffic Calming
Early results suggest that psychological traffic calming can be effective in reducing speed, without the need for the more intrusive physical measures of speed humps. Therefore, it is likely to be a useful speed management tool in the right locations. Further trials should be conducted and appropriate guidance developed.

Motor Manufacturers
Motor manufacturers should consider how they design cars to give drivers more awareness and better information about their actual speed.

Intelligent Speed Adaptation
Technologically, the ISA system is entirely feasible and trials indicate it is likely to significantly reduce casualties. ISA should continue to be developed and evaluated with the aim of introducing it as soon as feasible.

Public perception of this new technology will be crucial. Education campaigns should be developed to ensure that drivers clearly understand what it does and does not do.

Commercially Available Speed Management Systems
The development of devices (many of which are already available) to alert drivers when they are exceeding speed limits and to alert them when they are approaching a stretch of road with a known crash problem should be welcomed. However, standards need to be developed to ensure that this technology is used to improve drivers' personal speed management, and not just to 'get away' with breaking speed limits.

Speedometers
Motor manufacturers should urgently consider how they can improve the design of speedometers to help drivers maintain their awareness of their speed and to encourage drivers to stay within speed limits.

Employers
Employers should introduce Safer Speed policies, as part of their normal management of health and safety at work, to help ensure that staff who drive for work purposes are able to do so at safe and appropriate speeds.

Speed Awareness Courses
Speed awareness courses are likely to be a useful tool in promoting a strong educational message, both to drivers who deliberately break the limit regularly, and those who have mistakenly travelled at an illegal speed. National standards for should be developed to enable Speed Awareness Courses to be made nationally available.

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