SWOV Fact sheet

Speed choice: the influence of human, vehicle, and road

Summary
On average, about 40-50% of all drivers exceed the speed limit nowadays in the Netherlands. Drivers often deliberately choose a speed that is too high. Factors that play a role are haste, pleasure, or adapting to other traffic. However, driving too fast sometimes also happens unintentionally. Subjective speed perception is important here, in this case underestimation of one's driving speed. This happens, for example, if one has driven fast for a long time, or if there are no buildings or trees along the roadside as a reference for the speed driven. The nowadays quiet and comfortable cars and particular road features can also unintentionally lead to higher speeds than desired. Intentional and unintentional speeding offences can be prevented by an appropriate road layout, credible speed limits, and enforcement.

Background
Speeding lies at the heart of the road safety problem. A higher speed increases the probability of a crash happening and also leads to crashes being more serious (see the fact sheet *The relation between speed and crashes*). It has been estimated that too high a speed is involved in one in three of all fatal crashes (OECD/ECMT, 2006). And SWOV has calculated that, in the Netherlands, 25-30% fewer people would be injured if everybody were to obey the speed limit (Oei, 2001). At the moment this is certainly not the case. Although there are large differences between roads, it is no exception that 40-50% of all drivers exceed the speed limit (Van Schagen et al., 2004). This fact sheet discusses the factors that influence the speed choice of motorists. We will not be discussing other modes of transport. We also only examine situations in which the motorists really are free to choose, i.e. where a lower speed is not enforced by, for example, speed bumps or other traffic. We will make clear that speed choice is influenced by factors such as personal preferences, social pressure, road features, vehicle features, and all interactions between them.

What do motorists say about their own speed choice?
The majority of Dutch motorists claim that they generally abide by the speed limit (see *Figure 1*). When they do exceed the limit their self-reported reason is that they 'adapt to other traffic'. Other reasons are 'haste', 'pleasure', 'unintended', and 'boredom'.

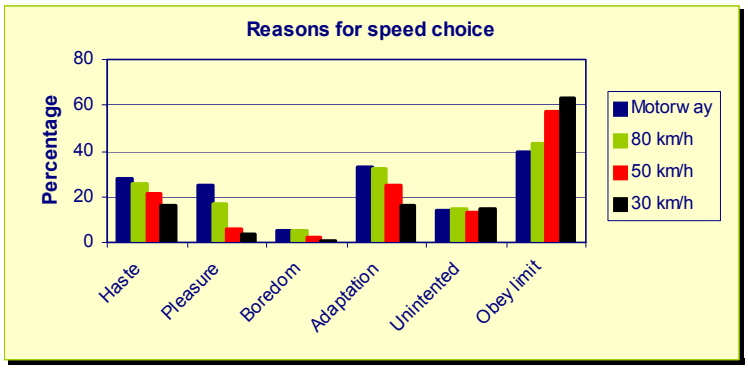

Figure 1. *Source: PROV[1] 2003 (Van der Houwen et al., 2004)*.

According to the PROV results of the 1990-2003 period, the percentage claiming to always obey the speed limit has increased. Also a shift in the reasons for exceeding the limit has occurred. 'Unintended exceeding the limit' and 'adapting speed to other traffic' are now being mentioned less than in the early

[1] The Periodic Regional Road Safety Survey (PROV) is a regularly repeated large-scale written questionnaire among about 8000 motorists in the Netherlands. The last one of which the results are available is the one held in 2003.

1990s. 'Haste' is also mentioned slightly less often. On the other hand, 'pleasure' and 'boredom' are mentioned more often than 10 years ago.

The self-reported reasons for obeying the speed limit are mainly because the limit is obligatory, it's good for safety, and a fine can thus be avoided. The environment and fuel costs are a lot less important (see *Figure 2*).

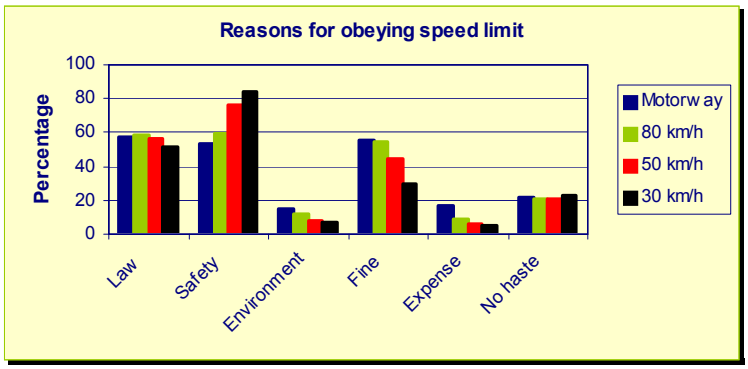

Figure 2. *Source: PROV 2003 (Van der Houwen et al., 2004).*

During the 1990-2003 period, an interesting development in the reasons 'safety' and 'fine' can be seen. In the 1990s motorists obeyed the limit ever more often to avoid a fine, and ever less often because of safety. Since 2000 this seems to have changed (see *Figure 3*).

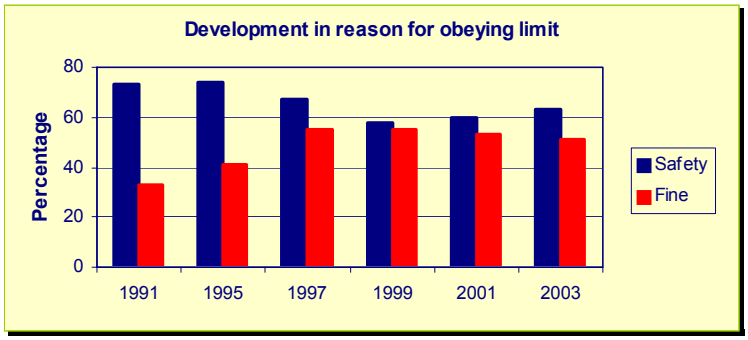

Figure 3. *Source: PROV 2003 (Van der Houwen et al., 2004).*

Which motorists drive faster?

To a large extent, speed choice is individual. Some drivers are inclined to drive faster than others, some obey the limit better than others. Generally speaking, it can be maintained that, on average, men drive faster than women, the young drive faster than the older, and business people drive faster than people driving for private purposes (see for example Van der Houwen et al., 2004).

In addition, a clear relation exists between certain individual characteristics and driving speed. One that has often been shown is the relation between speed choice and sensation seeking, in other words the extent to which someone is generally inclined to take risks and needs changes and new experiences (e.g. Heino et al., 1992). In general, people who have a great need for sensation also want to drive faster (e.g. Goldenbeld et al., 2006). Apart from that, Goldenbeld et al. found that all motorists, young and old, men and women wanted to drive faster than the speed limit that they themselves regarded as being safe. This is probably a confirmation of what has already been shown many times, viz. that motorists think they can drive better and safer than others. They also think that they can safely drive somewhat faster than others.

What influence does the speed limit have?

According to the international survey SARTRE (see Goldenbeld, 2003) 75-80% of Dutch motorists are satisfied with the current general speed limits, with the exception of those on motorways: 50% wants them to be higher. However, being satisfied with the limit does not always mean that one obeys it. One reason for this is motorists don't always know the speed limit on any given road (Hendriks, 2005). This

has led the Royal Dutch Tourist Club ANWB to argue for better information about the speed limit that applies. Another reason is that motorists are only influenced by the speed limit to a limited extent. Lowering the limit (e.g. by 20 km/h) only leads to a quarter of the effect intended (i.e. an average speed of only 5 km/h lower), at least if no other additional measures are taken (Finch, 1994; OECD/ECMT, 2006).

What influence does social pressure have?
Other traffic and car passengers also influence speed behaviour. As already indicated, adapting to other traffic is an important self-reported reason for exceeding the speed limit. Empirical data confirms that motorists let their speed choice be strongly influenced by how fast they think others are driving (Haglund & Åberg, 2000). Haglund & Åberg also found that motorists generally overestimate the speed of others. This causes a snowball which makes them drive even faster; this is also known as the contamination effect of speed (Connolly & Åberg, 1993).

Car passengers have an equivocal influence on the speed choice of motorists. Some motorists drive faster when there's a passenger, others drive slower, and yet others do not drive faster or slower. This has to do with, for example, the age and sex of the motorists, but the age and sex of the passengers also influences driving faster or slower (Reagan & Mitsopoulos, 2003; Engström, 2003). We can roughly say that it's especially the young men with other young male passengers who drive faster. When the passengers are, for example, parents or children or young females, they drive slower. Female and older motorists are either not influenced by passengers, or they slow down.

Why do people sometimes drive too fast unintentionally?
About 15% of motorists said that they sometimes exceed the speed limit unintentionally (see *Figure 1*). This is in spite of all cars having a speedometer that objectively tells you how fast you are driving, whenever you want to know. Many motorists, often unconsciously, are also influenced by the speed they 'experience'. However, this subjective speed perception is not very reliable, but often leads to over- or underestimating the actual speed. Underestimating the actual speed is of course the most dangerous. Studies of subjective speed perception have been carried out since the 1960s and 1970s. Based on these studies, together with more recent overview studies (e.g. ETSC, 1995; Martens et al., 1997; Elliot et al., 2003) we can distinguish four situations that can easily lead to underestimating the driving speed:

1. If a motorist has been driving for a long time at a high speed, e.g. on a motorway, he underestimates his speed more as time goes by and he drives faster without noticing it. Correct use of advanced or ordinary cruise control can prevent this, as can intervening or warning types of Intelligent Speed Assistance (ISA).

2. In transitional situations, i.e. when speed must be reduced considerably, the driver often doesn't take his foot off the pedal as much as he should. For example, this is the case after exiting from a motorway or when driving into an urban area, but also if a long stretch of straight road is followed by a series of bends. Physical speed limiters in these transitional situations, e.g. a roundabout at the end of the motorway exit road, or a narrowing of the road when entering an urban area, can help motorists to adapt their speed better during the following road stretch. A sudden series of bends does not make physical speed limiters desirable; of course warning signs are then a possibility. In Australia in such situations, they have experimented with lateral and longitudinal lines on the road; these work as psychological and not physical limiters (Fildes & Jarvis, 1994). Such lines are also used in the Netherlands near the entrances of an urban area. Assessment studies show that they generally have the desired effect, but there are doubts about how durable this effect is.

3. When there is little peripheral information, e.g. at nighttime, fog, but also on very 'open' roads in flat rural areas, motorists easily underestimate their speed. This is because speed perception is mainly determined by the information that arrives via the peripheral field of vision and less so by information via the central field of vision. Vertical elements in the peripheral field of vision, such as trees and buildings, lead to higher estimated speeds. A general rule is that one chooses a lower speed if the vertical elements are higher than the width of the road (ETSC, 1995).

4. When a car driver is seated at a considerable height above the road surface, he underestimates his speed more often. During the last few years, Sport Utility Vehicles (SUVs) and other jeep-like cars

have become increasingly popular. These vehicles have large wheels whereby speed experience is distorted; one appears to be driving slower. In a driving simulator with no speedometer, subjects drove an average of 7 km/hour faster when driving at the height of a SUV than at the height of a sports car. Two-thirds of the subjects were not aware that at SUV height they drove faster, and some even thought they were driving slower (Rudin-Brown, 2004).

What is the influence of the road and roadside features?

The road features and those of the direct environment also have a clear effect on speed choice. Everybody can recall examples of roads that have a completely different speed limit than you would expect; they almost provoke driving too fast. Objective speed measurements do indeed show large differences between roads. For example, an average of about 45% exceeded the speed limit on 80 km/hour roads in the Province of Zeeland. This was only 5% on some of these roads, but on others it was 60%. Road and road surroundings features that determine or partly determine the speed choice concern the cross section, the alignment, and the direct road environment (Martens et al., 1997; Aarts et al., 2006; Goldenbeld et al., 2006). In general, the relation of speed with these features is as follows:

Cross section

• Number of lanes:	more lanes	→ higher speed
• Road width:	wider	→ higher speed
• Width of the obstacle-free zone:	wider	→ higher speed
• Presence/Absence of emergency lane:	present	→ higher speed
• Presence/Absence of cycle track or service road:	present	→ higher speed
• Presence/Absence of road marking:	present	→ higher speed

Alignment

• Bendiness of the road (sight length):	fewer bends	→ higher speed
• Sort and state of road surface:	level road surface	→ higher speed

Road environment

• Buildings along the road	fewer buildings	→ higher speed
• Vegetation along the road	less vegetation	→ higher speed

These features are partly related to subjective speed perception, e.g. the quantity of peripheral information (see above). They are also partly related to the estimation of a safe speed along such a road and, in some cases, maybe also to the estimated speed limit applying there. As it happens, motorists regularly do not know what the speed limit is (Hendriks, 2005). In whatever way the influence of road and environment features exactly works, it is in any case very important that speed limits are supported by the road layout, so that limits are credible (see also Van Schagen et al., 2004). It is not so that the relations between certain road features and a high speed are always bad for safety. Some features such as a wider road or a wider obstacle-free zone, simultaneously increase the safety and with it compensate the higher speed, at least partly.

Which vehicle features influence speed choice?

Vehicles are developing all the time, especially cars. This also affects motorists' speed choice directly or indirectly.

In the first place, the driving comfort has increased a lot during the past decades. The noise level and vibrations inside the car at high speeds have decreased a lot. This especially applies to larger and heavier cars, but also to smaller ones. Such signals of driving too fast have thus disappeared almost completely.

In the second place, the power of car engines have increased considerably, making greater acceleration and higher top speeds possible (see for example De Mol, 2001). In actual fact the top speed of the vehicle can only determine the speed choice on roads where this top speed is also physically possible. In reality, this only applies to some parts of the motorway network, and only when little or no other traffic is around. However, there are indications that drivers of cars with high power engines also drive faster on other roads than motorways (Horswell & Coster, 2002). They found that this should be attributed partly to the fact that a car's greater power leads to choosing higher speeds and partly to the fact that 'speeders' simply choose a fast car, i.e. with more power.

Conclusion
Speed choice is a complex process and is related to many factors. As all cars have a speedometer, in principle driving speed and speeding offences are the result of a deliberate choice. Indeed, motorists often choose their speed intentionally. Reasons for obeying a speed limit are, for example, safety and avoiding a fine; reasons for exceeding the limit are, for example, haste and pleasure or adapting to other traffic. However, driving speed and speeding offences are also sometimes the result of an unconscious process in which subjective perception of the speed plays an important role. An example of this is that one underestimates one's speed if one has been driving for a long time at a high speed, or if peripheral information is missing. Certain vehicle features, such as a lack of feedback from noise or vibrations, and certain road features can also lead to unintentionally higher speeds than desired.

Although there are all sorts of conventional possibilities of preventing intended and unintended speeding offences such as enforcement, road layout, and credible speed limits, there is ultimately just one measure that puts the problem right structurally, and that is Intelligent Speed Assistance (ISA). An advisory/warning ISA certainly avoids all unintended speeding offences. Moreover, an ISA that actively intervenes also prevents intended speeding offences.

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