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Speed and risk of collision

From a safety perspective, an inappropriate high speed (IHS) is a speed at which a driver loses control of the driving task. Higher speeds are associated with increases in the probability of crashing and the severity of the outcome.

Speeding behaviour in Great Britain

Speeding is not an exceptional activity by British drivers and motorcyclists. In 2006, the incidence of any level of speed limit violation was 54% for both car drivers and motorcyclists on motorways, 45% and 48% respectively on dual carriageways and 49% and 51% in 30 mph zones. It was respectively 28% and 39% on 40 mph roads and lowest of all on single carriageway roads in non-built-up areas (11% and 27%). Motorcyclists offend proportionally more than car drivers on all road categories except for motorways.

Perhaps of more significance for road safety is the incidence of ‘excessive’ speeding, defined as the proportion of road users who break the limit by 10 mph or more on motorways, single and dual carriageways (non-built up areas), and by 5 mph or more in 40 and 30 mph zones (built-up areas). For car drivers in 2006, this was greatest on motorways and 30 mph roads (17% and 19% respectively) but reduced to 12% on dual carriageways. These proportions have been more or less stable since 2000 on motorways and dual carriageways but have declined on 30 mph roads. On 40 mph roads, the incidence of excessive speeding was 10% and, just as for the distribution of speeding in general, was lowest of all on single carriageway roads in non-built-up areas at 2%. Both these values have been reasonably stable over the past seven years. The ratio of ‘excessive’ to ‘slight’ speeding is highest in built-up areas and lowest on non-built-up single carriageway roads. For all road categories, the ratio of ‘excessive’ to 'slight' speeders is greater for motorcyclists than for car drivers.

Although speed may be inappropriate legally, it is not always necessarily unsafe in the sense that it pushes drivers closer to the threshold where driving task demands might exceed driver capability (although the introduction of variation in the traffic flow, with some drivers complying and others not, may lead to more traffic conflicts). Nevertheless, about one in six GB drivers exceeds the motorway speed limit by more than 10 mph and one in five exceeds the 30 mph limit by more than 5 mph. A small proportion of drivers (1%) exceeds this legal limit by a margin of more than 15 mph and the 40 mph limit by a margin of more than 20 mph.
Theoretical framework for understanding speed choice

A loss of control by a driver arises when the driving task demands momentarily exceed the driver’s capability. The degree of separation between task demand and capability is what defines task difficulty. Drivers drive in such a way as to maintain the level of task difficulty within a preferred range. Difficulty can be controlled by the driver influencing task demand, adjustment of speed being the primary mechanism for achieving this control. Difficulty can also be controlled by changes in effort, but within much narrower limits.

The driver’s risk threshold is the level above which risk is felt to be too great, at the upper boundary of the preferred range of task difficulty. Feelings of risk are triggered by elements of the unfolding scene around the driver and as a result may be prioritised in attention capture.

An important issue for driver safety is the accuracy of calibration of perceptions of capability and task demand (and therefore task difficulty). Clearly, overestimation of capability and/or underestimation of task demand will lead to the perception that the driving task is easier than it objectively is, and may lead to a dangerous level of compensatory speed adjustment. Poor calibration is most typical of inexperienced drivers.

In order to fully understand the origins of speed choice, a distinction also needs to be made between proximal and more distal determinants of driver capability, driving task demand and preferred range of task difficulty. Finally, apart from the process by which drivers choose a speed which maintains task difficulty within a range bounded by the risk threshold, drivers are also required to opt for a speed which complies with legal limits. The evidence cited above shows that there is often a conflict between these two speeds when the legal maximum speed is lower than the driver’s preferred speed.

Understanding demographic correlates of IHS

Research over the last decade confirms what might be called the young driver and young male driver ‘syndromes’. Young drivers are more likely to report an intention to speed and, indeed, they not only exceed the speed limit more but do so more excessively than older drivers. A greater proportion of their accidents is associated with driving too fast for the conditions. Their crashes are frequently the result of intentional high speed, including racing other drivers, and are more likely to occur at weekends and at night.

Males typically drive faster than females and have more fatal crashes per kilometre. Young males score higher on positive attitudes towards, and actual involvement in, risky driving behaviour, such as exceeding the speed limit by 20 km/h. For this group, such behaviour and higher levels of detected offence are more likely to
persist. They are also the group most likely to have speed as a collision factor and to have single-vehicle crashes. Behaviours associated with a high risk threshold tend to cluster together, such as speeding, close-following and dangerous overtaking, and are inevitably linked to the consequences of higher rates of conviction for violations and of collisions.

Apart from the lack of experience, and thus opportunity to develop knowledge of the contingencies of the road and traffic environment and more refined skills of situation awareness and vehicle control, the young driver, and especially the young male driver, may simply be immature, with incomplete development of self-knowledge, self-control, social responsibility and independence of judgement. Young drivers with Attention Deficit Hyperactivity Disorder (ADHD) may be particularly at risk because of a relative lack of self-control.

Age and sex differences are also related to traits of sensation seeking and aggressiveness. Adolescent boys report stronger tendencies on both these traits than adolescent girls and adolescents score higher than adults. Different socialisation processes may in part explain observed sex differences in driving behaviour.

**Distal correlates of driving speed**

Normative influences appear to have an effect on driver speed choice. Drivers tend to comply with the perceived norm which is often overestimated. Young drivers are also prone to overestimate the prevalence of reckless driving in their peer group and perceive more approval from significant others for their speeding. They also say they would drive faster with people their own age in their car. An early exit from formal education is linked to car uses other than for journey purposes, such as self-expression, status through fast driving, competition and entertainment. Driving without a destination is also associated with driving errors and violations.

**Default speeders** neglect to transfer control from perceived task difficulty to control by monitoring speed in relation to the legal limit. For **socially deviant speeders**, speeding is an expression of general social deviance and is associated with other forms of risk taking in traffic and increased collision involvement. This characteristic of defiance of the law may be linked to a lack of self-control.

Attitudes towards speeding are less negative than towards other types of moving violation and drivers are more permissive in their attitude to speeding at night. In general, more positive attitudes towards speeding under conditions of reduced task demand are associated with higher levels of speeding behaviour. These attitudes help explain the behaviour of **default speeders** and also the finding in some studies of a lack of relationship between attitudes and collision involvement. Negative attitudes towards obeying traffic rules in general are associated with greater involvement in risky driving behaviour, violation of traffic rules, near accidents and crashes.
Within the framework of the Theory of Planned Behaviour (TPB), the only independent predictor of observed speeding appears to be intention, a variable that represents a summary of the individual’s motivation for the behaviour in question. Intention may be associated with particular attitudes, subjective norms and perceived behavioural control.

TPB variables help translate demographic variables into theoretically more meaningful concepts. However, attempts to modify drivers’ attitudes have been found to produce little systematic change in either intentions or behaviour. As independent manipulation of TPB variables provides the only true experimental test of the theory, its validity remains open to question.

Personality variables are related to driver speed choice and there are profiles of different types of driver, characterised by different driving styles. One group of drivers, a high risk threshold group, drive more-or-less continuously with a higher risk threshold relative to others. Such drivers are impulsive, have reduced self-control, are relatively poorly socialised, seek intense sensations, are willing to take risks, perceive less danger in risk-taking, experience more anger while driving and exhibit more aggression. They are prone to excessive speeding and other moving violations, and have a higher crash rate. In contrast, a low risk threshold group do not allow motives that might raise the risk threshold (such as being in a hurry) to influence them. They also actively comply with the speed limit. A third group of opportunistic drivers are prepared to increase their speed as the task demand decreases, even if this means going over the speed limit. Nevertheless, they too do not allow motives that might raise the risk threshold to influence them. Finally there is a reactive risk taker group, who allow feelings to influence speed choice and who are prepared to raise the difficulty level if they are in a hurry or to escape a close-follower. However, this group is also sensitive to feelings of risk and avoids exceeding their risk threshold if possible.

Proximal correlates of driving speed

Recent evidence suggests that the driver’s emotional state and motivation to save time can both influence speed choice. Feelings of anger are associated with aggressive driving, speeding, penalties for speeding violations and crash experience. When anger is translated into aggressive driving, this may not only include excessive speed but interpersonal aggression, including chasing and speeding past the driver who was the source of the provocation. From a theoretical perspective, feelings of anger may raise the driver’s risk threshold or reduce the driver’s sensitivity to it or both.

Being in a hurry is not an unusual state and many drivers report driving faster when late for an appointment or meeting. Thus, not surprisingly, being in a hurry is associated with speeding, faster acceleration, hard braking, dangerous overtaking
and tailgating. Male drivers who report driving faster when late are more likely to have had an accident in the recent past.

**Inappropriate high speed: vulnerable groups and situational determinants**

For most of the time on the road, drivers choose a speed which maintains an adequate margin between task demand and their capability. Safety consequences arise, however, where the driver is poorly calibrated (i.e. in terms of underestimating task demand and/or overestimating capability), or where the driver operates with too high a risk threshold. For some drivers a high risk threshold appears to be a trait, and is associated with drivers who are immature or have characteristics of sensation seeking, aggression, poor self-control and social deviance. For most drivers there are also situational determinants which may have the effect of raising risk thresholds by motivating increases in speed. These include an emotional state of anger and the motivation to save time. Drivers described as having a ‘reactive’ driving style may be particularly vulnerable to such influences. Some drivers may also be subject to normative pressures to conform to the apparent speed of others which they overestimate.

**Powered two-wheelers**

Proportionately more motorcyclists exceed the speed limit than car drivers. However, excessive speed does not appear to be a major cause of motorcycle accidents. What seems to be much more relevant is IHS for conditions leading to a loss of control, such as on a bend. Just as with car drivers, a lack of experience can reduce capability and motivation for speed can increase task demand, increasing the difficulty of the task and narrowing the rider's safety margin. There is also some evidence (at least from abroad) of an adolescent riding subculture which reinforces high risk behaviour.
1 INTRODUCTION

The aim of this review is to draw together the national and international literature relating to inappropriate high speed (IHS) in car drivers and motorcyclists. The focus is on research literature published in the period 1995 to 2006, although reference to earlier work will occasionally be made where this is deemed pertinent. It is not intended to provide a critical analysis of the strengths and weaknesses of individual reports of research, although some critical observations will be made where considered appropriate. As the review is international in scope, it needs to be kept in mind that findings from other jurisdictions may not necessarily generalise to Great Britain because of historical, cultural and infrastructural differences, as well as differences in demographic profiles.

A further characteristic of this review is that it is organised around the key elements of a developed version of the Task-Capability Interface model and the concept of task-difficulty homeostasis (Fuller, 2000; Fuller and Santos, 2002). The potential value of this strategic approach is that it exploits the ability of the model to explain speed choice and its consequences and capitalises on the inclusive range of the model, which enables the integration of a large body of discrete findings into a more coherent picture. It is a lamentable characteristic of the current published research literature on road-user behaviour that so much of it is atheoretical, enabling not much more than empirical generalisation. The proliferation of the use of multivariate statistical modelling techniques is testament to this largely atheoretical status. Although the theoretical framework around which this review is written is certainly not the last word in theory development, even in the area of driver motivation, nevertheless perhaps it provides at least a step in the right direction.

One further characteristic of the published research reviewed here is that so little of it relates to established and growing psychological knowledge regarding human behaviour in general. It is almost as if many authors feel that road-user behaviour is in some sense exceptional and that what we know about human development, learning, attention, perception, motivation and so on is somehow not very relevant. Perhaps this characteristic is partly but inadvertently nourished by the emergence of specialist journals (at least one more was added in the last decade).

An inevitable distortion in the content of this review arises from the particular emphases of the published research on speed choice over the last decade. Although the relationship between demographic factors and speeding remains a popular topic, the last decade has seen a flourishing of interest in attitudinal research and attempts to relate attitudinal variables to behaviour, perhaps stimulated in part by the relatively accessible Theory of Planned Behaviour (TPB) (Ajzen, 1991), both in terms of its concepts and their apparent measurability. The reader will note, however, that there are often discrepancies between self-reported intentions and observed behaviour, and indeed between self-reported behaviour and observed
behaviour. There are several possible reasons for such discrepancies, including consistency and self-serving biases, poor self-awareness and distortions arising from the memory storage and retrieval processes; but also because situational determinants may override the driver's intentions. The important point, however, is that we should treat self-report data with a certain degree of scepticism.

There has also been a revival of interest in the exploration of more distal influences on speed choice, such as personality variables. Notable among these have been traits of sensation seeking and aggression. The study of normative influences on speed choice, either directly through social comparison or indirectly by mediating social deviance, is also beginning to receive more attention. Perhaps the most exciting concept to emerge is that of driving style and converging evidence for the identification of different ‘types’ of driver. This line of enquiry would seem to have considerable promise. Surprisingly few published studies concern proximal factors in speed choice, such as human factor variables, with anger, control motivation and time-saving emerging as the variables most studied. Finally, we have been able to find remarkably little research on the conditions for IHS in motorcyclists or more generally on the riders of powered two-wheelers. This work tends to show that the conditions for IHS in motorcyclists are in several respects similar to those for car drivers, but for this category of road user the consequences of the task exceeding rider capability are often that much more severe.
2 WHAT IS INAPPROPRIATE HIGH SPEED?

Two out of every three drivers in England report that at some time or other they will drive faster than the 30 mph speed limit, even when it feels unsafe to do so (Musselwhite, 2006). In the UK, speed is estimated to be involved in between 28% and 30% of fatal road crashes (Mosedale and Purdy, 2004). In the US, speed is cited as a contributory factor in 12% of all crashes and 30% of fatal crashes (Federal Highway Administration, 1998) and in New Zealand, travelling ‘too fast for conditions’ is the largest contributing factor to fatalities in motor vehicles (LTSA, 1996). In 1995, a European Transport Safety Council (ETSC) review concerning traffic injuries resulting from excess and inappropriate speed concluded that ‘there is a need to enhance awareness of conditions under which people tend to drive with excess or inappropriate speed, and understanding of the consequences of doing so’ (ETSC, 1995; p. 26).

From a safety perspective, an inappropriate high speed (IHS) is a speed at which a driver loses control of the driving task. Loss of control occurs if the driver is in an unavoidable collision with another road user or object, or if there is loss of directional control, as in a slide or skid. Speed is a crucial determinant of control because for any given segment of roadway, irrespective of its particular features, the faster the driver moves through the segment, the shorter the available time to take in and process information and the less time there is to make control adjustments and, indeed, correct those adjustments should feedback indicate they are not achieving the driver’s goals (see review by Aarts and van Schagen, 2006). In addition to this loss of driver response time, the distance a moving vehicle requires to be brought to a halt is proportional to the square of its speed (see for example www.atsb.gov.au). Faster vehicles travel further before coming to a stop. Thus, if nothing else changes except an increase in speed, this necessarily means an increase in the demands of the driving task and when those demands exceed the capability of the driver, loss of control follows and a collision or road run-off may ensue. It is hardly surprising, therefore, that there is a well-established positive correlation between speed and the probability of collision.
3 SPEED AND RISK OF COLLISION

Studies to determine the relationship between speed and crash probability have examined the effects of variations in average speed on particular road segments or road types (especially with the implementation of changes in speed limits), have analysed the relationship between self-reported speed and crash frequency, and have compared speeds of crash-involved vehicles with speeds of non-crash-involved vehicles under matched conditions. The general finding is that fast-moving vehicles have a higher crash rate than slow-moving vehicles. Thus, for example, raising speed limits in Hong Kong (50 km/h roads to 70 km/h and 70 km/h roads to 80 km/h) raised accident counts by between 20% and 30% (Wong et al., 2005). In the US, a speed limit increase from 55 to 65 mph on an ‘average’ high-speed road section is associated with a crash rate increase of around 3% (TRB, 2006). This relatively smaller increase in crash rate compared with Hong Kong may be attributed to the observation that speed limit increases of 10 mph in the US study produced much smaller increases in average speeds of around only 3 mph.

The relationship between speed and crash rate has been described as a power function (Maycock et al., 1998; Quimby et al., 1999; Taylor et al. 2002; Elvik et al., 2004) and as an exponential function (Fildes et al., 1991; Kloeden et al., 1997, 2001). As a general rule of thumb, a 1% increase in speed is approximately associated with a 2% increase in the injury crash rate, a 3% increase in the severe crash rate and a 4% increase in the fatal crash rate (Aarts and van Schagen, 2006). However, we must be wary of extrapolating from such rules of thumb, especially at lower speeds (unfortunately, in their meta-analysis of 98 studies, Elvik et al. (2004) were unable to find data that would permit a sufficiently stringent test of the logistic model, according to which the effects of changes of speed on safety depend on the initial level of speed). We must also be wary of committing the ‘ecological fallacy’ of inferring a relationship between relative speed and individual risk from an observed relationship between average speed and aggregated risk (Davis, 2002). Nevertheless, higher speeds imply greater driving task difficulty and therefore greater risk of collision. As a result of differences in road-user mix, traffic density, opportunities for conflict and road design, the demands of the driving task at any given speed on urban roads are generally greater than on rural roads and similarly on minor roads compared with major roads. Thus it might be predicted that a particular increase in speed on urban and minor roads is likely to bring the driver closer to the limits of her or his capability. The evidence bears this out. The crash rate increases faster with increasing speed on urban compared with rural roads and on minor compared with major roads (Nilsson, 2004).

It should be noted that what might underpin the relationship between speed and crash involvement, at least in part, is not the absolute level of flow speed per se but the impact of drivers who are significantly above mean flow speed who both raise the mean flow speed and collision frequency. In a theoretical paper, Navon (2003)
has shown that, given certain assumptions, the number of ‘accident prone
interactions’ between vehicles is inversely related to average speed on motorways.
Thus it may be relative speeding that is the key problem. In their recent review,
Aarts and van Schagen (2006) conclude that driving faster than the surrounding
traffic does increase the risk of crashing: speeds 5 km/h above the average in urban
areas and 10 km/h above the average in rural areas double the risk of a casualty
crash. According to the Australian Transport Safety Bureau (www.atsb.gov.au),
vehicles travelling 20 km/h above the average speed on rural roads have about six
times the casualty crash involvement of vehicles travelling at average speed. It can
be approximately stated that within the range of 0 to +1 standard deviations (0–10
km/h), the associated change in accident risk will be 4–6% per km/h (Jamson et al.,
2006). Furthermore, Liang et al. (1998) found that the standard deviation of speeds
on a rural freeway doubled during ‘fog events’ and tripled during snow. This kind of
observation is important because at road-section level, larger speed variance has
been found to be related to a higher crash rate (Aarts and van Schagen, 2006). It
appears that some drivers are failing to adjust their speed appropriately to changed
conditions. One reason for this may be that under conditions of reduced distance
cues, higher speeds are associated with a greater underestimation of time-to-
collision (demonstrated in a simulated driving task) (Cavallo et al., 1997).

The fundamental point, however, seems to be that those who drive fast are more
likely to have recently been crash-involved (Lassarre and Stradling, 2005). In a
study of learner drivers and of young fully licensed drivers in New South Wales,
Australia, Lam (2003a, 2003b) found that driving over the stated speed limit was
associated with an increased risk of a KSI (killed or seriously injured outcome)
crash. For the learner drivers this risk was from two to three-and-a-half times greater
across nearly all age groups of learner.

Finally in this section it should be emphasised that higher speeds are not just
associated with an increase in crash probability but also an increase in crash
severity. Four groups of states in the US which adopted higher interstate speed limits
during 1995–96 (from 5 to 15 mph) found the expected increase in average speeds
but also an increase of about 17% in crashes which were fatal (Farmer et al., 1999).
When a crash occurs, its severity depends on the change in speed of the vehicle at
impact. Outcome is directly related to the kinetic energy released, where kinetic
energy is a function of vehicle mass and velocity squared ($E_k = \frac{1}{2}mv^2$). As
kinetic energy is determined in part by the square of a vehicle’s speed, rather than by
speed alone, the probability of injury and the severity of injury increase
exponentially with vehicle speed (Federal Highway Administration, 1998). For car
occupants in crashes with an impact speed of 50 mph (80 km/h), the likelihood of
death is about 20 times that for an impact speed of 20 mph (32 km/h), given the
increases in kinetic energy and the contribution of other factors. For pedestrian
victims, although there are differences of opinion in different jurisdictions (Thomas
et al., 2005), it is estimated that 5% of those struck by a vehicle travelling at 20 mph
(32 km/h) die, at 30 mph (48 km/h) 45% die and at 40 mph (64 km/h) 85% die (ETSC, 1995).

Thus, in summary, higher speeds are associated with increases in the probability of crashing and the severity of the outcome. In the context of informing developments in road safety, these relationships make the understanding of the conditions for IHS a particularly compelling issue.
4 SPEEDING BEHAVIOUR IN GREAT BRITAIN

One definition of inappropriate high speed (IHS) is in terms of violation of traffic laws. An IHS is simply one that exceeds the legal speed limit. In a questionnaire survey of 198 drivers, intentions to speed at 10 mph above the speed limit ‘occasionally’ to ‘quite frequently’ were the norm on all road type scenarios presented, except for a busy shopping street (Lawton et al., 1997).

Annually the Department for Transport produces the Transport Statistics Bulletin of Vehicle Speeds in Great Britain. Speeds in excess of the stipulated limits are identified from numerous sites (in 2005, 86 sites were used, in 2006, 96) where the traffic is recorded using automatic traffic counters. These locations are chosen to facilitate the monitoring of ‘free speed’ and it is believed that incidents or congested conditions do not have a significant effect on the data recorded. Therefore it is physically possible for the driver to break the speed limit should he or she choose to do so. The 2005 report (Department for Transport, 2006), for which about 860 million vehicles were observed, is summarised here since it constituted the most up-to-date data at the time of the preparation of this review. In April 2007, the Department published data for 2006 (Department for Transport, 2007), and these are referred to in parentheses for comparison where deemed useful and tables now include the 2006 data.

![Figure 4.1: Percentage of vehicles exceeding the speed limits across five different road types (2005)]
Figure 4.1 represents the main findings from the 2005 data and identifies the percentage of vehicles that exceed the speed limit across five different road types. From this chart a few clear patterns can be established, patterns which have not changed significantly in the 2006 data. First, for motorways, dual carriageways and 30 mph zones the average percentage of vehicles breaking the respective speed limits is remarkably similar at approximately 50%. For single carriageways and 40 mph zones the percentage is considerably lower at 14% and 24% respectively. Second, motorcyclists consistently offend more than car drivers across all road types except in 30 mph zones, where their offending rates are the same. Third, heavy goods vehicle (HGV) drivers, although of not principal concern in this review, show the greatest variability in speeding behaviour. On motorways, and in 30 and 40 mph built-up zones, they show the lowest level of offending, and this is especially true on motorways where only 1% exceed the limit compared with 56% of cars drivers. However, on dual and single carriageways they are by far the biggest offenders with rates of 85% and 76% respectively exceeding the limit. This offence rate is presumably related to the lower speed limits for HGVs on these roads: 50 mph on dual carriageways and 40 mph on single carriageways.

In addition to looking at the overall percentage of road users who break the speed limit, it is also fruitful to look at the percentage of users who break it by a specified amount. For the purposes of this section of the review such behaviour is labelled ‘excessive speeding’. Individuals who participate in ‘excessive’ speeding are a significant subgroup and it is important to determine whether the trends in their behaviour match those of the overall speeding group. Figure 4.2 presents for 2005 a percentage breakdown of ‘excessive’ speeders, defined as road users who break the limit by 10 mph or more on motorways and on single and dual carriageways (non-built-up areas), and by 5 mph or more in 40 and 30 mph zones (built-up areas).

Among car drivers, 19% (2006 – 17%) exceeded the speed limit by more than 10 mph on motorways, 13% (2006 – 12%) on dual carriageways and 2% on single carriageways in non-built-up areas. On 40 mph roads in built-up areas, 9% (2006 – 10%) exceeded the limit by 5 mph or more and on 30 mph roads, 21% (2006 – 19%) did so.

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1 The Department for Transport reports do not produce average values for the number of vehicles exceeding the speed limit across each road type but nevertheless provide figures which enable these figures to be calculated as has been done for this review.

2 The Department for Transport reports include data relating to light goods vehicles (LGVs) and buses/coaches. These have been removed to reduce the amount of data being presented. The data for these vehicles however have been retained to calculate the average values for each road type.

3 The Department for Transport reports split heavy goods vehicles (HGVs) into five categories according to whether a vehicle is rigid or articulated and the number of axels that it has. Here the data from the resultant five categories have been subsumed into a single HGV category.
One potentially revealing comparison is in relation to the ratio of ‘excessive’ speeders to ‘slight’ speeders (the latter being the per cent of drivers/riders exceeding the limit minus the per cent exceeding the limit by more than 10 mph on non-built-up roads and by 5 mph on built-up roads) for car drivers and motorcyclists and for different categories of road. The data for 2005 and 2006 are presented in Table 4.1.

Two immediate conclusions can be drawn from these data. First, that the rank order among road types is the same for car drivers and motorcyclists, with the proportion of ‘excessive’ speeding relative to ‘slight’ speeding being highest in built-up areas and lowest on non-built-up single-carriageway roads. Second, that for all roads, the ratio of ‘excessive’ to ‘slight’ speeders is greater for motorcyclists than car drivers. The greatest differences are for single and dual carriageway roads, with 2.73 more...
excessive motorcycle speeders than car drivers on single-carriageway roads, rising in 2006 to 3.64, and 2.24 more on dual-carriageway roads (falling in 2006 to 1.97). The equivalent ratio for motorways is 1.65 (2006 – 1.87), for 40 mph built-up roads it is 1.79 (2006 – 1.87) and for 30 mph built-up roads it is 1.50 (2006 – 1.52).

With regard to more extreme levels of speeding, if we combine 30 mph and 40 mph roads, 1.4% of drivers exceed the limit by over 20 mph (1% in 2006) and, on 50 mph and 60 mph roads, nearly 4% drive at these more extreme speeds (Broughton, 2005). Adams-Guppy and Guppy (1995) found that 22% of a sample of British company car drivers reported they exceeded the motorway speed limit by at least 10 mph ‘very often’ and a further 33% reported doing so ‘quite often’. Speeding by 20 mph or more over the limit was reported by 13% ‘quite often’ or more frequently.

4.1 Changes in speeding behaviour over time

The Department for Transport report for 2005 also provides information relating to speeding rates going back to 2000. Table 4.2 provides a summary of these data. It should be noted that prior to 2002 only a sample of records was analysed, but from 2002 essentially all vehicle records from each site are included. The last column in Table 4.2 comments on any consistent pattern of change over the seven-year period 2000–06. Going through each vehicle type, some interesting patterns can be established. For motorcycles, speeding rates on motorways in 2006 are back down to the 2000/01 level and on dual carriageways they have returned to the 2004 level after a rise in 2005. However, in 30 mph zones the proportion of motorcyclists speeding is increasing, and in 40 mph zones and on single carriageways in non-built-up areas it is creeping back up to earlier levels.

For HGVs there has been little variation in the proportion of drivers exceeding the limit on motorways in the last three years, but a continuing decline on single and dual carriageways and in 30 mph zones. On the other hand, there has been a steady increase within 40 mph zones.

The data for car drivers show the most consistent findings. For motorways, single carriageways and 40 mph zones there has been little variation. But there has been a decline in the proportion of drivers exceeding the limit in 30 mph zones and on dual carriageways, with the 2006 levels being the lowest in the past seven years. This effect has been attributed to the concentrated application of speed cameras on such roads (Broughton, 2005). This interpretation is consistent with the results of a study of the effects of implementing fixed-site speed cameras at five 30 mph sites in Glasgow between April 2000 and October 2001. The proportion of speeding vehicles dropped from 64% to 31% (Lassarre and Stradling, 2005).

As with the overall speeding data, the Department for Transport reports for 2005 and 2006 also contain information relating to how ‘excessive’ speeding has changed across time. These data are presented in Table 4.3. For motorcyclists, the relative
incidence of excessive speeding has recently decreased on motorways and on dual
carriageways there has been a drop of 5% compared with 2005. Excessive speeding
on single carriageways has been somewhat variable, but there is little change in 30
and 40 mph zones. Compared with the pattern for less severe speed violation, it is
perhaps worth noting that the increases in 30 and 40 mph zones seen there are not
reflected in similar increases in excessive speeding.

There is little variation over time in levels of excessive speeding in HGVs on
motorways, single carriageways and in 40 mph zones. There has been a steady
decline on dual carriageways and, although there was a decrease in 30 mph zones in
2006, there is no consistent trend observable. Again, compared with the pattern for
less severe speeding, it is perhaps worth noting that the increases in 40 mph zones
seen there are not reflected in a similar increase in excessive speeding.

For car drivers, there has been little change over time in levels of excessive speeding
on all road types, with the exception of 30 mph zones, where there is a continuing
decline, and on dual carriageways, where there has been a slight decrease over the
past three years. This pattern reflects that for trends in less severe speeding levels.

To summarise key observations in this section, it is clear that speeding is not an
exceptional activity by British car drivers and motorcyclists. In 2006, the incidence
of any level of speed limit violation was greatest on motorways, dual carriageways
and in 30 mph zones – ranging between 45% and 54% on these road categories. It
was just over half this proportion (28%) on 40 mph roads for car drivers and over
two-thirds of this proportion (39%) for motorcyclists. Lowest speeding rates were on
single carriageway roads in non-built-up areas (11% for car drivers and 27% for
motorcyclists). Currently motorcyclists offend proportionally more than car drivers
on all road categories except for motorways.

Perhaps of more significance for road safety is the incidence of ‘excessive’ speeding.
For car drivers in 2006, this was greatest on motorways and 30 mph roads (17% and
19% respectively) but reduces to 12% on dual carriageways. These proportions have
been more or less stable since 2000 on motorways and dual carriageways, but have
dropped on 30 mph roads. On 40 mph roads, the incidence of excessive speeding
was 10% and, just as for the distribution of speeding in general, was lowest of all on
single carriageway roads in non-built-up areas at 2%. Both these values have been
reasonably stable over the past seven years. The ratio of ‘excessive’ to ‘slight’
speeding is highest in built-up areas and lowest on non-built-up single carriageway
roads. For all road categories, the ratio of ‘excessive’ to ‘slight’ speeders is greater
for motorcyclists than for car drivers.

The DfT 2005 report for the period 2000–05 provides data only for articulated HGVs for
non-built-up roads and rigid 2-axle HGVs for built up areas. It is assumed that the
pattern for these specific vehicles is representative of HGVs in general.
An important point to note with the definition of IHS in terms of exceeding the speed limit is that, although speed may be inappropriate legally, it is not necessarily unsafe in the sense that it pushes drivers closer to the threshold where driving task demands might exceed driver capability (Fuller et al., 2006), although it may contribute to variation in flow speeds and hence to an increase in traffic conflicts. Nevertheless, it is noteworthy that about one in six GB drivers exceeds the motorway speed limit by more than 10 mph and one in five exceeds the 30 mph limit by more than 5 mph. Furthermore, a small proportion of drivers (1%) exceeds this legal limit by a margin of more than 15 mph and the 40 mph limit by a margin of more than 20 mph.

<table>
<thead>
<tr>
<th>Road type</th>
<th>Vehicle type</th>
<th>Percentage exceeding limit – 2004</th>
<th>Percentage exceeding limit – 2005</th>
<th>Percentage exceeding limit – 2006</th>
<th>Comment looking at last seven years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motorways</td>
<td>Motorcycle</td>
<td>59</td>
<td>59</td>
<td>54</td>
<td>54% in 2000 and 2001</td>
</tr>
<tr>
<td></td>
<td>Car</td>
<td>56</td>
<td>56</td>
<td>54</td>
<td>Little variation</td>
</tr>
<tr>
<td></td>
<td>HGV</td>
<td>2</td>
<td>1</td>
<td>1.8</td>
<td>Has declined from high of 6% in 2000</td>
</tr>
<tr>
<td>Dual carriageways</td>
<td>Motorcycle</td>
<td>48</td>
<td>55</td>
<td>48</td>
<td>Low of 35% in 2001</td>
</tr>
<tr>
<td></td>
<td>Car</td>
<td>48</td>
<td>48</td>
<td>45</td>
<td>High of 52% in 2000 and low of 45% in 2006</td>
</tr>
<tr>
<td></td>
<td>HGV</td>
<td>86</td>
<td>86</td>
<td>82</td>
<td>Has declined steadily from a high of 90% in 2000</td>
</tr>
<tr>
<td>Single carriageways</td>
<td>Motorcycle</td>
<td>25</td>
<td>24</td>
<td>27</td>
<td>Lowest value of 22% occurred in 2003</td>
</tr>
<tr>
<td></td>
<td>Car</td>
<td>10</td>
<td>11</td>
<td>11</td>
<td>Little variation</td>
</tr>
<tr>
<td></td>
<td>HGV</td>
<td>79</td>
<td>78</td>
<td>76</td>
<td>Low of 68% in 2002</td>
</tr>
<tr>
<td>40 mph zone</td>
<td>Motorcycle</td>
<td>38</td>
<td>34</td>
<td>39</td>
<td>High of 46% in 2002</td>
</tr>
<tr>
<td></td>
<td>Car</td>
<td>27</td>
<td>25</td>
<td>28</td>
<td>Little variation</td>
</tr>
<tr>
<td></td>
<td>HGV</td>
<td>22</td>
<td>21</td>
<td>23</td>
<td>Generally on the increase from low of 15% in 2000</td>
</tr>
<tr>
<td>30 mph zone</td>
<td>Motorcycle</td>
<td>47</td>
<td>50</td>
<td>51</td>
<td>47% in 2002 &amp; 2004 and a high of 60% in 2000</td>
</tr>
<tr>
<td></td>
<td>Car</td>
<td>53</td>
<td>50</td>
<td>49</td>
<td>Has declined steadily from high of 66% in 2000</td>
</tr>
<tr>
<td></td>
<td>HGV</td>
<td>48</td>
<td>46</td>
<td>45</td>
<td>Has declined steadily from a high of 54% in 2000</td>
</tr>
<tr>
<td>Road type</td>
<td>Vehicle type</td>
<td>Percentage exceeding limit – 2004</td>
<td>Percentage exceeding limit – 2005</td>
<td>Percentage exceeding limit – 2006</td>
<td>Comment looking at last seven years</td>
</tr>
<tr>
<td>----------------------</td>
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<td>----------------------------------</td>
<td>----------------------------------</td>
<td>-------------------------------------</td>
</tr>
<tr>
<td>Motorways</td>
<td>Motorcycle</td>
<td>28</td>
<td>27</td>
<td>25</td>
<td>Low of 18% for 2000 and 2001</td>
</tr>
<tr>
<td></td>
<td>Car</td>
<td>19</td>
<td>19</td>
<td>17</td>
<td>Little variation</td>
</tr>
<tr>
<td></td>
<td>HGV</td>
<td>0*</td>
<td>0*</td>
<td>0</td>
<td>No variation</td>
</tr>
<tr>
<td>Dual carriageways</td>
<td>Motorcycle</td>
<td>21</td>
<td>25</td>
<td>20</td>
<td>High of 26% in 2002</td>
</tr>
<tr>
<td></td>
<td>Car</td>
<td>14</td>
<td>13</td>
<td>12</td>
<td>Recent decline</td>
</tr>
<tr>
<td></td>
<td>HGV</td>
<td>2</td>
<td>2</td>
<td>1.7</td>
<td>Steady decline</td>
</tr>
<tr>
<td>Single carriageways</td>
<td>Motorcycle</td>
<td>10</td>
<td>9</td>
<td>12</td>
<td>High of 15% in 2000</td>
</tr>
<tr>
<td></td>
<td>Car</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>Bottomed out to no variation</td>
</tr>
<tr>
<td></td>
<td>HGV</td>
<td>28</td>
<td>28</td>
<td>27</td>
<td>Little recent variation</td>
</tr>
<tr>
<td>40 mph zone</td>
<td>Motorcycle</td>
<td>19</td>
<td>17</td>
<td>20</td>
<td>High of 21% in 2000</td>
</tr>
<tr>
<td></td>
<td>Car</td>
<td>10</td>
<td>9</td>
<td>10</td>
<td>Little variation</td>
</tr>
<tr>
<td></td>
<td>HGV</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>Low of 3% in 2000 to 7% in 2002 which remains constant</td>
</tr>
<tr>
<td>30 mph zone</td>
<td>Motorcycle</td>
<td>24</td>
<td>26</td>
<td>25</td>
<td>Little recent variation</td>
</tr>
<tr>
<td></td>
<td>Car</td>
<td>22</td>
<td>21</td>
<td>19</td>
<td>High of 32% in 2000</td>
</tr>
<tr>
<td></td>
<td>HGV</td>
<td>18</td>
<td>18</td>
<td>14</td>
<td>No consistent trend</td>
</tr>
</tbody>
</table>

* The data presented here are slightly different from Figure 4.2. This is because the data for Figure 4.2 were calculated for this review and were based on all HGVs. In the Department for Transport 2005 report, the part which deals with the period between 2000 and 2005 only provides data for articulated HGVs for non-built-up roads and rigid two-axle HGVs for built-up areas. For the purposes of this review it is assumed that the pattern for these specific vehicles should be representative of HGVs in general.
5 THE TASK-CAPABILITY INTERFACE MODEL

The relationship between speed and loss of control is represented in the Task-Capability Interface (TCI) model (Fuller, 2000; Fuller and Santos, 2002), which will be used as a conceptual framework to assist in organising the diverse range of research findings reviewed later. Some of the research published in the last 10 years has a direct bearing on the validity of the model. The model starts with the self-evident truth that a loss of control by the driver necessarily arises when the demands of the driving task exceed the available capability of the driver (see Figure 5.1, path in upper-right direction). Speed is a crucial determinant of control because speed has the single greatest influence on task demand. When loss of control occurs, this may lead to a collision (or road run-off) but on some occasions the driver may be able to regain control (lucky escape), or the task may abruptly change by a potential collision-object changing course, thereby no longer presenting an obstacle to the approaching vehicle (see Figure 5.1).

![Figure 5.1: Control of the driving task arises out of the dynamic interface between task demands and driver capability. Speed is a key determinant of task demands](image)

5.1 Task difficulty

Task difficulty can be represented simply as the outcome of a real-time comparison between level of demand and level of capability, as represented in Figure 5.2. As just stated, loss of control occurs where task demand exceeds capability (as indicated by arrow A in Figure 5.2). However, the important point to note here is
that as demand approaches capability (see arrow B in Figure 5.2), the driver will experience the task as becoming progressively more difficult (Fuller et al., 2008). Thus, under conditions where task demand is less than driver capability, task difficulty is inversely proportional to the degree of separation between capability and demand. Difficulty is high where demand approaches the limits of capability and vice-versa. There is a direct correspondence between this concept and driver workload (de Waard, 2002), and it is inversely proportional to concepts used in other models such as spare capacity and safety margin (the higher the task difficulty the less the spare capacity and the lower the safety margin) (Summala, 2005). Task difficulty also provides an operational definition for the term ‘hazard’, capturing the observation that hazards on the roadway are not ‘givens’ but arise out of the dynamic interface between the driver’s immediate capability on the one hand and features of task demand (e.g. of the vehicle, other road-user behaviour, the physical environment and vehicle speed) on the other. It might also be noted that the closer a driver drives at the threshold where task demand approaches the limits of capability, the more likely it is that unpredicted or unpredictable events (such as the behaviour of other road users) may put demand beyond capability. This condition is reflected in Elvik’s proposed ‘law of cognitive capacity’, which states that the more cognitive capacity approaches its limits, the higher the accident rate (Elvik, 2006).

Figure 5.2: The interface between task demands and capability
This analysis represents in a simple way the **transactional** nature of situations in which loss of control of the driving task occurs. As an example, young male drivers aged 18 to 21 years, whose capability is impaired because they have consumed alcohol and whose driving task demand is elevated because they are speeding, feature in 40% of all loss of control fatal crashes involving their age and sex group (Laapotti and Keskinen, 1998).

We should note in passing that high speeds coupled with high capability may represent a similar level of task difficulty as that experienced with lower speeds coupled with lower capability (although the consequences of unexpected increases in task demand may be very different). This equivalence is recognisable in the contrast between the fast, self-confident progress of the experienced driver with the slow, tentative progress of the novice: they both may be operating at the same level of task difficulty, even though the objective demands of the driving task are greater in the former case.

However, an important implication of the transactional nature of driving task difficulty is that in order to understand where loss of control occurs we need to discover what determines driver capability on the one hand and what determines task demand, including speed choice, on the other. These determinants are represented in the schematic diagram in Figure 5.3.

**Figure 5.3: Elements of the Task-Capability Interface model**

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**Physiological characteristics**  
**Education/training/experience**  
**Competence**  
**Human factor variables**  
**CAPABILITY (C)**

**TASK DEMANDS (D)**  
**Physical environment**  
**Other road users**

**CONTROL**  
**LOSS OF CONTROL**

---

When **C > D**, the system is in control. When **C < D**, loss of control may occur. **LUCKY ESCAPE** and **COLLISION** represent the outcomes of these scenarios.
5.2 Determinants of driver capability and of driving task demand

Capability arises from the basic level of physiological competence of the individual, as represented in properties of the nervous and somatic systems and expressed, for example, in speed of information processing and of motor response. It also arises from accumulated declarative and procedural knowledge acquired through education and training and, above all, experience. All of these elements together define the uppermost level of competence of the driver. However, as is well established, to varying degrees this level of competence can be undermined by a large range of conditions known collectively as human factor variables (for a review see Fuller and Santos, 2002). These include conditions of arousal state (which may be linked to circadian rhythms), emotional state, fatigue state and motivational state. Their resulting impact may mean that available capability at any moment in time is less than the upper level of competence which would otherwise characterise the driver under ideal conditions (see Figure 5.3, descending path).

The determinants of the demands of the driving task are similarly multifarious and include the control and other functional features of the vehicle being driven, physical characteristics of the driving environment (e.g. road alignment and surface, level of visibility) and the presence and behaviour of other road users in the projected trajectory of the driver (see Figure 5.3). However, as stated earlier, the crucial determinant of driving task demand, and in the last analysis the control of the driving task, is speed choice. Thus, in order to understand inappropriate high speed (IHS), we need to identify the determinants of speed choice. Gabany et al. (1997) asked 124 students, 6 driver education teachers and 14 members of a National Safety Council Committee to list the reasons why they believed drivers chose to exceed the speed limit. One set of reasons implied impaired driver capability (not paying attention, angry or upset, on drink or drugs), other reasons implied choice for either functional or social motives. Functional motives were time pressure, for pleasure, risk/thrill seeking, escape and a sense of power and control; social motives were social pressure, to impress others, to defy authority/the law and for competition.
6 DETERMINATION OF SPEED CHOICE

6.1 Theoretical concepts

Several kinds of theoretical answer to the question of what determines speed choice have been proposed in the research literature over the past 30 years or so (see recent review by Fuller, 2006). Approaches with a predominantly behavioural orientation include the Zero-risk model (Näätänen and Summala, 1976), subsequently developed by Summala (e.g. Summala, 1986, 1997) and the Threat-Avoidance model (Fuller, 1984). These approaches argue that speeds selected under particular conditions which lead to positive outcomes become reinforced and are more likely to be repeated again under similar conditions. Largely internalising this three-term contingency of situation-behaviour-consequence in the form of beliefs and intentions is the Theory of Planned Behaviour (TPB) (Ajzen, 1991). In this it is beliefs about contingencies which become the key determinants of speed choice. Thus the behaviours for which the TPB multiplicative component of beliefs (values, times, expectancies) works best are instrumental behaviours (Elliott et al., 2005).

Parker et al. (1992b) found that attitude and subjective norm (i.e. perceived social pressure) together accounted for nearly 33% of the variance in intention to speed, although the most important single predictor was perceived behavioural control (i.e. belief about opportunities and resources to perform the behaviour), which added 14% to the amount of explained variance. However, Parker (1997) found that TPB variables accounted for only about 10% of the variance in observed driving speeds and, in more recent studies, Wallén Warner and Åberg (2005, 2006) found that TPB variables explained only between 14% and 28% of the variance in actual speeding behaviour and that perceived behavioural control did not contribute to its prediction.

Risk Homeostasis Theory specifies additional unobservable cognitive processes in the determination of speed choice (e.g. Wilde, 2001). In this theory, drivers aim for a particular level of risk, and speed choice is seen as an important device for minimising any discrepancy arising between the level of targeted risk and the level of risk as perceived by the driver. Finally, associated with the Task-Capability Interface (TCI) model is the hypothesis of task-difficulty homeostasis (see below), which postulates a process similar to risk homeostasis, but unlike Risk Homeostasis Theory does not rely on a driver’s statistical estimate of risk (see Simonet and Wilde, 1997) which, at the levels associated with everyday driving, is so low that it is beyond the limits of human information processing (e.g. Slovic et al., 1977; Haight, 1986). Bjornskau (2003), for example, puts the risk of an injury crash to a driver in Norway at 0.18 injury accidents per million kilometres, and West and Hall (1997) found that drivers average only one accident every nine driver years.
6.1.1 Task-difficulty homeostasis

The concept of task-difficulty homeostasis relates directly to the question of speed choice. It asserts that drivers drive in such a way as to maintain the level of driving task difficulty within a preferred range. This role of task-difficulty (or workload) homeostasis is represented in Figure 6.1. Based on perceived capability, effort motivation and the goals of a particular journey, a driver ‘selects’ a range of difficulty within which he or she is prepared to engage with the task of driving and drives in such a way as to maintain experienced task difficulty within that range. The manipulation of speed is seen as the primary mechanism for achieving this (Summala, 2005; Liu and Lee, 2005), although variations in effort, or taking on or dumping other tasks secondary to the primary driving task, may be used on occasion (e.g. see Hart and Wickens, 1990; Nunes and Recarte, 2005). It may be noted in passing that this hypothesis differs somewhat from that of Summala (1996, 2005) who proposes that trip decisions set an approximate target speed level rather than an acceptable range of task difficulty.

Experimental evidence for task-difficulty homeostasis is exemplified in the study by Hogema et al. (2005) who measured the effects of variations in motorway lighting on driver behaviour. They found that when the lighting was switched off there were increases in mental effort (operationalised in terms of increases in heart and blink rates) and decreases in speed. They concluded that: ‘When drivers have to deal with higher workload (i.e. task demand), they often have two options: they can increase their effort expenditure or they can try to reduce the task load. A reduction of speed is an example of a reduction of the task load. With a lower speed, drivers have more time available to anticipate and this reduces the workload’ (p. 366).

The role of speed manipulation in the maintenance of task-difficulty homeostasis as described here is not unlike its role as described by the concept of ‘spontaneous speed’, which, it is suggested, drivers select to respond adaptively to prevailing conditions (Couyoumdjian et al., 2002). However, in their model, these authors assume that this corresponds to the speed at which driver workload is set to a minimum, rather than to a level which is determined by driver capability and a range of possible motives.

If the hypothesis of task-difficulty homeostasis is correct, then we would expect that variations in task difficulty would be compensated for by changes in driver behaviour. Consistent with this is the highly predictable pattern of increased speeds on different categories of road when task difficulty typically drops, such as when roads are empty at night-time (Broughton, 2005; Lam, 2003a). More generally, Larsen (1995) measured the free speeds of drivers on different road segments in a 50 km/h zone and found an 11 km/h range from 49.2 km/h to 60.2 km/h. The highest mean speeds were associated with what Larsen rated as the easiest driving conditions.
Drivers also typically reduce speeds while negotiating intersections, but more so while simultaneously completing car-phone tasks (Liu and Lee, 2005). Drivers will generally avoid following vehicles that are travelling slightly more slowly than they are (Ban-Gera and Shinar, 2005) and choose to drive more slowly on a narrow version than a wider version of the same road (Uzzell and Muckle, 2005; Lewis-Evans and Charlton, 2006). In this latter study, which observed driving in a simulator, ratings of difficulty and of subjective risk were also higher for the narrower road. Interestingly, drivers were not aware of the road feature that mediated these differences, suggesting that decision-making was occurring at a pre-conscious level.

Again, consistent with the hypothesis of task-difficulty homeostasis are the proportions of drivers who state that they drive more slowly than usual when task difficulty increases, such as in fog (98%), heavy rain (96%) and on unfamiliar roads (88%) (Campbell and Stradling, 2003). Similarly Lawton et al. (1997) found that intentions to speed were lower when negative consequences were believed to be more likely.

Finally, consistent with the hypothesis of a **range** of task difficulty being selected, as opposed to a precise level, is the observation of Gregersen and Bjurulf (1996) that, in traffic zones where there is an increase in task demand, drivers’ speed reductions do not always fully compensate for the increase. On the other hand they may maintain their target separation between task demand and capability by raising capability through a compensatory increase in the level of effort invested in the task (increased vigilance, for example).
Evidence from simulation studies clearly confirms two key predictions from the hypothesis (Fuller et al., 2008). In these studies, drivers rated video sequences of road segments travelled at different speeds. The first confirmed prediction was that, if all else is held constant, ratings of task difficulty correlate with speed. The second was that estimates of statistical risk (i.e. of the frequency of loss of control or accident over a number of separate occasions) remain at zero until task demand begins to approach capability, the point corresponding to the driver's perception of a high level of difficulty and the possibility of a real hazard occurring. This threshold corresponds precisely with that identified by Corbett (1993) in an interview study of fast drivers. They distinguished between being in control at high speeds (even if well over the speed limit) and higher speeds where they would be at increased risk of accident. As Corbett states, ‘Thus provided drivers kept below their “safe maximum”, even if this was well above the speed limit, they did not believe their chances of harm were increased’ (p. 90).

What was unexpected in the Fuller et al. (2008) studies, however, was the discovery that, for a range of speeds, drivers’ subjective ratings of feelings of risk did not correspond to their statistical risk estimates. In particular, ratings of feelings of risk showed progressive increases with increases in speed, despite statistical risk estimates remaining at zero. In fact, over the whole range of speeds studied (from 20 to 100 mph), feelings of risk correlated virtually perfectly with speed and thus with ratings of task difficulty: as a road segment is travelled at progressively higher speeds both ratings of task difficulty and feelings of risk rise in tandem. This discovery led to the proposition that it is perhaps through feelings of risk that the driver evaluates, at least in part, the level of task difficulty being experienced at any moment (see Fuller (2007) for an extended discussion of how drivers may evaluate task difficulty). It should really come as no surprise that task difficulty should translate so readily into feelings of risk, however, given that a fundamental feature of the task of driving is to continually make responses to avoid otherwise certain catastrophe.

6.1.2 **Task difficulty as feelings of risk**

That feelings of risk may be important contributors to driver decision-making has long been proposed by Näätänen and Summala (1976) and recently strongly advocated by Vää (2005), who concludes that drivers seek a target feeling (in relation to risk) rather than a target estimate of statistical risk, the position defended by Wilde (1982, 2001). Summala and Näätänen (1988) postulated a ‘subjective risk’ or ‘fear’ monitor which alerts drivers to conditions where safety margin thresholds are exceeded and then influences driver decisions. With repeated exposure to similar conditions, it is argued that ‘drivers adapt to situations which at first elicited a “risk response” and drive most of the time with overlearnt habitual patterns based on safety margins, with no concern for risk: hence the label “zero-risk theory”’ (Summala, 1996; p.104). Thus Summala and Näätänen describe an experience-led shift from escape from a risk response to avoidance of it in driver decision-making.
The task-difficulty homeostasis hypothesis differs from this viewpoint, however, in suggesting that the effects of risk feelings on decision making are not binary (one moment they are irrelevant, the next they become salient): task difficulty and feelings of risk are continuously present variables which inform driver decisions (whether consciously or not). However, only when some threshold point is reached may risk feelings become particularly salient in driver consciousness.

A strong advocate for the role of feelings in decision making is Damasio (1994, 2003) who found that certain types of brain lesion specifically exclude access to feelings associated with objects, events and scenarios. At the same time these lesions degrade decision performance. He concludes that emotions provide a natural means for the brain to evaluate the environment and respond adaptively. Stimuli with which some feeling is associated capture attention. Thought can then be diverted to those stimuli, thereby enhancing the quality of decision making. The emotional signal is not necessarily a substitute for the reasoning process but it may mediate rapid adaptive responses without passing through some form of cognitive evaluation. As emotional signals are body-related, Damasio labelled this set of ideas ‘the somatic marker hypothesis’. Slovic et al. (2002) refer to a similar set of ideas as ‘the affect heuristic’. Through learning, somatic markers become linked to stimuli and patterns of stimuli. When a negative somatic marker is linked to an image or developing scenario, it sounds an alarm.

Thus the potential role of somatic markers in driver decision-making is in eliciting emotional responses to elements of the unfolding scene ahead of the driver and in directing attention to potential aversive stimuli in that scene (such as a rapidly looming fixed object in the direct path of the vehicle). Consistent with this hypothesis is the evidence that females, who are more reactive emotionally than males (Fujita et al., 1991), rate hazards as more risky than males, including traffic scenes (Ogawa et al., 1996; Soliday and Allen, 1972, cited in McKenna and Horswill, 1999), show more concern about hurting others (Ulleberg and Rundmo, 2002; Parker et al., 1992a) and are involved in fewer crashes involving intentional risk-taking (Laapotti and Keskinen, 1998).

### 6.1.3 Implications of the somatic marker hypothesis for speed choice

If we rephrase the hypothesis of task-difficulty homeostasis in terms of feelings of risk, the implication would be that drivers drive in such a way as to keep feelings of risk below some threshold level. As expressed by Deery (1999) ‘a driver determines the difficulty of his/her task by setting and accepting different risk thresholds’ (p. 226). If the behaviour of other road users, or the driver’s own behaviour (such as an increase in speed), should stimulate an increase in feelings of risk above this threshold level, then the driver will take action to bring the level of felt risk back down, such as by reducing speed. Thus the driver’s risk threshold may be defined as the point above which risk is felt to be too great. It represents the upper boundary of
the range of task difficulty within which the driver prefers to drive. Summala (2005) refers to an equivalent concept as the driver’s ‘safety margin threshold’.

If feelings of risk are important in driver decision-making, then we would expect that drivers who rate particular behaviours as being less risky than others would be more likely to engage in them. This is precisely what was found by Castella and Perez (2004) in a questionnaire study of 792 drivers. Male drivers rated 28 driving ‘infringements’ as significantly less dangerous than female drivers and were significantly more likely to engage in them.

It is possible, however, that increases in risk may not be felt because of being swamped by other feelings, or if felt they may be attributed to events other than those related to the driving task. Furthermore, for the novice driver, experience may not have provided sufficient learning opportunities to link particular potential hazard scenarios to feelings of risk. Finally, a preference for different levels of risk feeling may characterise different drivers or the same driver at different times. Each of these possibilities has implications for the occurrence of inappropriate high speed and the relevant evidence will be reviewed later (see Sections 8 and 9 on distal and proximal factors in high-risk thresholds).

6.2 Discrepancies between objective and subjective realities

The representation of task-difficulty homeostasis as represented in Figure 6.1 makes no allowance for possible discrepancies between perceived capability and actual capability and between perceived task demand and actual task demand, discrepancies which could have very significant implications for driver safety. To include this dimension, a parallel representation for perceived capability and task demand is presented in Figure 6.2.

One implication of this analysis is that if perceived capability is higher than objective capability, or perceived task demand is lower than objective task demand, the driver will arrive at a perceived level of task difficulty which is actually lower than it is objectively. With this process the driver will have less of a safety margin or less spare capacity than he or she thinks (see representation in Figure 6.3). Unfortunately, this combination of misperceptions appears to be a prevalent characteristic of young, inexperienced drivers who typically overestimate their capability relative to other drivers (i.e. poor calibration) (Matthews and Moran, 1986; Gregersen and Bjurulf, 1996) and underestimate the demands of the driving task, for example by rating potential hazards as less risky than more experienced drivers (Brown and Groeger, 1988; Deery, 1999). Thus they are prone to driving in a manner which is closer than they realise to the limits of their capability, unaware of their vulnerability to an impending loss of control. Consistent with this is the conclusion by Wilson and Greensmith (1983), from a study in which participants drove a 50 km route in an instrumented car, that accident-involved males adjust their
speeds to changing conditions less than accident-free males. Further evidence relating to this issue is discussed in Section 7 on young drivers.

A similar divergence between perceived and actual task demand can emerge for drivers in general as a result of the phenomenon of speed adaptation. A moderate speed after travelling for a time at a high speed tends to be perceived as inordinately slow. In one study (Schmidt and Tiffin, 1969), drivers were asked to reduce their speed to 40 mph after driving at 70 mph for 40 miles. With the speedometer occluded, they slowed on average to 53.4 mph, objectively having about 80 feet less in which to stop than they thought they had. This effect was observable even after much shorter exposure to a continuous high speed and even when drivers were aware of the phenomenon and actively attempted to take it into account in their speed estimate. Larsen (1995) reported that drivers speeding over 10 km/h higher than the 50 km/h limit underestimate their speed.
A divergence between objective task demand and what it appears to be can also arise as a result of accumulated experience of road and traffic contingencies, yielding an underestimate of objective task difficulty. This may occur where unsafe behaviour has been rewarded in the past (with no aversive outcome – see Lawton and Parker, 1998) and where discriminative stimuli cease to be reliable (e.g. undetected change in the condition of the road surface). An experimental demonstration of the effects of the former process was published by Delhomme and Meyer in 1997, who argued that drivers who choose unsafe behaviours which do not lead to culpable accidents would experience an increase in the positive assessment of their ability and perceived control while driving. They randomly assigned 120 male drivers to one of three conditions. In one condition, drivers’ attention was focused on their past unsafe (but accident free) behaviours in order to activate the memory of experiences of perceived control, and, in a second condition, attention was focused on past safe behaviours. In the third condition, attention was focused on neutral material. Participants then viewed a series of video scenes, taken from the perspective of the driver, which stopped at the point where some adaptive response could be necessary. In the first condition, drivers rated their ability and feelings of control over the driving situation as superior to others. They also chose higher speeds, especially the younger age group (mean age 21.2 years). The authors concluded that, because of their ‘misleading’ driving experience of surviving unsafe behaviour without mishap, ‘Novice drivers . . . do not therefore adapt their behaviour sufficiently to the driving situations they encounter’ (p. 173). Presumably more experienced drivers are also vulnerable to this phenomenon.
For the novice driver, the unreliability and relative rarity of key contingencies between events on the road can also make it difficult to learn cause and effect relationships (Fuller, 1991). Inexperienced drivers account for a third of accidents caused by the over-taker (Clarke et al., 1999). Forty-two per cent of these accidents were found to be of the following types, which might be directly attributed to inadequate learning or experience of contingencies:

1. Failure to observe the indicator of right-turning vehicle ahead or misinterpretation of the signal (13.5%).
2. Overtaking into a bend with little forward visibility (10.6%).
3. Overtaking towards a hill-crest with little forward visibility (9.2%).
4. Loss of control on completion of an overtaking manoeuvre (8.5%).

Travelling at excess speed is associated with types 1, 2 and 4.

Another discrepancy that arises between objective and subjective realities is in differences between observed and self-reported speeding behaviour. The most extensive European data relating to reported speeding behaviour comes from SARTRE (Social Attitudes to Road Traffic Risk in Europe), a questionnaire-based research project conducted by a consortium of European researchers across participating countries. Two of its main aims were to measure car drivers’ reported behaviours and attitudes. It was repeated at three time intervals (1991–92, 1996–97 and from 2002–03) and had a sample of approximately 1,000 participants from each participating country on each occasion. This discussion will concentrate primarily on the 2002–03 (SARTRE 3) data since it is the most up-to-date (INRETS, 2004). The composite data from SARTRE facilitates comparisons across EU countries and to a notional European average. The data that relate to speed fall into various sections and each one will be dealt with separately below.

SARTRE has several questions addressing speeding behaviour. Since these questions require retrospective self-report, the data are subject to error beyond that associated with direct measurement. The sources of this error range from a poor knowledge of their own behaviour and an inaccurate perception of their own behaviour, to the desire to represent oneself in a favourable light. This error does not invalidate these data but rather requires us to treat them as something other than actual behaviour, i.e. as self-reported behaviour. Frequently the disparity between these two is an interesting finding in and of itself.

Figure 6.4 represents the reported speeding behaviour across two road types: motorways and built-up areas. It further depicts the frequency of observed speeding as calculated from the annual speeding statistics (Department for Transport, 2004). The 2003 data were used since they were comparable in timing with the SARTRE 3 data.
Note the five road categories depicted earlier in Figures 4.1 and 4.2 have been replaced in Figure 6.4 by only three categories. This is because only these categories are common to both the SARTRE and Department for Transport reports.

Figure 6.4 not only indicates that there is considerable variation between reported and observed speeding but that the nature of this variation is dependent on road type. Taking motorways first, the actual percentage of vehicles observed breaking the speed limit (labelled ‘observed’ in Figure 6.4) is estimated to be 51%. For the reported behaviour, if we exclude only those participants who indicate they never speed, the figure for breaking the speed limit is 76%. It could be argued that excluding only those people who indicate that they never speed is quite conservative and that in fact respondents who indicate that they rarely speed should also be excluded. If this approach is adopted, the figure for reported speeding decreases to 56%. This is closer to the actual figure of 51%, leading to the interpretation that reported speeding behaviour is just slightly above actual speeding behaviour.

However, when looking at the data for built-up areas with a 30 mph limit the pattern is quite different. The actual speeding behaviour has been estimated at 57%. For the reported behaviours, if we exclude only those respondents who indicate that they never speed in built-up areas we are left with 52% that do. However, if the data are treated in the same way as for motorways, such that respondents who indicate that
they rarely speed are also removed, then the percentage reporting that they speed drops to 16%.

Clearly the patterns across the two road types are different. On motorways, reported speeding is in excess of actual speeding, while in built-up areas (with 30 mph limits) reported speeding is considerably below actual speeding. Two possible explanations can be offered for this: either speeding in built-up areas is less morally acceptable to admit to, or many motorists are breaking the limits in these zones without actually knowing it. This pattern is slightly disrupted when built-up areas with 40 mph limits are considered. The SARTRE survey did not make a distinction between built-up areas with different speed limits (as the Department for Transport dataset does) and therefore the comparison must be made with the generic built-up area with no specified limit. However, if all those individuals who indicated that they either ‘never’ or ‘rarely’ speeded are excluded, then the reported instance of speeding behaviour (16%) is still lower than that of the actual speeding (27%).

It is also interesting to look at UK drivers’ beliefs about how often they think other drivers speed (independent of road type). When the ‘never’ and ‘rarely’ responses are removed, 98.4% of drivers indicate that they think other drivers speed. It is obvious that the observed data do not corroborate this. It appears, therefore, that others’ speeding behaviour is much exaggerated in most people’s eyes. This may be important in producing a distorted normative influence of others’ behaviour on the individual driver (see Section 8.1 on normative influences and driving culture).

6.3 The distinction between proximal and distal determinants of model elements

The representation of task-difficulty homeostasis as represented in Figure 6.1 does not highlight the distinction between proximal and more distal determinants of driver capability, task demand and target task difficulty or risk threshold (the term ‘risk threshold’ will occasionally be used interchangeably with ‘target task difficulty’ – both terms are regarded as functionally equivalent at the upper boundary of target task difficulty). With regard to capability, clearly some determinants are remote, such as the driver’s education and accumulated experience, whereas others are more immediate in their effects, such as many of the human factors variables (e.g. fatigue, distraction and level of effort). Similarly, task demand is partly determined by remote decisions by the driver, such as which car to buy, whether to drive or use other means to get to the goal destination, whether to drive at a particular time of day, under particular visibility conditions, on a particular route and so on. Other determinants of task demand are considerably more proximal and affect the task in real-time, such as the road surface or the behaviour of other road users with a potential to occupy the same space as the driver’s vehicle. These distinctions represent what some authors refer to as the hierarchical nature of driver decision-making, ranging from the more strategic (i.e. distal) decisions to decisions
about particular manoeuvres (i.e. proximal) (Botticher and Van der Molen, 1988) and are graphically represented in Figure 6.5.

Distal and proximal factors also determine risk threshold. Journey goals (e.g. the need for a quick journey) may be proximal if arising from unexpected delays on the road or more distal if caused by delays before setting off. The disposition of the driver to opt for a particular risk threshold (i.e. a smaller or larger safety margin), as represented for example by elements of the driver’s personality (Sümer et al., 2005), is an even more distal factor. To take account of this proximal/distal distinction in
the development of the model, variables need to be identified as either having an
effect in real-time during driving or as having an effect more remotely (see Figure
6.5).

6.4 Speed limit compliance

Apart from the process of keeping perceived task difficulty within the range of
acceptable task difficulty or feelings of risk below the target risk threshold, speed
choice (decision and response in Figure 6.5) may also be determined by the degree
to which the driver is motivated to comply with the speed limit (disposition to
comply with speed limit in Figure 6.5). Compliance should not induce conflict in a
driver where the posted speed limit is for a speed which is higher than the speed
which would maintain perceived task difficulty within the driver’s target range, and
corresponding feelings of risk below the driver’s risk threshold. Thirty miles per
hour through a congested high street thronging with pedestrians or 60 mph around a
very sharp (i.e. small radius) bend on a narrow country lane would surely generate,
for most drivers, too high a level of perceived task difficulty and feeling of risk.
However, where the posted speed limit is for a speed lower than that which would
maintain perceived task difficulty within the driver’s target range (i.e. the driver’s
preferred speed would be higher than the limit), the driver has to switch from
control-by-task difficulty/risk feeling to control-by-compliance with the law.

Using the TPB as a framework for describing speed choice, Letirand and Delhomme
(2005) found that the higher the level of perceived behavioural control a driver had
over observing the speed limit, the lower was the intention to speed. Predictions of
self-reported speeding behaviour improved when intention and perceived
behavioural control over complying with the speed limit were taken into account as
well as exceeding the speed limit (the usual measure taken). These results argue for
the separate inclusion of measures of compliance as well as measures of deviation in
modelling driver speed choice.

6.5 Summary of theoretical discussion of the determination of
speed choice

A loss of control by a driver arises when driving task demands momentarily exceed
the driver’s capability. Speed has the single greatest influence on task demand and is
therefore a crucial determinant of whether or not control is maintained.

Task difficulty is defined as the degree of separation between task demand and
capability. Drivers drive in such a way as to maintain the level of task difficulty
within a preferred range. Adjustment of speed is the primary mechanism for
achieving this.
Ratings of task difficulty correlate very highly with ratings of feelings of risk, across the entire range of speeds studied (20–100 mph), but not with drivers’ statistical estimates of risk, until the level of speed at which the driver feels comfortable is exceeded. Thus it may be restated that drivers drive in such a way as to keep feelings of risk below some threshold level. The driver’s risk threshold is the level above which risk is felt to be too great, at the upper boundary of the preferred range of task difficulty. Feelings of risk are triggered by elements of the unfolding scene around the driver and as a result may be prioritised in attention capture.

An important issue for driver safety is the accuracy of calibration of perceptions of capability and task demand (and therefore task difficulty). Clearly, overestimation of capability and/or underestimation of task demand will lead to the perception that the driving task is easier than it objectively is, and may lead to a dangerous level of compensatory speed adjustment.

In order to fully understand the origins of speed choice, a distinction also needs to be made between proximal and more distal determinants of driver capability, driving task demand and preferred range of task difficulty (and risk threshold). Finally, apart from the process by which drivers choose a speed which maintains task difficulty within a range bounded by the risk threshold, drivers are also required to opt for a speed which complies with legal limits. Evidence shows that there is often a conflict between these two speeds, where the legal maximum speed is lower than the driver’s preferred speed.

Using the concepts of the TCI model, target task difficulty and risk threshold, the review will proceed by examining the conditions under which a high risk threshold is selected. The discussion will begin by looking at demographic factors, before systematic examination of distal factors (normative influences, social deviance, attitudes, beliefs and personality) and proximal factors (anger, control motivation and time-saving). The review will then conclude with a specific discussion of inappropriate high speed and motorcycle riding.
7 THE CONDITIONS FOR SELECTING A HIGH RISK THRESHOLD: WHO DOES IT?

Are there some individuals who are more disposed than others to target a high level of task difficulty or risk threshold (see the ‘Disposition to adopt particular risk threshold’ box in Figure 6.5)? Lajunen et al. (1998) argue that since drivers actually determine the margin of error they accept, driving style can be assumed to reflect drivers’ individual personality characteristics, attitudes and motives.

7.1 Young drivers

Younger drivers are more likely to report an intention to speed (Lawton et al., 1997). With regard to actual driving, in a study of on-road driving in which 61 participants were unobtrusively observed, Boyce and Geller (2002) found that younger drivers exceeded the speed limit more and obtained higher ‘at risk’ scores (including speeding, tailgating, close-following and time off task). Laapotti et al. (2001) found that young novice drivers had more offences (mainly for speeding) than middle-aged novice drivers. Clarke et al. (1999), using a procedure of ‘structured case interpretation’, analysed the police files of 973 overtaking accidents which occurred in Nottinghamshire from 1989 to 1993 inclusive and found that about 33% of overtaking accidents of inexperienced drivers were associated with travelling at excess speed. In a later study, Clarke et al. (2005) analysed 1,296 detailed reports of the accidents of 17–25-year-old drivers which occurred in the years 1994 to 1996 in the UK. They found that these accidents were frequently the result of voluntary ‘risk-taking’ factors rather than caused by ‘skill deficit’ factors. Speed dominated the risk-taking factors, being involved in approximately 26% of the ‘to blame’ cases and contributing to an even larger proportion of accidents in the hours of darkness. In contrast, alcohol was a factor in only about 7% of ‘to blame’ cases. Recklessness, as in racing or exceptionally high speed, appeared in approximately 6% of ‘to blame’ cases (which also increased in the hours of darkness) and risky overtaking in about 2%. Clarke et al. concluded that: ‘Darkness seems not to be especially dangerous in itself, rather it is the young drivers’ reasons and attitudes towards driving in the evening that put them at increased risk of accident. Deliberate speeding, recklessness and excessive alcohol consumption seem to be the main problems . . . ’ (p. 528). Clarke et al. also present a striking image of the fundamental ‘illusion of control’ error made by young drivers in assuming that they can drive safely at a level where task demand is so high that it is dangerously close to the limits of capability. Young drivers ‘talk and behave as if this envelope – the dividing line between accident-free driving and collision – is visible, precise and stable . . . But . . . they are prancing on a crumbling cliff, not a hard edge. If this gives way, it will do so without warning, without apparent cause, and without the chance of recovery. No one can tell exactly where the danger zone begins. There is no clear line between safety and catastrophe. And what division there is, is constantly
changing. Given that “the envelope” works like that, the only requirement is to keep well away from the edge’ (p. 529).

Analysis of over 2,000 police narrative descriptions of non-fatal accidents in two states of the US yielded a rather similar picture for drivers aged 16–19 years (McKnight and McKnight, 2003). Over 20% of accidents were attributed to inappropriate speed, with younger drivers having a greater proportion of their accidents associated with driving too fast for the conditions. Nevertheless, only 0.7% of the accidents were associated with speeds over 70 mph. In contrast to Clarke et al. (2005), the authors interpreted these results as suggesting that these young drivers’ crashes were more attributable to low capability due to inexperience rather than to deliberate risk-taking. One aspect of this low capability may be the driver’s relative lack of responsiveness to road features that more experienced drivers take into account in choosing preferred speed and what they consider to be a safe limit (Goldenblend et al., 2006).

A similar picture was reported from an analysis of the 1995 database of 225,589 crashes in Florida. Young drivers were found to be over-involved in crashes related to speeding, crashes on curves and crashes that resulted in an overturn or were head-on or involved running off the road (Abdel-Aty et al., 1999). They were also over-involved in crashes at weekends and crashes at night. In a questionnaire study of 41,000 novice drivers in Finland (representing 25% of all novice drivers in 1989–90), Laapotti et al. (2001) also found that about 26% of all young novice driver accidents occurred at night and that younger novices and male novices had more accidents at night than older or female novices. Dobson et al. (1999) found that 11% of young women (mean age 21.8 years), who were involved in accidents in the previous three years, said that they were driving too fast at the time of their most recent accident. This contrasted with 4% in a group of older women (mean age 48.7 years).

Although young drivers as a group are more involved in speed-related collisions, it is important to note that the majority of young drivers do not speed to excess or cause serious crashes (NHTSA, 1995).

7.2 Young male drivers

Independent of mileage driven, 17–20-year-olds report the highest normal and preferred speeds across a range of road types, with males typically reporting higher speeds than females, the sexes not converging until at least age 50 (Stradling et al., 2004). Direct observation of drivers confirms this. Males drive faster than females and overall have more fatal crashes per kilometre (Massie et al., 1995). Of all drivers involved in fatal crashes, young males are the most likely to have speed as a collision factor. In 1995, nearly 40% of fatal crashes involving males 20 years and younger were speed related (NHTSA, 1995) and the proportion of speed-related crashes to all crashes decreased with increased driver age. Similarly in Finland,
young male driver fatal crashes are more likely to be associated with speeding (the speed limit was exceeded in nearly half of all cases and 47% were off-road crashes) (Laapotti and Keskinen, 2004).

In their results, McKnight and McKnight (2003) found that young males were more likely to have accidents involving speeds that were unsafe for conditions. Further evidence for the high risk threshold behaviour of inexperienced male drivers comes from a study of Swedish drivers by Monarrez-Espino et al. (2006) who found that, in the first year of licensing, males’ single-vehicle crash rate was five times that of females’. The single-vehicle crash rate is a useful indicator of risk level because the incidence of such accidents is presumably not usually biased by the ‘chance’ presence and behaviour of another road user (although it may include some instances of suicide). Furthermore, males have a personal injury crash earlier in this first year and male crashes were more likely to be fatal, indicating higher speeds at the point of impact. The majority of these crashes occurred during non-working hours. Despite this evidence from Sweden, in Finland Laapotti et al. (2001) found that the proportion of single-vehicle accidents in the first three months as a driver was approximately equivalent for males and females (44% and 48% respectively). Nevertheless, the typical differences in accident patterns between female and male drivers has remained stable over the past two decades (Laapotti and Keskinen, 2004), despite the increased participation of female drivers. Overall differences in crash rate, however, may be a function of differences in exposure: Briem et al. (2002) reported in their sample of 257 young (17–23 years) male and female drivers that the normal sex difference in accident involvement disappeared when kilometres driven was controlled for.

In a cluster analysis of features of 2,498 young Norwegian drivers (mean age 18.5 years), Ulleberg (2002) found six groups of drivers with different profiles. However, in each group the same pattern of sex differences emerged, with males scoring significantly higher on risk-enhancing attitudes and amount of risky driving behaviour. They also had higher accident rates, perceived less risk and rated their driving skills as better. Similarly, Özkan and Lajunen (2006), in a study of 217 undergraduate students in Turkey, found that safety skills, which are negatively associated with accident involvement, increased as a function of degree of femininity, measured on the Bem Sex Role Inventory. The safety skill concept was operationalised in seven questions about driving behaviour, such as ‘avoiding unnecessary risk’. In contrast, the self-reported level of perceptual-motor skill in driving was positively correlated with accident involvement and increased as a function of masculinity and being male. The authors concluded that high levels of safety skill may buffer the risk-supporting effects of perceptual-motor skill.

Males are also more likely to become persistent risky drivers (Begg and Langley, 2004), defined as those individuals who sustained engagement in risky driving when aged between 21 and 26 years. In fact there was very little evidence of any persistent risky driving among the 26-year-old females. The most prevalent risk behaviours
were exceeding the open road speed limit by at least 20 km/h (males 17%; females 2%) and driving fast for the thrill of it (males 7%; females 1%). It is noteworthy that in their sample of 933 young drivers in New Zealand, overtaking on a solid centre line and speeding up if someone tries to overtake did not persist in either group.

The consequences of these risky driving behaviours are perhaps illustrated by a study of self-reported risky driving and injury variables in a sample of over 21,000 New Zealand drivers (Blows et al., 2005). Drivers who reported frequently racing a motor vehicle for excitement and driving at 20 km/h over the speed limit in the previous year were two to four times more likely to have been injured in the same time-period. They also had a higher number of traffic convictions. Similarly, Stradling (2004) found, in his analysis of speeding behaviour and collision involvement of Scottish car drivers, that twice as many males were speeders (i.e. had ever been stopped by the police for speeding or flashed by a speed camera in the previous three years) and nearly twice as many speeders had been involved in a collision as a driver. In a postal questionnaire of 791 English car drivers, Stradling et al. (2004) also reported that drivers who had been caught for speeding in the previous three years were 59% more likely to have been crash-involved in that period (although this relationship was confounded with mileage).

A recent UK study by Musselwhite (2006) has highlighted the propensity of young male drivers to adopt inappropriate speeds. In his study, 1,686 drivers who were approached at motorway service stations and local garages along a holiday route in the south of England during summer months, completed a questionnaire concerning the frequency with which they engaged in various, mainly unsafe, driving behaviours in 30 mph zones. Questionnaire items were based on the findings of 47 semi-structured interviews. Using hierarchical cluster analysis, Musselwhite was able to identify four clusters of drivers, two of which were strikingly contrasted. One group of concern here he labelled ‘continuous risk takers’. This group were characterised by self-reports of a relatively high frequency of behaviours which are consistent with sustaining an (objectively) high level of risk threshold and thus, in our terms, might more appropriately be called high risk threshold drivers. These behaviours included fast acceleration and heavy braking, driving faster than 30 mph even if it felt unsafe to do so and overtaking a slow vehicle even if it meant an oncoming vehicle had to slow down or take some other avoiding action. They were also the least likely to reduce their speed if they realised they were travelling faster than they thought they were. This group drove the most number of miles per week (mean of 143 miles per week – 43% more than the contrasting group) but the striking point here is that 90% were male and they were the youngest group, with a mean age of 26.4 years. This group comprised 14.4% of the total sample.

In their unobtrusive study of on-road driving, Boyce and Geller (2002) also found that certain driving behaviours clustered together, specifically speeding, close-following and time spent engaged in behaviours which were unrelated to the driving task. They concluded that this evidence supported the concept of a ‘problem
behaviour syndrome’. Consistent with these findings are the results of an analysis of 20,725 questionnaires in the SARTRE database for 1998 (Golias and Karlaftis, 2002). Drivers who reported speeding also tended to report driving more dangerously (e.g. close-following, dangerous overtaking and driving through amber). This combination was associated with younger drivers, male drivers and drivers with a larger engine size. Lawton et al. (1997) presented drivers with five scenarios of different road types and asked about intentions to speed over the next 12 months. One group (approximately 11% of the sample) emerged who reported intending to speed frequently in at least four of these scenarios. These drivers were significantly younger than the average for the sample as a whole and were more likely to be male.

A key question in relation to understanding the behaviour of these drivers further is whether or not their objectively high levels of task difficulty are intentional. If they overestimate their capability, then task difficulty will be subjectively lower than it should be and the task will appear more controllable than it actually is; a similar result arises if they underestimate task demand or their feelings of risk are lower than ought to be warranted by the situation. In Clarke’s terms, these drivers would be surprised when the cliff crumbled away from beneath them. The review of attitudes later (Section 8.3), however, will show that many of these drivers deliberately drive close to the upper level of their capability and thus have a high risk threshold. The most dangerous scenario is when both of these interpretations apply: the driver deliberately accepts a high level of risk but is simultaneously poorly ‘calibrated’ – the risk accepted is objectively higher than the driver realises. The crumbling cliff edge extends much further inland than is apparent.

To summarise these empirical findings, research over the last decade confirms what might be called the young driver and young male driver ‘syndromes’. Young drivers are more likely to report an intention to speed and do indeed not only exceed the speed limit more but do so more excessively than older drivers. A greater proportion of their accidents is associated with driving too fast for the conditions. Their crashes are frequently the result of intentional high speed, including racing other drivers, and are more likely to occur at weekends and at night.

Males typically drive faster than females and have more fatal crashes per kilometre. Young males score higher on positive attitudes towards, and actual involvement in, risky driving behaviour, such as exceeding the speed limit by 20 km/h. For this group, such behaviour and higher levels of detected offence, are more likely to persist. They are also the group most likely to have speed as a collision factor and to have single-vehicle crashes. Behaviours associated with a high risk threshold tend to cluster together, such as speeding, close-following and dangerous overtaking, and are inevitably linked to the consequences of higher rates of conviction for violations and of collisions (see also similar conclusions in the review by Ward and Lancaster, 2003).
Age and sex differences alone do not, of course, explain why young and male drivers are more likely to speed and are disproportionately over-involved in collisions, even if this can be associated with higher risk thresholds (in addition to poor capability or differential risk exposure, for example – see Laapotti et al., 2001). We are still left with the question as to why younger and male drivers might have higher risk thresholds. Both distal and proximal factors may be relevant here. Arnett et al. (1997), in a study of a sample of 139 17–18-year-old drivers who completed a driving behaviour questionnaire and a sub-sample of 59 who kept a driving log for 10 days, found that driving 20 mph or more over the speed limit, racing the car, passing in a no-passing zone and driving when intoxicated were significantly related to traits of sensation seeking and aggressiveness. Adolescent boys reported stronger tendencies on both these traits than adolescent girls, and the adolescents scored significantly higher on both these variables than adults (age range 41–59 years). The influence of these traits is reviewed more fully later (see Section 8.4). In addition to these trait-related effects, they also found that respondents exceeded the speed limit to a greater degree when actually feeling angry. The influence of anger is also reviewed later (see Section 9.1).

Of course, a key feature of younger drivers is that they necessarily lack experience, relative to most others. The ability to anticipate imminent changes in task demand and adjust speed in a pre-adaptive manner provides for less steep gradients of speed change. This ability also helps drivers avoid situations where the time-window of opportunity to make adjustments (e.g. of speed) becomes too short to maintain control of the vehicle. A typical example would be attempting to take a bend at too high a speed, having to brake hard and then entering into a skid. Accurate anticipation of task demand and knowledge of the constraints on adaptive possibilities (e.g. regarding vehicle handling characteristics, road surface, etc.) requires protracted and direct learning. Because of this requirement, drivers with relatively little experience of the contingencies involved in interacting with the road and traffic are less likely to make appropriate anticipatory, pre-adaptive responses and are thus more likely to get into inappropriate high speed situations.

Steinberg (2004) argues that adolescents are passing through a period of vulnerability. On the one hand they seek increased levels of novelty and stimulation in order to achieve the same feeling of pleasure – they require a higher degree of risk to achieve the same level of stimulation. On the other hand, the self-regulating processes that govern impulse control, foresight and planning are still maturing. This asynchrony lies at the heart of the disposition to take risks, essentially because there may be weak self-control over reward-seeking impulses, a situation that may be exacerbated by heightened sensitivity to the influences of peer pressure and emotion-led reactions.

Young drivers with Attention Deficit Hyperactivity Disorder (ADHD) may be particularly vulnerable in these respects. ADHD affects 3–8% of children and is relatively persistent throughout adolescence and adulthood, with 50–75% of
individuals diagnosed with ADHD in childhood continuing to display at least some symptoms into adulthood (Richards et al., 2006). Persons with ADHD are often characterised as distractible and impulsive, and deficits have been demonstrated in laboratory tasks which test for the inhibition of a stimulus set (distractibility) and inhibition of a response set (impulsivity) (Casey et al., 2002).

ADHD young adults are cited more often for speeding, are involved in more crashes and in more injury crashes than controls matched for age, sex and educational level (Barkley et al., 1996). Richards et al. (2006) have shown that the primary deficit in ADHD, response inhibition, extends to emotional self-regulation. Drivers with ADHD report significantly more driving anger and engage less in ‘adaptive’ anger expression than non-ADHD controls.

From a theoretical perspective, apart from possible influences of uncontrolled mood states which disrupt performance (see Sections 8.4.2 and 9.1) on anger and aggression), ADHD drivers with poor inhibitory control may be prone to delay responding to escalations in task difficulty, persisting with a given speed, for example, despite the task demand pushing them closer to their risk or even capability-limit thresholds. For this young driver group in particular, further research on their potential for vulnerability and how it might be managed would seem to be a matter that merits some attention.

In sum, apart from the lack of experience, and thus opportunity to develop knowledge of the contingencies of the road and traffic environment and more refined skills of situation awareness and vehicle control, the young driver, and especially the young male driver, may simply be immature, with incomplete development of self-knowledge, self-control, social responsibility and independence of judgement. Young drivers with ADHD may be particularly at risk because of a relative lack of self-control.

With regard to observed sex differences, Yagil (1998) suggests these may be due to different socialisation processes for women and men. Girls are encouraged to be dependent and obedient, non-competitive and passive, and are expected to avoid risk-taking. Boys on the other hand are encouraged to express anger, take risks, compete and to be independent. Thus women, more than men, express unquestioning compliance with traffic laws and men are more likely to commit driving violations. A review of normative and cultural influences follows.
8 THE CONDITIONS FOR SELECTING A HIGH RISK THRESHOLD: DISTAL FACTORS

8.1 Normative influences and driving culture

O’Connell (2002) warns us that the design and construction of the road and traffic system ‘must not be based on an erroneous model of humans as abstract rational actors, isolated from their social context and operating on purely “objective” criteria’ (p. 201). Driving is a socially regulated form of behaviour (Zaidel, 1992; Åberg, 1998) and speed choice may well come under the influence of social forces from both within the vehicle (i.e. from passengers) and outside the vehicle. Kimura (1993) observed that the perceived speed of others had a strong effect on the driver’s intention to speed. Similarly, Åberg et al. (1997) have suggested that drivers tend to influence each other’s speed. They reported that drivers typically want to drive like others but they tend to overestimate others’ speed (a finding also reported by Walton and Bathurst (1998)), believe that others think they are driving too slowly and thus drive faster to be more compliant, a phenomenon described as a ‘false consensus’ (Ross et al., 1977). Haglund and Åberg (2000) replicated the earlier study on 90 km/h roads (the earlier study was confined to 50 km/h roads) and found that drivers driving faster than others were more likely to state that a high proportion of drivers exceeded the speed limit by more than 10 km/h. They also had a positive attitude towards speeding. Quimby (2005) reports that in the SARTRE 3 survey, 92% of UK drivers thought that other drivers exceeded the speed limit ‘often’ or more frequently, although only 5% reported that they ‘very much’ enjoyed driving fast. Gerrard et al. (1996) found that adolescents overestimate the prevalence of reckless driving among their peers and this overestimate predicts greater compliance with the perceived ‘norm’. Also a favourable image of reckless driving increases the likelihood of the behaviour being performed and this in turn increases its favourability rating (Gibbons and Gerrard, 1995). Thus drivers seem to be constantly monitoring their own and others’ performance, wanting to match their own behaviour with that of their peers. The obvious problem is, of course, that with overestimation of the frequency and degree of others’ speeding behaviour, this process of social comparison creates a positive feedback loop that can act to ratchet up traffic speed.

One issue with these studies, however, is that of interpretation. It may be the case that rather than drivers following a false consensus, they may be justifying their own aberrant behaviour by pretending that it is in fact more the norm, making their own behaviour appear less deviant. Haglund and Åberg (2000) comment that attitudes towards and motives for speed are more strongly related to speed choice than is the estimated rate of other drivers’ speeding.
Peer-group influence on speed choice is evident from the work of Parker et al. (1992b) who reported that younger drivers perceive more approval from salient others for their speeding (as well as for their close-following and risky overtaking). They are also more motivated to comply with the perceived wishes of their referents. Stradling et al. (2003) found that 36% of 17–20-year-old males said they would drive faster with people their own age in the car. Hardly any drivers said they would drive faster with children or older people as passengers.

Keskinen has extended the typical three-level hierarchical conceptualisation of driving actions (execution of control response, selection of manoeuvre, goals and context of driving) to include a higher level of ‘goals for life and skills for living’ (see Laapotti et al., 2001) which ‘refers to the importance of cars and driving for the driver’s personal development and to skills for self-control’ (p. 760). This level enables us to embrace the sorts of personal and cultural context of driving as described below. Steg (2004), for example, in analysing different motives for car use, distinguished between three multidimensional classes of motive: instrumental (convenience, speed, flexibility, safety), social (self expression, status expression, social comparison, conformity) and affective (mood alteration, pleasure, arousal).

Moller (2004) explored the psychosocial functions of driving using focus groups of young Copenhagen drivers \( (n = 29) \) representing two broad education exit levels, roughly equivalent to secondary and tertiary education. It was found that driving was used as a means to attract attention, to identify with adult status and to assimilate status through fast and assertive driving, as an opportunity to express and demonstrate mastery of the task, particularly under conditions of high task demand, and as a means to express and exploit a new-found mobility. An early exit from formal education was associated with ‘driving as a shared and worshipped activity thereby creating the basis for the use of the car as a tool for self-expression, show-off, competing and entertainment with friends through risk-taking behaviour’ (p. 1086). It was concluded that the driving behaviour of young drivers is influenced by motives other than driving safely and that norms within the peer-group influence the manner and extent to which these motives are expressed in driving behaviour.

Exploring the relationship between ‘life-style factors’ and types of aberrant driving behaviour, Chliaoutakis et al. (2005) found that ‘driving without destination’ was the most significant predictor of driving errors (measured with a modified version of the Driver Behaviour Questionnaire (DBQ)), the only factor associated with ‘aggressive violations’ and one of two factors associated with ‘ordinary violations’ (the other factor was participation in sports). About 10% of respondents reported that they often drove with no destination in mind and almost a third reported driving this way more often than ‘rarely’. Young novice drivers, who often drive for pleasure, to get rid of their frustrations or to seek thrills, drive faster, more aggressively and competitively and with smaller safety margins than others. They also have higher accident involvement (Wahlquist, 1996, cited in Engstrome et al., 2003).
In summary, normative influences appear to have an effect on driver behaviour, although the possibility remains that some drivers’ reported perceptions of others may provide a justification for their own deviant behaviour. Regarding speed choice, drivers tend to comply with the perceived norm which is often overestimated. Young drivers are also prone to overestimate the prevalence of reckless driving in their peer group and perceive more approval from significant others for their speeding. They also say they would drive faster with people their own age in their car. An early exit from formal education is linked to car uses other than for journey purposes, such as self-expression, status through fast driving, competition and entertainment. Driving without a destination is also associated with driving errors and violations.

8.2 Social deviance

8.2.1 General social deviance

The norm of particular demographic groups may create a need to display deviance (O’Connell, 2002). In their studies of young Norwegian drivers, Ulleberg and Rundmo (2003) and Oltedal and Rundmo (2006) found that high scores on ‘normlessness’ were associated with self-reported risk taking in traffic. Individuals scoring high on this trait are assumed to have low barriers towards socially unapproved behaviour, to have low respect for traffic rules and regulations, and may have a general tendency towards irresponsible behaviour.

The role of social deviance in collision risk was also explored through a self-report questionnaire in a sample of 108 drivers by West et al. (1993). Social deviance was measured by items which included evasion of payment of income tax, TV licence fees and public transport fares, making fraudulent insurance claims, taking false sick-leave and traffic violations, such as illegal parking. They found that the 25% highest scorers reported four times the number of accidents than the 25% lowest scorers. This relationship was independent of driver age, sex or annual mileage, but part of the relationship between social deviance and accidents was accounted for by a relationship with increased driving speed. They speculated that social deviance may be caused by a tendency to focus on immediate gratification of needs to the exclusion of considering possible aversive consequences. Thus ‘fast driving may arise from greater emphasis on the need to make good progress with less consideration of the adverse consequences of an accident’ (pp. 217–218).

Consistent with this interpretation is the finding by Trimpop and Kirkcaldy (1997) that two key distinctions between an accident group and a non-accident group of young male Canadian drivers were immediate sensations rather than pleasure in organising and anticipating goals, and a lower need for personal control. Indeed, as O’Connell (2002) points out, there can be a weakening or removal of inhibition that normally restrains people from acting on their impulses, a phenomenon known as ‘disinhibition’. He cites as a good example the effect of alcohol in facilitating aggression. It has this effect, not so much by ‘stepping on the gas’, but rather by ‘immobilising the brakes’.
8.2.2 Violation of driving regulations

As discussed earlier (see Section 6.4 on speed limit compliance), where the speed limit is for a speed lower than the speed a driver would otherwise choose to maintain task difficulty within an acceptable margin (i.e. below risk threshold), the compliant driver must switch control to the speedometer read-out. In essence, target task difficulty becomes target speed limit. However, at times this switch does not occur for many drivers. Stradling et al. (2003) found in a sample of 1,000 Scottish drivers that only 30% of male drivers and 45% of female drivers agreed that speed limits on motorways should not be broken at all. The figures for ‘other roads’ were respectively 43% and 55%. Carthy et al. (1993) found that 85% of UK drivers reported exceeding the speed limit when the road was quiet and clear. Letirand and Delhomme (2005) presented the following scenario to a convenience sample of 238 young male drivers and asked them at what speed they would drive in this situation in free-flow conditions:

‘It is around 2 o’clock in the afternoon, you are driving your usual car on a 90 km/h speed limit national road. You are alone in the car. The road is straight, has no intersections, and there is good, long distance visibility. The road surface is good and dry. Traffic is flowing and the outside temperature is 15 degrees C.’

Only 8% declared that they would keep down to the speed limit. Lawton et al. (1997) found that most drivers make judgements about the type of road on which they are driving and their intentions to speed vary with the degree of speeding they consider acceptable.

In a study of rural drivers who had been prosecuted for exceeding the speed limit, Blincoe et al. (2006) found that 18–24% of the sample expressed a sense of being ‘wrongly’ or unfairly caught as they felt they were safe drivers. Groups were distinguished in terms of their responses to the introduction of speed cameras (see Corbett and Simon, 1999). Significantly more of a deterred group (speed has reduced since the introduction of speed cameras) said their speeding was accidental. There was a pervasive sense in comments reported from groups identified as manipulators (who slow down only in the area of speed cameras) and defiers (who exceed limits and did not reduce their speed since the introduction of cameras) that not only did they consider themselves safe, competent drivers but that they adopted speeds that were appropriate to the conditions and that at times the speed limit was inappropriately low. This response to the driving task is nicely captured by a 42-year-old female driver who was caught doing 47 mph in a 40 mph zone: ‘As an advanced driver, if the traffic did not allow the speed I would not have done it! With nobody on the road or pavement and good weather conditions, why slow down!’.

Not surprisingly, drivers experience anger more than shame when stopped by a police officer after committing a violation under these circumstances (see Yagil, 2005).
Furthermore, as concluded by the Federal Highway Administration (1998): ‘In general, changing speed limits on low and moderate speed roads appears to have little or no effect on speed and thus little or no effect on crashes. This suggests that drivers travel at speeds they feel are reasonable and safe for the road and traffic, regardless of the posted limit’. Jamson (2006) recorded the voluntary use of an Intelligent Speed Adaptation system, which prevented the vehicle from exceeding the speed limit, and noted that drivers disengaged the system when the controlled speed was incompatible with what the drivers felt was more appropriate: ‘the test drivers appear to have driven at a speed they felt comfortable with given the road and traffic conditions’ (p. 204). Similarly, Larsen (1995) concluded that ‘drivers to a certain extent assess what speed level they find reasonable in a specific situation. And if the road design more or less invites to drive faster than the speed limits allow, which was in fact the case on some of the road sections where we found the highest speeds, it is an important factor behind speed choice’ (p. 9). Thus, it is no surprise to find that four out of the eight most common reasons given by UK drivers to justify their speeding were as follows:

- ‘It was unintentional.’
- ‘I think the limit is wrongly set for this location.’
- ‘I don’t think the same speed limit should apply at all times [the empty road, at night].’
- ‘My speeding is acceptable because it is not a lot over the limit and others abuse the limit more flagrantly’ (Silcock et al., 2000).

These reasons all suggest that the drivers considered they were driving at an appropriate speed at the time their violation was detected and underpin the conclusion of Zakowska (1997) that the key to safe roadway design is that it elicits appropriate behaviour from the driver.

It might be expected that drivers who are generally less law-compliant than others would be more likely to continue driving at the speed they considered appropriate (i.e. under control-by-task difficulty) in speed-restricted zones and this, indeed, appears to be the case (Begg and Langley, 2004). If these drivers are also those who target a higher risk threshold than others, they will feel more conflict in speed-restricted zones and thus are even more likely to violate the limit.

Laapotti and Keskinen (2004) found that males were 3.6 times more likely to have committed traffic offences and young male novice drivers were also more likely to be persistent offenders, compared with female or middle-aged novice drivers (Laapotti et al., 2001). Yagil (1998) examined sex and age-related differences in drivers’ motives for compliance with traffic laws in a sample of 181 respondents. As mentioned earlier, women drivers were found to have a stronger sense of obligation to obey the law than did men and evaluated traffic laws more positively. Thus women were less likely than men to report exceeding the speed limit, even if they...
were convinced it would be safe to do so. The greatest sex difference was among the younger drivers. A sense of obligation to obey traffic laws was measured with five statements, such as ‘It is okay to violate traffic laws sometimes as long as the driver is careful’ and ‘A good driver can allow himself or herself to exceed the speed limit’. Among the female drivers, the stronger the sense of obligation to obey the law and the higher the evaluation of that law, the weaker the perceived gain in the commission of traffic violations.

Even people who are generally law-abiding citizens may be less likely to comply with what they consider to be a bad law (Makinen et al., 1999; Yagil, 2005) and driving on a roadway at a speed limit which delivers a level of task difficulty notably lower than a level within the driver’s target range is likely to induce lower compliance for this reason. The driver breaks the limit on such a section of roadway because the limit is perceived to be a ‘bad law’ on that section. If drivers perceive speed limits to be out of touch with perceived task difficulty, then it is hardly surprising that compliance with those limits is weak and needs to be enforced. This line of reasoning adds weight to the practice of basing the speed limit close to the 85th percentile of free speed, which seems to be an appropriate method for reconciling legal upper speed with the target task difficulty acceptable to a majority of drivers.

A further point in relation to conditions where the speed limit delivers a level of difficulty below the target range of the driver is that the driver may well develop feelings of frustration and/or boredom and enter lower levels of physiological activation, all of which may have implications for driver safety, such as in reduced vigilance and attention (Banuls and Montoro, 2001), vulnerability to distraction, and in engaging in additional non-driving related tasks to increase workload. In this connection, Recarte and Nunes (2002) have provided experimental evidence which suggests that if a driver is constrained to go more slowly than his or her preferred speed (because of a speed limit), attention to non-driving related tasks distracts the driver from monitoring speed (i.e. observing the speedometer) and this can lead to small but significant increases in speed in the preferred, unrestrained direction. Finally, it is also possible that restraining speed below preferred speed in a speed-limit zone may perhaps motivate a kind of rebound excessive speed once the restriction has been passed. This kind of phenomenon has been observed in road sections immediately after speed limit enforcement by static police units (Shinar and Stiebel, 1986).

In a questionnaire study of university students in Japan, intentions to violate speed limits (in hypothetical scenarios) were found to be correlated with positive affective and cognitive evaluations (Kimura, 1993). Affective evaluations of speed included ratings of pleasure, interest, lack of uneasiness and fear; cognitive evaluations included need, derestiction of speed, keeping up with the traffic flow and when provoked by a following car. Burgess (1998) measured intentions to violate traffic regulations and conventions, including speeding through a motorway contra-flow, in
a sample of 115 clients attending a Driver Improvement Course in Devon. Intentions to violate were significantly correlated with egoism, defined as the philosophy of someone who takes care of their own well-being at the expense of the community.

The higher the rating of danger of a violation, the less it is engaged in (Castella and Perez, 2004). However, drivers who report a very high intention to speed in response to a series of hypothetical scenarios are also those who intend to speed excessively and this relationship is independent of perceived negative consequences (Lawton et al., 1997). What distinguishes these drivers from others seems to be a general disregard for the rules of the road. In their prospective study relating driver characteristics to accident outcome, Norris et al. (2000) found that violations of traffic rules and speed limits were highly predictive of subsequent collisions. Parker et al. (1995) obtained information from 1,373 UK drivers on their accident record over a total of six years and self-reports of driving behaviour, collected in the middle of the period. The frequency of committing driving violations (such as disregarding the speed limit late at night or very early in the morning, overtaking a slow driver on the inside lane and tailgating a driver to signal that he or she should go faster or get out of the way) was correlated with involvement in active loss of control accidents, independently of age, sex and years with a full licence, although the strength of the relationship declined with increasing age and experience.

In a study focusing exclusively on women drivers’ behaviour (Dobson et al., 1999), highest mean scores for the same pattern of violations were found for young women drivers (mean age 21.8 years). In fact, the younger women scored higher than older women drivers (mean age 48.7 years) on all eight items of the DBQ violations scale. They also had three times as many accidents in the previous three years and the number reporting more than one accident was seven times greater. It should be noted that because measures of speeding behaviour (e.g. ‘Do you exceed the speed limit in built-up areas?’; ‘Do you exceed the 70 mph speed limit during a motorway journey?’) were not clearly associated with particular types of active accident in the Parker et al. (1995) study, it was suggested that active loss of control accidents owe more to a failure to adjust speed to the prevailing conditions, rather than to high speeds per se. At least consistent with this is the observation by Dobson et al. that there was only one reported collision with a pedestrian over the previous three years in each of their two age groups of women drivers.

Another way of looking at the violation of driving regulations is in terms of driver behaviour in relation to speed cameras. As indicated earlier, Corbett and Simon (1999) identified distinct categories among urban drivers. These consisted of conformers who always, or nearly always, comply with speed limits, deterred who reduced their speeds since the introduction of cameras, manipulators who slow down just in the area of the camera site, and defiers who exceed speed limits and have not reduced their speed since the advent of cameras. Conformers appear to voluntarily comply with legal speed limits because they have an internalised value of obedience to the law, whereas the deterred, and especially the manipulators,
exhibit compliance mainly as a response to the threat of external punishments (Yagil, 2005). Defiers appear to be a conspicuously socially deviant group.

Further research (Corbett and Simon, 1999) showed that individual assignment to type is reasonably stable and not site-specific. Furthermore, conformers were found to be the oldest and most experienced drivers, to have the lowest offending and speeding scores, and the lowest observed speeds. They were least likely to have had an accident in the previous three years and were most likely to accept the link between speed and accident risk. Manipulators and defiers were at the other end of each of these scales, with defiers having the highest speeding and offending scores and the highest observed speeds. Unlike the manipulators, however, defiers continued to speed despite the introduction of cameras, as if uncaring of the threat of detection. Blincoe et al. (2006) were able to show that these categories applied equally to rural drivers who had been prosecuted for exceeding the speed limit. However, for all groups except the deterred group, the proportion reporting one or more accidents in the previous three years was similar (15.2–15.6%). The corresponding rate for the deterred group was 11.1%.

In sum, failure to comply with speed limits reflects, in part, a failure in the requirement on the otherwise ‘ordinary’ driver to transfer control from perceived task difficulty or feelings of risk to control by monitoring speed in relation to the legal limit. We might call such drivers ‘default speeders’, in that they fail to fulfil the obligation to comply with the law, while maintaining perceived task difficulty or risk within their target range. On the other hand, the violation of speed limits is also, in some drivers, an intentional act and an expression of general social deviance, which is associated with other forms of risk taking in traffic and to increased collision involvement. This characteristic of defiance of the law may be linked to a lack of self-control, in the sense of the individual focusing on immediate gratification at the expense of considering future consequences. These drivers constitute a ‘socially deviant speeder’ group.

8.3 Attitudes, beliefs and behaviour

In the SARTRE 3 survey (INRETS, 2004), participants were asked whether they thought 15 potential factors were a cause of road accidents. For the UK sample ($n = 1,237$) ‘drinking and driving’ was the factor that most people (91%) thought was a causal factor either often, very often or always. The next biggest contributing factor was thought to be ‘driving too fast’, identified by 87% of the sample. In third place was ‘following too closely to the vehicle in front’, being selected by 85%. Parker et al. (1992b) interviewed a stratified sample of 881 UK drivers and found that views about speeding were less negative than about other violations, such as close following, dangerous overtaking and drink-driving. Female beliefs about speeding were more safety oriented than male beliefs. They also found a more permissive attitude to speeding at night (11 p.m. compared with 4 p.m.) and that younger drivers felt it was harder to resist speeding, and they saw their friends and
partners as having lower expectations that they would refrain from doing so. However, it should be noted that beliefs and attitudes were not systematically related to accident history.

Brown and Cotton (2003) interviewed drivers about their perceptions of risk in relation to speeding and found that those who held beliefs such as ‘it’s OK to speed when there are no cars around or when driving on a straight road’ reported higher levels of speeding behaviour (cited in Fylan et al., 2006). This finding is entirely consistent with predictions from the hypothesis of task-difficulty homeostasis: as task demand decreases, drivers increase their speed to maintain their preferred difficulty level.

A dissociation between reported speeding behaviour and reported dangerous driving has been demonstrated for the entire SARTRE 3 sample (Quimby, 2005). For example, Quimby highlighted that, although 14% of UK respondents indicated that they drove ‘a little’ or ‘much faster’ than other drivers in the UK, only 3% indicated that they drove ‘a bit more’ or ‘much more dangerously’. The implication of this is that many drivers do not consider their own speeding to be dangerous. In this regard it is interesting to look at the UK data broken down by gender and age category, as is done in Figure 8.1.

Graph ‘a’ in Figure 8.1 depicts the percentage of respondents by gender and age group who report driving ‘a little’ or ‘much faster’ than other drivers. It conveys that this is much more prevalent among males and that it decreases from 32% within the under 24 age category to 10% for the over 55s. When the reporting of driving ‘a bit more’ or ‘much more dangerously’ than other drivers is considered (graph ‘b’) the instances are much lower. The effect of gender is much less clear and there is only a slight impact of age, such that reporting driving more dangerously than others decreases with age. If graph ‘b’ is subtracted from graph ‘a’, a potential depiction of those drivers who think their speeding is unrelated to dangerous driving is obtained and is presented in graph ‘c’. Here the patterns of age and gender are very clear. It is more of a problem for males and one which decreases with age. It is worth noting also that it is not just a phenomenon associated with young males, since the figures are high among both the 25–39 age category (22%) and the 40–54 category (19%). For around one in five male drivers under the age of 55 years, driving a little or much faster than other drivers is not perceived to be more dangerous.

The attitudes of young Finnish drivers (aged 18 to 20 years) towards obeying traffic rules and driving safely were compared over a 23-year period by Laapotti et al. (2003). They found that young drivers in 2001 showed a modest but significantly more negative shift in attitudes compared with the equivalent age group in 1978, with a larger deterioration found among males. Nevertheless, the differences between male and female drivers generally remained the same. The degree of negative attitude was associated with higher odds of being involved in traffic accidents, committing offences and driving while slightly drunk. A gender
difference in attitudes towards some aspects of risky driving was also reported in a New Zealand study of 14- and 16-year-olds by Harré et al. (2000). However, of more interest for our purposes here, it was noted that the older adolescents (many of whom drove) had riskier attitudes towards speeding than the younger, non-driving adolescents.

Guppy (1993) interviewed 937 male drivers with regard to their expectations about being caught for speeding (10 mph over the limit) or being involved in a speed-related accident and found that these consequences were seen as less probable for the self as opposed to the average driver. Interestingly, drivers who reported having been stopped by the police at least once in the preceding five years perceived these
consequences as being less likely than drivers who had not been stopped. On the other hand, Ulleberg and Rundmo (2003) found that adolescent drivers who perceived the risk related to traffic accidents as high, reported that they were less likely to take risks when driving.

Ulleberg and Rundmo (2002) explored the relationship between self-reported attitudes and self-reported risk-taking behaviour in a sample of 3,942 Norwegian participants aged 16–23 years. Eleven dimensions of risk-taking attitudes were identified, including speeding (‘I think it is OK to speed if the traffic conditions allow you to do so’), progress-motivated non-compliance with traffic rules (‘sometimes it is necessary to break the traffic rules in order to get ahead’) and joyriding (‘driving is more than transportation, it is also speeding and fun’). The highest correlation among all dimensions ($r = 0.68$) was between speeding and progress-motivated non-compliance with traffic rules. Males scored significantly higher than females on the three dimensions identified here and all three dimensions correlated significantly with self-reports of risk-taking behaviour ($r = 0.45$ in all cases). These were, in fact, the highest correlations obtained between attitude dimensions and self-reported risk behaviour, which included items on fast driving, speeding, running red and amber lights, tailgating and responsiveness to peer pressure. In a survey of 1,932 adolescent drivers (mean age 18.5 years), Ulleberg and Rundmo (2003) found that those with a positive attitude towards road safety were less likely to report risky driving behaviour ($r = -0.79, p < 0.01$).

Nevertheless, a questionnaire study of Canadian undergraduates by Whissell and Bigelow (2003) was unable to find any relationship between seven attitude variables (including a speeding attitude scale) and actual reported crashes.

Iversen and Rundmo (2004) examined the relationship between attitudes to traffic safety issues and self-reported risk behaviour in traffic and the relationship between these variables and involvement in near-accidents and actual accidents in a representative sample of 2,614 Norwegian drivers. Principal component analyses identified three underlying attitude factors or dimensions; the first and the one most relevant to this review they labelled ‘attitude towards rule violations and speeding’. Component attitudes loading highly on this factor are listed in Table 8.1.

<table>
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<tr>
<th>Order</th>
<th>Component attitudes</th>
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<tbody>
<tr>
<td>1</td>
<td>Speed limits are exceeded because they are too restrictive</td>
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<td>2</td>
<td>When road conditions are good and nobody is around driving at 100 mph is ok</td>
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<tr>
<td>3</td>
<td>It makes sense to exceed speed limits to get ahead of ‘Sunday drivers’</td>
</tr>
<tr>
<td>4</td>
<td>Taking chances and breaking a few rules does not necessarily make bad drivers</td>
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<tr>
<td>5</td>
<td>If you are a good driver it is acceptable to drive a little faster</td>
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Such attitudes were endorsed (agree or strongly agree) by 11% of the entire sample and rejected (disagree or strongly disagree) by 28% of the sample. Twenty-three per cent believed that, when road conditions are good and nobody is around, driving at 100 mph is OK and 28% that it makes sense to exceed speed limits to get ahead of ‘Sunday drivers’.

With respect to risk-taking behaviour, seven dimensions were found, the first two of which were entitled ‘violation of traffic rules and speeding’ and ‘reckless driving/fun-riding’. These were the most strongly correlated of the dimensions ($r = 0.63$, a degree of correspondence which actually raises the question of their independence). Component behaviours loading highly on these two factors are listed in Table 8.2.

<table>
<thead>
<tr>
<th>Table 8.2: Component behaviours loading on the dimensions ‘violation of traffic rules and speeding’ and ‘reckless driving/fun-riding’ (rank order)</th>
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<tr>
<td><strong>Order</strong></td>
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<tr>
<td><strong>Violation of traffic rules and speeding</strong></td>
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<tr>
<td><strong>Reckless driving/fun-riding</strong></td>
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The violation of traffic rules and speeding were expressed (often or very often) by 12% of the entire sample and were rejected (seldom or never) by 38% of the sample. Thirty-one per cent exceed the 50 mph speed limit by 10 mph or more and 69% similarly for the 80–90 mph limit. Thirty-five per cent overtake the car ahead when it is keeping to the speed limit and more than 50% drive faster to make up for delays in making an appointment. Males, younger respondents and those holding a licence for a shorter time (less than 10 years) were more likely to hold unsafe attitudes and admit to unsafe behaviour in traffic.

With regard to near and actual accidents, over 15% of respondents had experienced an injury accident and 68% had been involved in a damage-only accident. Eighty-two per cent had experienced a near-accident as a driver. Structural equation modelling revealed that risk behaviour was strongly linked to driver attitudes, independently of driver sex, age and experience (period the licence held). Similarly, risk behaviour was found to be strongly linked to involvement in near-accidents and actual collisions, explaining 21% of the total variance.
Adams-Guppy and Guppy (1995) found that company car drivers who more frequently exceeded the speed limit on UK motorways were more likely to rate themselves as confident, aware and impatient drivers, and to rate speeding as less important as a risk factor. They also felt under more time-pressure.

West and Hall (1997), in a survey of 406 drivers in London and Hertfordshire, found that drivers with a more positive attitude to driving violations, and who rated more highly on a measure of social deviance, drove faster and reported more accidents, independent of annual mileage.

The Theory of Planned Behaviour (TPB) is predicated on the assumption that there is a causal relationship between beliefs, attitudes, intentions and behaviour (Elliott et al., 2004). Thus, not surprisingly it has been used by several researchers as a framework to explore the relationship between attitudes and speed choice. It may be recalled that the theory specifies attitudes to the behaviour, subjective norms regarding it (i.e. perceived social pressure) and perceived control over the behaviour (i.e. beliefs about the availability of opportunities and resources to perform the behaviour) as determinants of behavioural intention and thus behaviour. Although not a test of the theory as such, studies typically measure the statistical associations between each of the determining variables (operationalised through various questions, depending on the study) and behavioural intention, and sometimes self-reported or actual behaviour.

Parker (1997) measured the speeds of individual drivers on roads which included 30, 40 and 60 mph sections and then obtained measures of the TPB variables relating to speeding behaviour through in-home interview. It was found that the TPB variables accounted for only about 10% of the variance in observed driving speeds. The only significant independent predictor of observed speed was intention. In another study which measured actual speeding behaviour, Wallén Warner and Åberg (2005) found that the original TPB model failed to capture what people did. A modified model was able to explain 14% of the variance in behaviour but, ‘contrary to the Theory of Planned Behaviour subjective norm did not turn out to be a significant determinant. Furthermore, self-reported present behaviour, but not perceived behavioural control, contributed to the prediction of drivers’ everyday speeding behaviour’ (p. 509). Newman et al. (2004) also found in their analysis of factors predicting intentions to speed in a work vehicle as opposed to a private vehicle that subjective norm was not related to speeding intentions. The strongest positive correlation with intentions to speed in both kinds of vehicle was the additional variable of ‘anticipated regret’. This reflects the expected affective consequences of breaking the rules. On this dimension, respondents were more likely to feel guilty about speeding in a work vehicle.

Nevertheless, Elliott et al. (2003a) found that the key intervening variables of TPB can be demonstrated to mediate for the most part the relationships between age and sex and intention to speed, as well as to predict future self-reported speeding.
behaviour in built-up areas (over a three-month period). However, although according to the authors higher socio-economic groups are more likely to report speeding, the TPB components did not capture this. It was also found that the strength of the relationships between perceived behavioural control and intention to speed and speeding behaviour decreased with increasing frequency of prior behaviour.

In a subsequent study, Elliott et al. (2004) prospectively related standard TPB variables concerning avoiding exceeding or exceeding the speed limit over the following week to the proportion of journey distance exceeding the speed limit by at least 10% on different road types in a simulated driving task. Of the TPB variables, the only independent predictor of observed (in simulator) speeding was intention, a result which echoes the earlier finding by Parker (1997). However, attitude, subjective norm and perceived behavioural control were all independent predictors of intention to avoid exceeding the speed limit.

In a further study, Elliott et al. (2005) examined the belief precursors to the TPB components, values and expectancies, and found that their interaction (multiplicative) contributed to a small degree to the prediction of attitudes, subjective norms, perceived control and behavioural intentions. The belief predictors identified are listed in Table 8.3.

<table>
<thead>
<tr>
<th>Table 8.3: Belief predictors (of attitude, subjective norm and perceived control) in intention to comply with speed limits in a built-up area over the next three months. Italicised beliefs work against the intention (adapted from Elliott et al., 2005)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Attitude and intention</strong></td>
</tr>
<tr>
<td>Puts pedestrians at less risk</td>
</tr>
<tr>
<td>Reduces my chances of an accident</td>
</tr>
<tr>
<td><em>Makes it difficult to keep up with traffic</em></td>
</tr>
<tr>
<td>Uses less fuel</td>
</tr>
<tr>
<td>Makes me feel relaxed</td>
</tr>
<tr>
<td>Makes it easier to detect hazards</td>
</tr>
</tbody>
</table>

| **Subjective norm and intention**               |
| Parents/children would want me to keep within the speed limit |
| Spouse/partner would want me to keep within the speed limit |

| **Perceived control and intention**             |
| Late/in a rush                                 |
| Other motorists exceeding the speed limit      |
| Long straight roads                            |

In their review of social cognitive predictors of speeding, Fylan et al. (2006) concluded that the variable of perceived behavioural control was a large and significant predictor of speeding intentions and behaviour. Consistent with their
conclusion is the finding by Horswill and Coster (2002) that drivers of higher performance vehicles drive faster on residential roads with a 30 mph speed limit. The effect appears to be bi-directional: faster drivers prefer to buy higher performance vehicles and higher performance vehicles cause drivers to opt to travel faster. Engine size is also linked to the association between speeding and other measures of dangerous driving (Golias and Karlaftis, 2002).

To summarise, attitudes towards speeding are less negative than towards other types of moving violation and drivers are more permissive in their attitude to speeding at night. In general, more positive attitudes towards speeding under conditions of reduced task demand are associated with higher levels of speeding behaviour. These attitudes help explain the behaviour of ‘default speeders’ (i.e. non-socially deviant speeders) and also the finding in some studies of a lack of relationship between attitudes and collision involvement. Nevertheless, negative attitudes towards obeying traffic rules in general are associated with greater involvement in risky driving behaviour, the violation of traffic rules, near-accidents and crashes.

Elliott et al. (2004) point out that the TPB provides a potentially useful approach for identifying attitudinal variables that may predict speeding behaviour, for explaining the relationships between demographic variables, such as age and sex, and speeding behaviour, and for identifying variables which might be amenable to change through safety interventions. In relation to the first of these, the evidence reviewed here suggests that the only independent predictor of observed speeding, whether on the road or in a driving simulator, appears to be intention, a variable that represents a summary of the individual’s motivation for the behaviour in question. Intention in turn may, depending on the particular study, be associated with particular attitudes, subjective norms and perceived behavioural control.

With regard to the second potential use of the TPB, Elliott et al. (2004) have shown that the TPB variables are more powerful predictors of speeding behaviour than demographic variables, such as age and sex, and thus help translate those variables into theoretically more meaningful (and useful) concepts. However, with regard to the final potential use of the TPB, in identifying targets for remedial or preventative interventions, Elliott et al. conclude, from a review of the literature, that attempts to modify drivers’ attitudes have been found to produce little systematic change in either intentions or behaviour. Although this may be in part due to inadequacies in the design of these attempts, this conclusion is disappointing for the theory, as independent manipulation of TPB variables provides the only true experimental test of the theory.

### 8.4 Personality

In a questionnaire survey of 1,932 adolescent drivers in Norway, Ulleberg and Rundmo (2003) found that a total of 47% of the variance in attitude towards traffic safety was explained by different personality traits and concluded that the effects of
personality on behaviour was not direct but rather mediated by the influence of
personality traits on attitudes. Briem et al. (2002) reported that seven psychological
characteristics predicted accident frequency in the previous three years in their
sample of 257 young drivers. Characteristics included excitement and novelty
seeking, safety motivation and impaired capability.

In a sample of 1,001 drivers from three cities in Turkey, Sümer et al. (2005)
explored the relationship between the ‘Big Five’ personality dimensions of
Openness, Conscientiousness, Extraversion, Agreeableness and Neuroticism (see
Costa and McCrae, 1995) as distal factors and various aberrant driving behaviours
(using a Turkish version of the DBQ) as more proximal factors related to accident
risk. Using structural equation modelling, the results indicated that four of the five
personality factors had clear indirect effects on accident risk. A low level of
Conscientiousness (dependability, responsibility and self-discipline) was associated
most strongly with aberrant driving, which in turn was associated with enhanced
accident risk. This was followed by low levels of Agreeableness (helpfulness, trust),
suggested to be a risk-disposing factor because of its association with socially
deviant behaviour and rule-breaking. Finally, both Extraversion (warmth,
excitement-seeking) and Neuroticism (negative affect, anxiety) were found to have
weak but positive effects on aberrant driving behaviour and indirect effects on risk.
It was suggested that the more extraverted and neurotic drivers may be particularly
at risk when they fail to control thrill-seeking motives or drive under stress.

In a rare prospective study of a sample of 500 drivers, Norris et al. (2000) found that
having a prior accident increased the risk for a subsequent accident by 103%. This is
consistent with the proposition that certain drivers are more at risk than others.
Dunbar (1966) refers to ‘a “rebel” type, as an accident-susceptible individual
characterised by pronounced impulsivity, reduced self-control, adventure-seeking
survey of 305 older drivers (aged 57–87 years) in the state of Alabama found an
association between impulsivity and the violation of traffic laws, as well as the
commission of driving manoeuvre errors (Owsley et al., 2003). Violations were
based on a modified version of the DBQ and included items related to chasing other
vehicles, racing them and deliberate disregard of speed limits. Begg and Langley
(2004) found that drivers who persisted with fast driving for thrills and exceeding
the speed limit by more than 20 km/h at age 26 years were typified by low scores in
self-control, harm avoidance and traditionalism at age 18 years, as well as a
disposition to aggressive behaviour, as measured on a self-report delinquency scale.
The relationship between self-control and driving violations was also identified by
Castella and Perez (2004). They measured ‘sensitivity to reward’ which is ‘related to
the absence of inhibition in conduct and awareness of the signals of reward’. Scores
on this measure were significantly correlated with self-reports of the frequency of
committing driving violations in both male and female drivers.
Using video sequences of potential hazards and a measure of the latest point at which drivers were prepared to take avoiding action, Arendasy et al. (2005) claim to have identified a one-dimensional latent personality trait, which can be interpreted as ‘subjectively accepted amount of risk’.

8.4.1 Sensation seeking

Sensation seeking is a trait defined in part by the seeking of intense sensations and the willingness to take physical, social, legal and financial risks for the sake of such experiences (Zuckerman, 1994). Scores on Zuckerman’s Sensation Seeking Scale strongly predict self-reported preferred driving speed (Sümer, 2003; Jonah et al., 2001) and a measure of sensation seeking (unspecified) was found to be significantly related to speed choice in a simulated driving task (McKenna, 2004) and in response to static photographs of roads (Goldenblend et al., 2006); to self-reported risk taking in traffic (Ulleberg and Rundmo, 2003); to higher preferred speeds on motorways, country lanes and the high street (Burgess, 1998); to degree of speeding over the limit (McKenna, 2005); and to loss of control and collision involvement (Stradling et al., 2004). Drivers who score relatively highly on Zuckerman’s Sensation Seeking Scale are more likely to receive higher scores for risky driving (Dahlen et al., 2005), commit driving violations (Trimpop and Kirkcaldy, 1997; Arnett et al., 1997; Burgess, 1998; Castella and Perez, 2004 (using a measure of tolerance of monotony)) and to crash (Jonah, 1997; Lawton and Parker, 1998). Of the 40 studies reviewed by Jonah (1997), only four did not find a significant positive relationship between sensation seeking and some aspect of risky driving, a relationship which has been observed among drivers in the UK, Finland, the Netherlands, Norway, Sweden, Canada and the United States. High sensation-seekers are also more likely to be young males (Stradling et al., 2004), to report aggressive driving habits (Jonah et al., 2001) and to score higher on a measure of aggressiveness (Arnett et al., 1997). Consistent with this is the finding by Lajunen and Summala (1997) that both sensation seeking and driving aggression are negatively associated with degree of safety orientation in young male conscripts and the finding by Schwebel et al. (2006) that sensation seeking, anger/hostility and low conscientiousness each independently predicted risky driving, as measured through both self-report and more directly in a virtual driving task (see below for specific review of roles of anger and aggression).

Joyriding involves the dangerous driving of stolen cars. Kellett and Gross (2006) interviewed 54 male joyriders aged between 15 and 21 years who were in custody in the UK. The main motivation for the behaviour seemed to be mood modification. They engaged in the behaviour for the thrill of it and for some it seemed to have become almost addictive.

High sensation-seekers are clearly opting for a higher level of task difficulty or risk threshold than other drivers. They are also less likely to take account of impaired capability in managing task difficulty. In a simulator study, high sensation-seekers
who thought they had been drinking alcohol took more risks compared with those who thought they had not. The opposite was the case with low sensation-seekers who reduced task demands when they thought they had been drinking (McMillen et al., 1989). Thus in terms of exposure to risk, the sensation seeker is perhaps doubly disadvantaged; on the one hand disposed to seek the thrill of operating close to the threshold where the level of task demand meets the upper level of capability, and at the same time making no adjustment in task demand to compensate for impaired capability. High sensation-seekers perceive less danger in risky driving behaviour (Jonah, 1997).

8.4.2 Trait anger and aggression

Trait driving anger refers to a distal predisposition and may be distinguished from state driving anger which refers to a proximal condition. According to Deffenbacher et al. (2003), trait driving anger ‘refers to a person’s general propensity to become angered frequently and intensely when driving’, whereas state driving anger ‘describes angry emotional and physiological arousal stemming from a specific driving event’ (p. 702). These two are not independent, however, as not surprisingly high trait anger drivers report significantly more anger (2.4 times) in normal traffic, when stuck in rush hour traffic and when yelled at by another driver (Deffenbacher et al., 2003). In three-day driving logs, they also reported more frequent and intense anger, and engaged in more aggressive and risky driving behaviour. These same authors also found that in a driving simulation task, high trait anger drivers reported greater state anger and verbal and physical aggressive tendencies when in a ‘high impedance’ situation (i.e. delayed progress). They concluded that it appears that a person’s disposition to anger interacts with sources of provocation on the road, with high trait anger drivers becoming more angry and responding more aggressively than low trait anger drivers. With regard to inappropriate high speed, a significantly greater proportion of them drove more than 10 mph over the limit (40% versus 10%) and averaged over 20 mph over the limit (12% versus 0%). Consistent with these findings, self-ratings of aggressive tendencies are positively correlated with driving speed (Arnett et al., 1997; Sümër, 2003).

Norris et al. (2000) found that high hostility coupled with low self-esteem increased the odds of being involved in a motor vehicle accident by 53%. However, Gidron et al. (2003) have shown that the relationship between hostility and dangerous driving behaviour and accidents is attenuated in drivers who score higher on a measure of internal locus of control, although they caution that this relationship may not necessarily be causal.

In a study aimed at identifying subtypes of young drivers in a sample of 2,498 respondents, Ulleberg (2002) identified two high risk threshold groups, characterised by high scores on sensation seeking, driving anger and aggression, and low scores on altruism. Both groups had a high risk driving style and risk-taking attitudes, and reported a relatively high accident involvement. High risk driving
style was based on three scales measuring speeding, rule violations and self-assertive behaviour in traffic. The two groups were differentiated on the dimension of anxiety, with the high anxiety group having a relatively high perceived risk of injury and low confidence in their own skills.

Ward et al. (1998) also identified a younger group of drivers who had a greater propensity for becoming angry and violent in the traffic context, and were more inclined to express aggressive attitudes towards driving in general, endorsing views such as ‘It’s important to show other drivers they can’t take advantage of you’.

In an experimental on-road study, Liu and Lee (2005) found that aggressive drivers drove faster and braked later than non-aggressive drivers (independent of car-phone use). Comparing high- with low-speeding violators, McKenna (2005) similarly found that those who tended to choose higher speeds were more aggressive. They were also more inclined to use their vehicle as an emotional outlet and to be less attentive while driving.

8.4.3 Driving style

It may be recalled in the discussion of young male driver characteristics that Musselwhite (2006) identified a high risk threshold group of drivers. These drivers share similarities with Ulleberg’s low anxiety, high risk threshold group. The contrasting group in Musselwhite’s study were labelled ‘unintended risk takers’ who were characterised by a relatively low frequency of unsafe behaviours, consistent with sustaining a relatively low risk threshold. These drivers were the most likely to reduce their speed if they realised they were travelling faster than they thought they were and were least likely to change their behaviour when there was a motive to raise their risk threshold (such as when in a hurry). This group had slightly more females (53%) than males but was the oldest of the four groups, with mean age of 41.9 years. The group comprised 38.7% of the total sample. Lawton et al. (1997) found a similar group of low risk threshold drivers who reported that they never or rarely intended to speed in any of five scenarios differing in road type. These drivers tended to be older and were more likely to be female, although this difference was not statistically significant. Lajunen et al. (1998) and Ulleberg (2002) also found a low risk threshold group with safer attitudes and driving style. They tended to be higher on anxiety but low on sensation seeking, anger and aggression.

The remaining two groups identified by Musselwhite were labelled ‘reactive risk takers’ and ‘calculated risk takers’, each group comprising about 23% of the total sample of drivers. The former were, in many respects, like the high risk threshold drivers in responding to motives to drive faster (e.g. drive faster when in a hurry and to increase the gap if a car was close behind) and, in particular, they were also likely to exceed the 30 mph limit when feeling angry, annoyed or irritated (see Section 9.1 on anger). Unlike the high risk threshold group, however, they did not drive faster than 30 mph when it felt unsafe, neither did they engage in dangerous overtaking or
use other lanes to get ahead. This group was mainly female (73%). In contrast, the ‘calculated risk takers’, who were mainly male (69%), did not let negative feelings affect their speed or raise their risk thresholds when late. Nevertheless, they were quite likely to use a different lane from other traffic going in the same direction to avoid being held up and to go faster than the 30 mph limit if it felt safe. We might aptly describe this group of drivers as ‘opportunistic’. This group is rather like one identified by Larsen (1995). He found that drivers who were observed to drive faster than others report that they often exceeded speed limits, felt uncomfortable driving behind a speed-compliant vehicle through a town or one that was going slower than themselves, and regarded it as more important to adjust their speed to that of faster others or to the physical road environment than to comply with the speed limit. Thus they tended not to check their speed on their speedometers, which they saw as a distraction from their attention to other road users. They considered speed limits should be higher, especially on major urban roads, and saw no special importance for safety to exceed the limit by 15 km/h.

It is tempting to consider that there may be a link between types of driver as identified by Musselwhite (2006) and the different responses to speed cameras, as described by Corbett and Simon (1999) and discussed earlier. **Defiers** and **conformers** look very much like high and low risk threshold drivers respectively, and the **manipulators** look very much like the opportunistic drivers. However, the link between the **deterred** group and Musselwhite’s categories is perhaps not quite so clear.

This whole matter of driver types and their associated characteristics is clearly an empirical issue which merits further research, not only for our basic understanding of driver behaviour but also to inform the development of interventions tailored to possible individual differences. Such individual differences can emerge very early on in driving. Groeger (2001) reported an exploratory study which showed that, even among L-drivers, level of speed choice was stable over time (sampled over several months up to taking the driving test) and quite consistent across different speed zones (30 and 15 mph).

What emerges from this review of recent work relating personality variables to driver speed choice are profiles of different types of driver, characterised by different driving styles. We should of course continue to be wary of extrapolating from aggregated data to individuals and recognise that there is some considerable degree of overlap between the ratings of the different groups identified, for example, by Musselwhite. We should also note that Musselwhite’s groupings are not independent of the age or sex category of group members. Nevertheless, this study, and the evidence relating to personality variables, have important implications for the task-difficulty homeostasis analysis. It appears that there is one group of drivers who drive more-or-less continuously with a high risk threshold relative to others. Such drivers are impulsive, have reduced self-control, are relatively poorly socialised, seek intense sensations, are willing to take risks, perceive less danger in
risk-taking, experience more anger while driving and exhibit more aggression. They are prone to excessive speeding and other moving violations, and have a higher crash rate. In contrast, a second group sustain a low risk threshold and do not allow motives that might raise it (such as being in a hurry) to influence them. They also actively comply with the speed limit. On the other hand, a third identified group are prepared to increase their speed as task demand decreases, even if this means going over the speed limit (opportunistic drivers). Nevertheless, they too do not allow motives that might raise risk threshold (such as being in a hurry) to influence them. Finally there is a group who do allow feelings to influence speed choice and who are prepared to raise the difficulty level if they are in a hurry or to escape a close-follower (reactive risk takers). However, this group is also sensitive to feelings of risk and avoids exceeding their risk threshold if possible.
9 INFLUENCES ON THE DRIVER’S RISK THRESHOLD: PROXIMAL FACTORS

Both the Task-Capability Interface (TCI) model and Summala’s Zero Risk theory (e.g. Summala, 1997) identify the importance of motivational conditions which may raise the risk threshold of the driver (called ‘extra motives’ in Summala’s theory), leading to the conclusion in the review by Rothengatter (2002) that external motives can influence a driver’s willingness to take risks and that, as a result, their behaviour may become less adaptive to prevailing road and traffic conditions.

9.1 Anger

In a representative sample of US drivers, self-reported levels of angry/threatening driving behaviour were significantly associated with habitually exceeding the speed limit, receipt of moving-violation tickets in the previous year and crash experience (Wells-Parker et al., 2002). Angry/threatening behaviours included speeding past others to express displeasure, preventing others from entering a lane or from overtaking, chasing another driver or making a sudden threatening move, tailgating and trying to cut another car off the road. These results were independent of gender, age, driving frequency, annual miles driven and level of verbal expression of anger. Mesken et al. (2002) found that speeding violations were reliably associated \( r = 0.58 \) with measures of interpersonal aggression on the roadway. These included overtaking on the inside, pushing in at the last minute and giving chase when angry.

Arnett et al. (1997) found that in their sample of 17–18-year-old drivers (who kept a driving log for 10 days) that they exceeded the speed limit to a greater degree when angry than when they were experiencing any other emotion. McKenna (2005) found that drivers who had broken the speed limit by a large margin were significantly more annoyed prior to the violation than were other speeders. Speeding violations were also associated with the frequency of errors and lapses while driving. In their questionnaire study of 1,356 adolescent drivers (mainly aged 18 or 19 years), Oltedal and Rundmo (2006) found that irritability explained a significant part (10%) of the variance in risky driving. In a sample of mainly female young drivers, Dahlen et al. (2005) found links between a self-report measure of risky driving, which included speeding, and self-reported feelings of anger (and impulsiveness) while driving. However, the links were relatively weak and angry driving was not associated in this study with accident history.

Chapman et al. (2004) studied 100 drivers who kept a tape-recorded log of their car journey experiences over a period of two weeks. Participants reported feeling anger on 21.5% of their journeys and that these feelings of anger caused them to commit aggressive acts on 17% of occasions (since this reporting was spontaneous, it may
be an underestimate). Of 65 aggressive acts, 20 involved speeding, 6 tailgating, 5 aggressive overtaking and 2 involved chasing other vehicles. Ward et al. (1998), however, point out that anger does not necessarily lead to aggression and aggressive driving. In their study of 362 drivers (mean age 44.7 years) in Northamptonshire, using a range of self-report measures, they found reported levels of anger for different traffic events accounted for less than 20% of the reported level of violence exhibited (which may relate to the distinction between ‘angry’ aggression and ‘instrumental’ aggression – see, for example, Sternberg (2004), p. 523). Indeed the self-reported levels of violence in traffic were very low and primarily intended to communicate anger.

Thus feelings of anger may be associated with speeding. When anger is translated into aggressive driving, this may not only include excessive speed but interpersonal aggression, including chasing and speeding past the driver who was the source of the provocation. A state of anger appears to motivate an increase in the level of the driver’s risk threshold or reduce the driver’s sensitivity to it (or perhaps both at the same time). In a laboratory experiment which evaluated the effects of induced emotion on risky choices to win money, Fessler et al. (2004) found that anger increased risk taking in men (but not women).

9.2 Control motivation

Transient motivational states can affect driver decision-making and one such state is the driver’s control motivation – the motivation to control driving task difficulty. In a laboratory study, Delhomme and Meyer (1998) showed that previous experience of failure at a problem-solving task (non-driving related) can lead to stronger decelerations in relation to speed choice for upcoming intersections in static images of road scenes. The effect was stronger in more experienced novice drivers. The authors suggested that the intervening variable mediating this relationship was ‘control motivation’, being stimulated in drivers who had just experienced a failure of control. Although this study has somewhat questionable ecological validity, the implication is that low control motivation could lead to higher speeds.

Control can be transferred from the driver to, for example, an ISA (Intelligent Speed Adaptation) system which actively prevents the driver from exceeding the speed limit and we might expect some drivers to be more reluctant than others to do this. In an admittedly small sample of drivers ($n = 8$), Jamson (2006) found that, under optional conditions, drivers used the ISA system only about 50% of the time and that drivers who enjoyed speeding were less likely to use the ISA system. Contrary to the study by Delhomme and Meyer (1998), this result suggests that drivers with a higher motivation for control may prefer higher speeds.
9.3 Time saving

When instructed to drive under time pressure on a short journey in a simulator, drivers felt more activation, more aroused and more stress – and drove faster – than drivers instructed to ‘drive as they normally would’ (Oliveras et al., 2002). The motivational importance of trip duration is demonstrated in an analysis of self reports of trade-off of different levels of decreased risk for additional trip time in hypothetical scenarios by Yannis et al. (2005). They found that the disposition to opt for higher levels of safety depended on the cost in terms of the absolute amount of additional trip time, independent of the length of the journey. Furthermore, Fylan et al. (2006) point out that the perceived benefits of speeding (e.g. shorter journey time) may be as important in determining intentions and behaviour as the associated risks, if not more so.

Only 4.4% of drivers report that they are never in a hurry to get somewhere and 5.4% report that they are always in a hurry (Musselwhite, 2006). The unweighted mean rating for being in a hurry in a sample of 1,655 drivers is 4.45 on a scale from 1 = never to 7 = always. The important point for our purposes, however, is that, compared with normal, when in a hurry, drivers are significantly more likely to use fast acceleration and hard braking, and overtake dangerously. Unweighted mean ratings of speed-related behaviours associated with being late are rank ordered in Table 9.1.

<table>
<thead>
<tr>
<th>Order</th>
<th>Speed-related behaviour</th>
<th>Unweighted mean (1 = never, 7 = always)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Use other lanes to get ahead</td>
<td>5.17</td>
</tr>
<tr>
<td>2</td>
<td>Use faster accelerating and heavy braking</td>
<td>4.77</td>
</tr>
<tr>
<td>3</td>
<td>Go faster than 30 mph limit</td>
<td>4.73</td>
</tr>
<tr>
<td>4</td>
<td>Tailgate</td>
<td>4.05</td>
</tr>
<tr>
<td>5</td>
<td>Overtake dangerously</td>
<td>3.33</td>
</tr>
</tbody>
</table>

In a recent survey of 619 long-haul truck drivers in five Australian states (NTC, 2006), it was found that a quarter of drivers reported that they frequently experienced pressure to drive over the speed limit to meet deadlines. The situations most likely to trigger speeding were running late, low levels of task difficulty at the speed limit (and low likelihood of getting caught for speeding under those circumstances) and keeping up with traffic flow (this latter finding might help explain why there is such a high incidence of HGV drivers exceeding their lower legal limits on dual and single carriageways – see Figure 4.1).

Adams-Guppy and Guppy (1995) questioned 572 British company car drivers and found that around 20% agreed with the statement that it was important to be punctual for appointments, even if it meant breaking the speed limit. This variable
accounted for 13% of the variance in reported speeding behaviour. Stradling et al. (2003), Campbell and Stradling (2003) and Stradling (2004) found, on the basis of in-home interviews of quota samples of drivers in Scotland, that the most prevalent reason given for driving faster than usual was ‘when late for a meeting or appointment’ (52–58%). The percentages for ‘when the traffic ahead is moving faster than you normally drive’ and for ‘when feeling stressed’ were 27–30% and 20–21% respectively. Interestingly, 19–23% said they would drive slower than usual when feeling stressed. Younger drivers (17–44 years) were more likely to drive faster when late for a meeting or when the weather was hot. The youngest drivers (17–24 years) were least likely to slow their speed when driving in rain. Eighty per cent of 17–20-year-old males said they would drive faster if running behind schedule. Those males who were more likely to report driving faster when running behind schedule or late for an appointment were more likely to have been accident involved in the previous three years. Silcock et al. (2000) found that ‘being in a hurry’ was one of the eight most common reasons given by UK drivers for speeding. McKenna (2004) reported that a considerable proportion of a sample of 440 drivers caught speeding indicated that time pressure had played some role in their speed choice. In a subsequent study of 9,470 speeders (McKenna, 2005), 33% indicated that time pressure at the time of their speeding offence was ‘quite’ to ‘very’ important, and those who had broken the limit by a large margin reported more time pressure.

In summary, recent evidence suggests that both the driver’s emotional state and motivation to save time can influence speed choice, although the role of control motivation remains unclear. Feelings of anger are associated with aggressive driving, speeding, penalties for speeding violations and crash experience. Referring to the earlier discussion of the implications of the somatic marker hypothesis for speed choice, it may be that feelings of anger during driving swamp risk feelings arising from potential threatening elements in the road and traffic environment, disposing the driver to underestimate the difficulty of the driving task. This, in turn, could provoke the driver into driving faster to bring task difficulty back up to the preferred level.

Being in a hurry is not an unusual state and many drivers report driving faster when late for an appointment or meeting. Thus, not surprisingly, being in a hurry is associated with speeding, faster acceleration, hard braking, dangerous overtaking and tailgating. Male drivers who report driving faster when late are more likely to have had an accident in the recent past.
10 POWERED TWO-WHEELERS

In 2003, powered two-wheelers (PTWs) travelled about 5.6 billion vehicle kilometres in the UK with their riders having a relative risk of a KSI (killed or seriously injured outcome) accident nearly 50 times higher than that for car drivers (Broughton and Stradling, 2005). An analysis of the data for Scotland (Sexton et al., 2004) indicates that the majority of PTW KSI accidents occur in non-built-up areas, mainly involving bikes with an engine capacity of 500cc or above and loss of control on single-carriageway roads with a 60 mph speed limit.

10.1 Speeding behaviour of motorcyclists in Great Britain

Between 2002 and 2005 the proportion of motorcyclists exceeding the speed limit by more than 10 mph on motorways has remained within the range 27–28% on dual-carriageways within the range 21–25% (with a declining trend reversed in 2005), and on single-carriageways (non-built-up) within the range 9–11% (Department for Transport, 2006). As mentioned in the earlier discussion of the incidence of speeding (see Section 4), these values are all substantially higher than the equivalent values for car drivers.

In built-up areas, between 2002 and 2005, the proportion of motorcyclists exceeding the speed limit by 5 mph or more on 40 mph roads ranged between 17% and 22% (with a declining trend) and on 30 mph roads within the range 24% to 29% (Department for Transport, 2006). Again, these values are higher than the equivalent values for car drivers, although not substantially so on 30 mph limit roads (e.g. in 2005 the values for motorcycles and cars exceeding the 30 mph limit by 5 mph or more were respectively 26% and 21%). Nevertheless, analysis of the ratios of ‘excessive’ to ‘slight’ speeders shows clearly that if a motorcyclist is speeding he or she is more likely than a car driver to be speeding ‘excessively’.

10.2 The relationship between motorcycle speed and accidents

In order to better understand the nature and causes of PTW accidents, the Association of European Motorcycle Manufacturers (ACEM), with the support of the European Commission and other partners, conducted an extensive in-depth study of 921 motorcycle and moped accidents during the period 1999–2000 in five European countries: France, Germany, the Netherlands, Spain and Italy (MAIDS, 2004). Travelling and impact speeds for all PTW categories were found to be quite low, most often below 50 km/h. There were relatively few cases in which excess speed was related to accident causation. Only 6% of all accidents were reported to have had a travelling speed of 100 km/h or more, although 21% of single-vehicle accidents were associated with such high speeds. The most frequent contributing factor was a failure to see the PTW within the traffic environment due to a lack of driver attention, temporary view obstructions or the low conspicuity of the PTW.
Clarke et al. (2004) examined 1,790 motorcycle accident files from UK Midland police forces and found that only about 2% were the result of the motorcyclist speeding. Inappropriate speed for the conditions accounted for 5.6% of accidents where the speed limit was not broken. Over 15% of cases involved loss of control on a bend. Such accidents are one-and-a-half times more likely to cause serious injuries and more than twice as likely to cause the death of the rider or pillion passenger, compared with the accident sample as a whole. Loss of control on a bend is the most common cause of a motorcycle single-vehicle accident and is associated with an inappropriately high speed, use of ‘super-sport’ bikes, riding for pleasure in groups and inexperience. Twenty per cent of accidents (where some blame is attributable to the rider) in the 16–20-year-old age range and nearly a third of accidents in the 31–35-year-old age range involve going out of control on a bend. The accident database shows a steady reduction in the number of accidents as the age of riders increases beyond 35 years.

In an analysis of 6,348 crashed motorcyclists in France, de Lapparent (2006) found that motorcycling during the night increases significantly the average probability of a severe or fatal crash, a vulnerability which he suggests might be related to higher speeds on relatively empty roads.

10.3 Self-reports of rider attitudes and behaviour

Of a questionnaire sample of 247 riders, who were members of the Motorcycle Action Group, 58% admitted to ‘always’ or ‘frequently’ breaking the speed limit (Clarke et al., 2004). The remaining respondents admitted to ‘occasionally’ breaking the limit when they thought it was safe to do so. Nevertheless, a quarter of respondents thought a major cause of motorcycle accidents was motorcyclists riding too fast for the conditions. Thus, as pointed out by the authors, riders seem to be making a clear distinction between breaking the speed limit on the one hand and riding at speeds that are too fast for conditions on the other. This is precisely the point made earlier in the discussion of speed limit compliance (see Section 8.2.2), namely that breaking the speed limit need not necessarily have implications for road-user safety. Despite being at odds with the law, the rider’s speed may still maintain risk threshold at a ‘normal’ level and leave an adequate safety margin between task demand and rider capability.

Elliott et al. (2003b) surveyed 8,666 randomly selected GB motorcyclists (mean age 43 years, 92% male) to explore the frequency of self-reported errors and violations, and the relationship between these behaviours and accident involvement. Six per cent reported being involved in an accident in the previous 12 months, in which they were at least partly to blame. Higher mileage, younger age and shorter experience were all found to be significant ‘predictors’ of blame-accident involvement. Independently of these demographic variables, errors (essentially failures of attention) and high speed behaviour (in contrast to the research cited above) were both significantly related to involvement. Baughan et al. (2004) also found from a
survey of 11,360 GB motorcyclists randomly selected from the Driver and Vehicle Licensing Authority (DVLA) database, that a liking for speed and a self-reported ‘risky riding style’ were associated with behavioural errors and these in turn were associated with the amount of accident involvement.

‘Inattentive blindness’ research in the laboratory suggests that when engaged in an attention-demanding task, some participants fail to notice otherwise obvious objects in front of their eyes (Simons and Chabris, 1999). The strength of this effect is related to the difficulty of the task. If these findings can be generalised to the ‘real world’, they imply that riders may be more likely to miss noticing events in front of them under conditions of high task difficulty, such as when riding fast. Inattentive blindness is also particularly strong for unexpected objects (Most et al., 2005) and this perhaps implies that riders with undeveloped expectations (such as relatively inexperienced riders), or highly developed expectations which are confounded (such as in very experienced riders), may be more disposed to inattentive blindness. This strand of research provides a laboratory analogue of real-world observations of links between errors of attention and high speed, as reported, for example, by Elliott et al. (2003b). Similar conditions in other road users, such as car drivers, may also induce inattentive blindness and make PTW riders more difficult to detect. Interestingly, it is clear from the laboratory studies of the phenomenon that some participants are more prone to the effect than others. The investigation of such individual differences (which seem to have been ignored to date) and their implications for driver safety would seem warranted.

Jamson (2004) carried out a further questionnaire survey of 4,304 male and 437 female motorcyclists in Great Britain which examined self-reported intentions to speed and motivations for speeding (as well as other rider behaviours not of relevance to this review). Participants were presented with three scenarios which related to excessive speed and asked about their intentions to speed in each scenario and about the ‘standard’ Theory of Planned Behaviour (TPB) variables of attitudes, perceived social pressures and perceived behavioural control. The different scenarios gave similar results. Taking the motorway scenario as an example, 42.5% of riders expressed an intention to speed. On average these riders were younger, had engaged in more speeding in the past, possessed a positive attitude towards speeding (including exhilaration and the ability to beat the surrounding traffic), did not see it as morally wrong or feel pressure from others not to speed and tended not to see themselves as ‘safe’ riders. Nevertheless, compared with the non-intenders, they did not associate speeding with feelings of anxiety or an increase in accident risk – they were more likely to intend to speed when conditions were conducive, such as on dry days, good roads and when traffic was light.

10.4 Riding style

Broughton and Stradling (2005) explored the relationship between feelings of risk and enjoyment by getting PTW riders to rate scenes of various road conditions.
They identified three types of rider risk profiles as ‘risk averse’ (enjoyment and perceived risk are negatively correlated), ‘risk seekers’ (enjoyment and perceived risk are positively correlated) and ‘risk acceptors’ (inverted U-shaped relationship between enjoyment and perceived risk). These rider types appear somewhat equivalent to the categories of car driver identified by Musselwhite (2006), which were respectively, in our terms, low risk threshold, high risk threshold and opportunistic groups (i.e. his ‘unintended risk takers’, ‘continuous risk takers’ and ‘calculated risk takers’).

Horswill and Helman (2003) explored the question as to whether or not it was motorcyclists’ own behaviour that contributed to their inflated accident risk relative to car drivers, independent of demographic factors (compared with the age and sex profile of car drivers, motorcyclists are more likely to be young and male). Using various simulation tasks, they found that motorcyclists travelled faster, pulled out into smaller gaps and overtook more often than matched car drivers, but also more often than a group of motorcyclists who were asked to imagine that they were driving their usual car. Unobtrusive roadside observation of speeds of motorcycles and cars confirmed the simulator findings. The authors concluded that the effects were mainly the result of being on a motorcycle, rather than being a characteristic of a motorcyclist: motorcyclists do not appear to be a unique group of people that differ from the general driving population in terms of the risk measures assessed.

However, just as has been shown with car drivers (Moller, 2004), there appears to be a subculture of young PTW users who exhibit risky riding (especially high speed). A study of 14–17-year-old Italian adolescents showed that this behaviour was associated with other risk-taking behaviour (e.g. risky sports) and anti-social behaviour (e.g. aggression, theft, vandalism, lying and disobedience), especially for boys. This profile was situated in an adolescent subculture of aimless ‘hanging about’ and riding for fun (Bina et al., 2006). The authors concluded that the high risk behaviour on the road may serve developmental needs of identifying with adulthood, demonstration of mastery, and enhancement of self-esteem and status.

Thus, although proportionately more motorcyclists exceed the speed limit than car drivers, excessive speed does not appear to be a major cause of motorcycle accidents. What seems to be much more relevant is inappropriate high speed (IHS) for conditions, leading to loss of control, such as on a bend. Just as with car drivers, a lack of experience can reduce capability and motivation for speed can increase task demand, increasing the difficulty of the task and shrinking the safety margin. There is also some evidence (at least from abroad) of an adolescent riding subculture which reinforces high risk behaviour.
11 INAPPROPRIATE HIGH SPEED: VULNERABLE GROUPS AND SITUATIONAL DETERMINANTS

Evidence over the last 10 years supports the general proposition of the Task-Capability Interface (TCI) model that drivers use speed to maintain task difficulty (the separation between task demand and available capability) within a preferred range in a closed feedback loop. The upper limit of this range is defined as the driver's risk threshold – the point above which risk is felt to be too great. Increases in speed raise task demand and bring the driver closer to his or her risk threshold and, if speed continues to increase, beyond that threshold up to and eventually beyond the limit of capability for dealing with the road and traffic situation.

From this perspective the road safety problem for drivers may be defined in terms of risk thresholds that are too high – too close to the limit of the driver's capability. For most of the time on the roadway, drivers generally select a speed that is appropriate to the conditions, in the sense of enabling maintenance of a safe margin between task demand and capability. However, high risk thresholds may arise because the driver is poorly calibrated, that is the driver underestimates task demand or overestimates capability. Under such conditions the driver's objective risk threshold will be higher than the driver realises.

Young, inexperienced drivers are poorly calibrated in relation to judgements of both task demand and capability, leading to an underestimation of objective task difficulty. This can lead to these drivers adopting speeds that they think are safer than they actually are. Inexperienced drivers also have lower levels of capability simply because they have not yet had the opportunity to learn the less frequently occurring contingencies of the road and traffic environment. Thus, for example, keeping pace with a fast traffic stream may represent a much higher level of task difficulty for the novice. Herein lies an argument to support the notion that inexperienced drivers should be exposed in a graduated way to increases in task demand.

With regard to impaired calibration, most drivers, irrespective of age and experience, are vulnerable to underestimation of task demand (and therefore task difficulty) because of the phenomena of speed adaptation and past reinforcement of unsafe driving behaviour. Both of these processes can lead to drivers adopting speeds which are less safe than they think.

High risk thresholds are associated with particular demographic groups. Young drivers, and especially young male drivers, are more likely to drive with a high risk threshold, represented by speeding and other behaviours, such as tailgating and dangerous overtaking. This pattern is more likely to persist in young adult males.
Loss of control and collisions are more likely to occur for young drivers at night and on weekends. This is, of course, a reflection of exposure, weekend nights being associated with a concentration of social activity. Relatively empty roads reduce apparent task demand and thus encourage increases in speed. This is particularly dangerous where the road design is incompatible with such increases and where there are vulnerable other road users. Driving at night is also associated with factors which impair capability, such as alcohol, drugs, fatigue and drowsiness.

What helps explain these demographic associations is a range of more distal influences on driver speed choice which subsequently influence driver risk threshold. These are:

- the trait of sensation seeking;
- the trait of anger and aggression;
- immaturity, especially with regard to:
  - poor self-control;
  - weak socialisation (general social deviance); and
  - sensitivity to peer-group influence regarding deviant driving behaviour;
- recreational use of the vehicle; and
- expressive use of the vehicle.

Although these influences on speed choice are particularly associated with younger and male drivers in particular, factors such as sensation seeking, aggression, poor self-control and social deviance are also evident in some older drivers. There is converging evidence that driver ‘types’ may be distinguished in terms of their typical risk thresholds, with **high risk threshold**, **low risk threshold**, **opportunistic** and **reactive** types having been tentatively identified.

Potential distal determinants of speed choice and risk threshold are driver attitudes. These are generally congruent with self-reported speeding, other driving violations and with high risk driving behaviours (as well as collision rates). Evidence suggests that attitudes may not necessarily link directly to behaviour, but a relationship is mediated through their influence on behavioural intention.

Because drivers use speed as a means to manage task difficulty, where the speed limit is for a speed lower than the one which would otherwise be chosen, there may be a tension between compliance and what drivers consider to be safe. When considering drivers who speed, the concept of task difficulty homeostasis has enabled a separation between two types of speed violator: **default speeders**, who fail to transfer control from perceived task difficulty to the speed limit, and **socially deviant speeders**, for whom speeding is an expression of a high risk threshold and involves violation for its own sake as part of a socially deviant profile.
The greatest incidence of speeding in Great Britain (i.e. about 50% of drivers) is on motorways and dual carriageways and in 30 mph zones. In 30 mph zones, about one in five drivers exceed the speed limit by more than 5 mph. Owing to the increased likelihood of encounters with pedestrians and cyclists in 30 mph zones, and the sensitivity of these vulnerable road users to vehicle impact speed in the event of a collision, it may be suggested that targeting speeding in these zones should be prioritised. It is also the case that drivers seem most prone to under-report their speeding in these zones, implying that they are speeding without realising it.

Although there has been remarkably little work over the past decade on the effects of human factor variables on driver speed choice (directly or mediated through human factor variable influences on driver capability), proximal factors that have been linked to the choice of higher speeds (and therefore higher risk thresholds) are an emotional state of anger and the motivation to save time. Drivers described as having a ‘reactive’ driving style may be particularly vulnerable to such influences. Some drivers may also be subject to normative pressures to conform to the apparent speed of others. There is evidence that drivers tend to overestimate the degree of speeding in others and this misperception may thus encourage more speeding. It may be particularly useful to increase drivers’ awareness of these human factor influences and of their effects in potentially narrowing safety margins.

Finally, it might be noted that over the period covered by this review, several components identified in the TCI model as having a bearing on driver speed choice appear to have received scant attention. These include effort motivation, the role of education and training, features of road design and vehicle characteristics.
The difficulty of the driving task arises out of the interaction between the demands of the task and the driver’s available capability for that task. Speed directly affects the difficulty of the driving task. For any given road and traffic scenario, the faster one travels the less the available time to take information in, process it, make decisions, execute those decisions and make any necessary error corrections. Increases in task difficulty may be experienced as increases in feelings of risk. This is hardly surprising, given the likely punishing consequences of loss of control of the task. However, this enables us to refer to the upper limit of task difficulty, which a driver is prepared to accept, as the driver’s risk threshold.

Drivers generally choose a speed such that the difficulty of the task falls within the range they are prepared to accept and, in particular, does not exceed their risk threshold. This process is known as task-difficulty homeostasis. Drivers typically vary in their risk thresholds, however. Some are characterised by a low threshold, they tend to comply with speed limits and do not allow momentary influences to raise their risk thresholds. A second group are radically different and characteristically drive with a relatively high risk threshold. Their driving style typically involves not just higher speeds but more extreme speed limit violations and other risky behaviours, such as close-following, dangerous overtaking and aggressive driving. They tend to hold positive attitudes to such behaviours, are prone to sensation seeking, vulnerable to normative influences from their peers and may be part of a driving subculture which uses driving for recreational purposes other than getting from A to B. They are most likely to be young, male and immature. Not surprisingly they are more likely to be convicted for violations and are more likely to be involved in collisions.

Nevertheless, if the driver underestimates driving task demand or overestimates his capability, the objective level of task difficulty will be greater than the driver perceives. The driver will think he or she is in a safer situation than he or she is objectively and will have less of a safety margin than he or she presumes. Such incorrect calibration is most typical of inexperienced drivers and may well account for some of their overrepresentation in collisions. The higher risk experienced is not something that is intentionally sought.

Sometimes the speed a driver chooses in maintaining task-difficulty homeostasis is actually higher than the posted limit. When some drivers detect this, such as the low risk threshold drivers described above, they reduce their speed to comply with the limit. Others may not do this, particularly if enforcement is not in evidence (police presence, safety camera, speed bump). Drivers who behave in this way may be labelled as opportunistic drivers. It is not so much that they are fundamentally motivated in principle to defy regulations, but rather that their speeding is a reflection of the normal process of speed adjustment to conditions. These elicit a
higher speed than the posted limit, but this speed is not corrected downwards in compliance with that limit.

Apart from the basic process of varying speed to maintain task difficulty/feelings of risk within an acceptable range, a driver's choice of speed may also be influenced by other motives. Some of these may be relatively stable characteristics of the individual, such as a disposition for aggressive behaviour, the desire to experience strong sensations or the desire to transgress authority and social conventions, as found in many of the high risk threshold group. Others motives may be more acute, such as a desire to make up for lost time, to get home as quickly as possible or to beat a target journey time. Or they may relate to temporary mood states, such as a fleeting feeling of anger. Drivers who are influenced by their emotional state to drive faster than they would otherwise do may be described as reactive.

The important point is that motivational influences which raise speed simultaneously raise the difficulty of the driving task, raise the driver's risk threshold and reduce the driver's safety margin.

From the perspective of where to focus interventions to reduce the prevalence of inappropriate high speed (IHS), it is clear that there are particular target groups and particular target situations. One target group is that of inexperienced drivers who are poorly calibrated. They need to develop more reliable perceptions of their own capability and of the changing demands of the driving task. A second group are high risk threshold drivers. These are most likely to be young and male. They will only become safer drivers if they lower their risk thresholds when engaging with the road and traffic system. A third group are those reactive drivers who characteristically allow their mood state to raise their speed choice. There is some evidence that female drivers are overrepresented in this group.

Particular target situations are those involving motives for time saving, such as when trying to get to a destination in a shorter time, and those in which drivers allow their mood state to increase their speed. The mood state which most typically promotes this is a feeling of anger.


