

Towards credible speed limits

Summary

A speed limit is credible if it meets the expectations that are evoked by the road and the road environment. Credible speed limits are expected to encourage drivers to keep to the limit better. In a series of studies SWOV has elaborated the concept of 'credible speed limits'. A photograph study, for example, was used to determine which characteristics of road and environment most influence the credibility; in a driving simulator experiment we studied whether the driving behaviour was indeed influenced by these characteristics. The results indicate that it is possible to choose a speed limit that is more credible for everybody; improving the credibility of the speed limit can be achieved by either adapting the speed limit itself or the road layout. Based on these findings, SWOV, several Dutch provinces, the Directorate-General for Public Works and Water Management, and a consultancy firm, jointly developed a method that can support policy makers in the realization of safe speeds and credible limits.

Background and content

The concept of 'credible speed limits' was introduced in the Netherlands in *Safe and credible speed limits; A strategic exploration* (Van Schagen, Wegman & Roszbach, 2004). Safe, credible speed limits are expected to result in motorists obeying the speed limits better. This can lead to a considerable reduction in the number of road crash casualties (see the SWOV Fact sheet [Measures for speed management](#)).

In itself the idea of credible speed limits is not new. Comparable terms have been used abroad, such as 'realistic speed limits' (Fildes & Lee, 1993) and 'acceptable speed limits' (Risser & Lehner, 1998). However, until now – as far as we know – it has not yet been attempted to make these terms concrete and applicable in practice. SWOV has tried to do so in a number of successive studies. This Fact sheet will present the most important results of these studies.

What is a credible speed limit?

A credible speed limit is defined as a speed limit that matches the image that is evoked by the road and the traffic situation (Van Schagen, Wegman & Roszbach, 2004). For example, if a road has a 60 km/h limit, it must not look like a road that would normally have a limit of 80 km/h; that is not credible. It is equally implausible if a road looks like a 60 km/h road, but is actually an 80 km/h road. Both the road and its environment must make it logical and credible that the one road has a lower limit than the other. If a limit is not credible, drivers will be more inclined to choose their own speed. If limits are experienced as being incredible too often, it will also damage the trust in the speed limit system as a whole. In addition, it is important to realize that the credibility of a limit is not an absolute measure. Credibility is a sliding scale that varies from 'very credible' to 'very incredible'. A speed limit can be incredible either because the limit is considered to be too high or too low.

The above definition of credibility distinguishes between the 'road image' and 'the situation image'. The 'road image' is formed by the static features of the road and its environment, such as the lining and markings, bends, buildings, and vegetation; the 'situation image' is created by the dynamic features of the traffic situation such as weather conditions and the amount of traffic. The dynamic features are particularly relevant for dynamic speed limits, i.e. limits that are being tuned to the current circumstances. At present, the Netherlands mainly has static limits, meaning that the degree of credibility is mainly determined by the static features.

Which characteristics of road and environment influence credibility?

A first step in converting the concept of credibility into practical applications is to answer the question whether the degree of credibility can be attributed to specific features of the road or its environment. In a survey using photographs of 80 km/h roads (Goldenfeld, Van Schagen & Drupsteen, 2006) approximately 600 motorists indicated their preferred and safe driving speeds for 27 road situations –

without being informed of the actual speed limit. The difference between the preferred speed or safe limit and the actual limit was considered an indication of the credibility of the speed limit in force. The photograph study showed that the credibility of a speed limit is indeed influenced by specific features of the road and the environment. This means that it is possible to improve the credibility of the limit by better tuning of the speed limit and certain features of the road and its environment. According to the photograph study the following features influence the credibility of the limit on 80 km/h roads:

- the road width;
- the presence or absence of a bend;
- the view ahead;
- the view to the right;
- the clarity of the situation;
- the presence or absence of buildings;
- the presence or absence of trees on the right hand side.

Are there differences between motorists?

The previously mentioned study of Goldenbeld, Van Schagen & Drupsteen (2006) also determined that drivers differ in the extent to which they find the limits credible. Some drivers prefer a speed which is considerably faster than the limit in force and regard a (considerably) higher limit as still being safe. Among other things, the differences depend on age (younger people find a higher limit safer than older people) and sensation seeking (people with a strong need of sensation or risk taking find a higher speed limit safer than those with a lesser need of sensation seeking). There also seems to be a relation between the number of speeding fines and the extent to which a higher limit is still considered as being safe. Unfortunately, these personal differences make it impossible to determine a speed limit that is equally credible for everybody.

Fortunately, it seems possible to determine a speed limit that is *more* credible for everyone. There are only few differences between drivers in the way in which they are influenced by the road and environment features. The features that influence everybody are the presence or absence of a bend, the clarity of the situation, the view ahead, and the view to the right. However, young novice drivers are less influenced by road and environment features than older drivers. The presence of buildings, the road width, and the presence or absence of trees on the right hand side of the road were only found to have an influence on older drivers; all features that influenced younger drivers also influenced older motorists.

What are the effects on driving speed?

Credible speed limits are supposed to result in drivers obeying speed limits better. In a driving simulator, SWOV studied whether this was really the case (Van Nes et al., 2007b). In a simulator, a total of 20 subjects drove the same rural route twice along roads with a limit of 60, 80, or 100 km/h; these were access roads, distributor roads, and through roads respectively. The credibility of these limits was manipulated beforehand by varying a number of features known to be relevant: the road width, the presence or absence of buildings, the presence or absence of vegetation, the number of lanes, and the road markings. Variations were chosen in such a way that the final layout agreed with the current Dutch guidelines.

In the first experimental drive the speed limit was not shown. The credibility of the existing speed limit was then determined for each road by comparing the speed that was driven intuitively with the limit in force. The credibility deviated from the optimum credibility in two directions: not or less credible because the limit in force was too high (in that case the intuitive speed was lower than the speed limit) or because the limit in force was too low (in that case the intuitive speed was higher than the intended speed limit).

In the second experimental drive the speed limits were shown on traffic signs. During this drive the degree of credibility did indeed influence the driving speed. More credible limits resulted in an average driving speed that was closer to the limit. When the limit was experienced as being too low, the average speed was a considerably higher than the limit; for limits that were experienced as being too high, the average speed was lower than the limit. There are indications that drivers older than 50 are more influenced by the credibility of limits than younger ones; gender and sensation seeking have no influence here.

In the driving simulator study the effects on speeding offences and speed differences were also measured. In accordance with the expectations, on average less time was spent speeding when the

limit was credible than when the limit was considered as being too low. The effect on speed differences was less obvious, but there are indications that there are fewer large differences between drivers when the limits were credible than when they were experienced as being too high or too low.

What to do if a speed limit is not credible?

If a speed limit is not credible, there basically are two possibilities to do something about it: *either* change the limit, *or* change the layout of the road or the environment. If the first option is chosen, adapting the speed limit, this must not be in conflict with road safety. A safe limit remains the starting point, no matter what. The road's function, traffic composition, potential conflict types, traffic volume, etc. will always need to be considered (see also SWOV Fact sheet [Measures for speed management](#)). Finally, the possibility remains that for certain reasons neither the speed limit nor the road layout can be changed when the limit is not credible. An example is the 80 km/h speed limit on motorways for environmental reasons. In these cases it is advisable to explicitly communicate the reason for the low limit to the road user, as is done in e.g. Germany ('Umweltschutz') and France ('Pollution'). It goes without saying that the reason given should also be credible.

What practical use is there for credible speed limits?

As is evident from the studies discussed above, the concept of credible speed limits has sufficient potential to be translated into practical traffic applications. Based on the survey study, the simulation study, and an additional literature study in which relevant road and environment features of other than 80 km/h roads were identified, an initial effort has been made to draw up a checklist 'credibility' (Van Nes et al., 2007a). In a way, a checklist for credible limits is a contradiction in terms. Credibility is a concept that involves the overall image of a road and its environment. The checklist has divided this overall image in a limited number of separate elements that can be easily assessed.

The starting point that SWOV used for drawing up the checklist was that the road layout was already in accordance with the Dutch guidelines for different road categories. The credibility features that had been identified and were not dealt with in the guidelines, were reduced to five accelerators/decelerators (see *Table 1*). Accelerators are road or environment elements that intuitively, independent of the limit, elicit a higher speed. Decelerators are road or environment elements that intuitively, independent of the limit, evoke a lower speed.

	Accelerators	Decelerators
1. Straight road sections	Long straight road sections	Short straight sections (many bends or intersections)
2. Physical speed limiters	Physical speed limiters not present	Physical speed limiters present
3. Openness of the situation	Open, clear road environment	Closed, inconveniently arranged road environment
4. Road width	Wide road	Narrow road
5. Road surface	Smooth road surface	Rough road surface

Table 1. *Five features of road and road environment that can function as accelerators or decelerators*

Next, a distinction was made between primary and secondary accelerators and decelerators. Short road sections and physical speed limiters literally force motorists to drive slower. On long road sections and when physical speed limiters are absent, the physical obstacles for driving fast are missing. These two elements were called primary accelerators and decelerators

The other three elements are secondary accelerators and decelerators: an open/closed environment, road width, and road surface. In an *open road environment* a driver has an unobstructed view, both left and right; in a closed environment the view is obstructed, for example by buildings or vegetation. In a closed road environment drivers are inclined to use a lower speed. A closed road environment thus strengthens the 'short sections' decelerator, whereas an open road environment strengthens the 'long sections' accelerator. Road width also affects credibility. A wide road acts as an accelerator and a narrow road as a decelerator. This is the case for both the entire road width and the lane width. Finally, the *road surface* has an influence on credibility. A smooth road surface, e.g. asphalt, encourages faster driving whereas a rough road surface like bricks or bumpy asphalt, invites lower speeds.

Towards a decision support system for road authorities

Together with several Dutch provinces, the Directorate-General for Public Works and Water Management, and a consultancy firm, SWOV developed a method that supports policy makers in the realization of safe speeds and credible speed limits (VSGS; see Aarts & Van Nes, 2007). Not only does the method assist in the analysis of problems in the area of safe and credible speeds, it also offers handles for the decision making about the measures that are required. These measures relate to 1) adapting the speed limit, 2) adapting the road layout and elements of the road environment, or 3) supplementary police enforcement. The method has already been applied to the regional road network in the Provinces of Fryslân and Zeeland (see Aarts et al., 2010) and on the road network of the city region Parkstad in the Province of Limburg; this has resulted in several points of departure for future policy regarding speed management. The data that has been collected for the VSGS method are presently being used for further research into the concept of 'credibility', specifically into the precise features that have an influence on credibility. The results will be used for further improvement of credibility analysis making use of the VSGS method.

Conclusion

This Fact sheet describes a number of SWOV studies that were carried out to make the concept of credible speed limits more concrete and applicable. The studies confirm that, in principle, this is possible. The studies indicate that certain specific road and environment features influence the credibility of the speed limit. It is not possible to determine a limit that is equally credible for all drivers; it is, however, possible to determine a limit that is *more* credible for all. After all, the studies show that drivers are to a large extent influenced by the same road and environment features. Furthermore, the driving simulator study has indicated that credible speed limits also have the desired effect on driving speed behaviour: a credible speed limit is obeyed better.

There are still quite a few problems in the practical application of credible speed limits. For example, we must realize that we cannot simply increase a speed limit because it would be more credible. A safe limit always remains a primary prerequisite. The alternative – to alter the road image – can sometimes be achieved with relatively simple means, but in other cases it will be more difficult.

Furthermore, not all research questions have been answered. The credibility of speed limits is determined by a combination of a various factors in the road environment, of which only a few were investigated in the studies. Dynamic factors, such as the presence of other traffic and the weather conditions, have been left out. The studies also leave the question unanswered of what to do if the road environment changes within a particular road section. It is theoretically undesirable and practically impossible to alter the speed limit every 100 metres. In other words, credible speed limits are a promising point of action for speed management and, therefore for road safety. However, large scale application in practice still requires a lot of development.

Publications and sources

(SWOV reports in Dutch have a summary in English)

Aarts, L.T. & Nes, N. van (2007). [Een helpende hand bij snelheidsbeleid gericht op veiligheid en geloofwaardigheid. Eerste aanzet voor een beslissingsondersteunend instrument voor veilige snelheden en geloofwaardige snelheidslimieten.](#) D-2007-2. Stichting Wetenschappelijk Onderzoek Verkeersveiligheid SWOV, Leidschendam.

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