

Summary:

Factors influencing driving speed

The setting of speed limits has proven an effective measure to manage drivers' speed and thereby the risk of road accidents. The present report consists of two parts, treating two different issues related to the relationship between speed limits and driving speeds. Part 1 investigates to what extent changing the speed limit on a section of road affects the speed level on adjacent road sections where the speed limit remains unchanged. Part 2 is a roadside study of factors influencing compliance with speed limits, where drivers were interviewed after their speeds had been measured.

Part 1: Effects of changed speed limits

Previous research has shown that the speed level on a given section of road is higher for cars coming from an adjacent section with a higher speed limit compared to cars from a section with a lower limit. In addition, there is some evidence that the effects of a change in speed limits can be traced also on roads that are not directly connected to the section where the limit was changed. This has been explained by the concept of *speed generalisation*; i.e., a change in speed behaviour on a road generalises to other roads, possibly on the basis of common characteristics of the roads and their environments.

In this study we consider speed changes on road sections that are adjacent to a section where the speed limit has been changed, and we use the term *generalisation* for such effects. If speed changes can be observed on adjacent sections, a possible next step could be to investigate speed changes on non-adjacent roads in an area where a considerable part of the network gets new speed limits.

Speed data were collected from permanent speed measurement points on sections where the speed limits had been changed, and where measure points were available also on the adjacent road section. Five sections where the speed limits had been changed during 2001-2002 were included in the analyses. On

three sections the speed limit was reduced from 80 to 70 km/h, on one section it was reduced from 90 to 80 km/h, and on the final one (a motorway) it was increased from 90 to 100 km/h. Only the latter two sections completely satisfied the criteria for assessing the generalisation effect.

Data from the measurement point on the adjacent section, for traffic coming *towards* the section of changed speed limit, were used as reference data. To investigate the direct effect of the changed speed limit, the speed change from before to after on the section of the changed limit was compared to the corresponding change at the reference point. The generalisation was assessed by comparing data from the two driving directions at the reference point. If the change in speed from before to after the change of the speed limit was larger (and in the expected direction) for traffic coming from the section of the change than for traffic in the opposite direction, it was taken as evidence for a generalisation effect.

The basic data were hourly averages of the spot speed of all cars at the measurement point. The hourly average speeds were weighted by the corresponding number of cars, and the analyses were based on comparisons of medians and 85th percentiles of weighted hourly average speeds between the before and after periods.

Speed limit change	Speed measurement point	Net speed change (km/h)	
		Median	85th percentile
80 → 70	Vingnes, E6 Oppland	0,5	- 0,5
80 → 70	Mortensrud, E6 Oslo	0,0	- 1,0
80 → 70	Vassenden, Rv 4 Oppland	- 0,6	- 1,0
90 → 80	Uthus, E6 Hedmark*	- 1,8	- 1,5
90 → 100	Karihaugen, E6 Oslo*, left lane	1,5	1,5

* Criteria for assessment of generalisation are satisfied

Source: TØI report 765/2005

The table shows net speed change on the adjacent road section; i.e., the change from before to after the new speed limit, adjusted for the corresponding change in the reference data. For the 85th percentile speed there was a speed reduction for all sections where the speed limit had been reduced on the adjacent section, and an increase where the limit had been increased on the adjacent section. For the median speed the results were somewhat more mixed, but also here the change was clearly in the expected direction for the two sections that were most suited for assessment of the generalisation effect.

Even though the results do indicate some generalisation, the absolute speed change is rather modest. The largest observed effect is in the order of 2% of the speed limit. On the other hand, compared to the speed change on the section where the speed limit was changed, it is more notable. For example, the generalisation effect for E6 in Hedmark is about 50% of the speed change on the section where the limit was changed.

Effects in this order of magnitude are sufficiently interesting to indicate that further research might be useful. In future studies, the choice of test sections and speed measurement points could be determined on a more theoretical basis, and not just on availability. The fact that it was difficult to find existing road sections with speed measurement points on both the section where the speed limit was changed and on an adjacent section, shows that special studies with dedicated measuring equipment is necessary to get a more thorough assessment of speed generalisation. It might also be interesting to measure whether a possible generalisation effect decreases with increasing distance from the section where the speed limit was changed. This necessitates measurements on different sites on the adjacent section.

This study did not investigate the issue of generalisation to non-adjacent road sections. In more comprehensive studies in the future it would be interesting to include such sections as well. Further investigation presupposes some coordination with plans for revision of speed limits, in order to set up an assessment scheme for the collection of both before and after data from test sections as well as reference sections.

Conceivably the same behavioural mechanisms may be involved in generalisation both to adjacent and to non-adjacent sections. A possible hypothesis is that generalisation is partly a function of the distance from the section with the changed speed limit, and partly of the similarity between the sections. An implication of

this is that the largest generalisation effect would be found on sections that are both adjacent and similar to the section with changed speed limit, and that a smaller effect could be expected on non-adjacent but similar sections, and also on adjacent sections with somewhat different road design or environment. There is little reason to expect generalisation to road sections that are neither adjacent nor similar to the section with new speed limits, although the possibility that changed speed limits on a large part of the network may change the drivers' general perception of acceptable or comfortable speed cannot be ruled out. The main hypothesis for further studies would be that speed generalisation from one road section to another is stronger the more visually similar the sections are.

The spreading of speed changes to adjacent road sections implies that more complex models are needed to predict the total effect of changing the speed limits for parts of the network. Most available studies of the effects of speed limits on speed or accidents consider only effects on road sections where the limits have been changed and not on the remainder of the road network.

Part 2: Speed measurement and roadside interview

Part 2 of the study addressed relationships of driving speed to drivers' attitudes and opinions about speed and speed limits, as well as to other characteristics of the drivers, the cars, and the trip. A source of error in previous studies of the relationship between observed speed and information from drivers is the speedometer error, which implies that most drivers actually drive at a slower speed than their speedometer indicates. This study attempted to control for this source of error by testing the speedometer of each car that was included in the study.

The main focus of the study was on the relationship of speed to the following factors:

- a) Driver background (age, gender, driving experience, and other characteristics)
- b) Trip characteristics (travel purpose, trip length)
- c) Motives (time pressure, safety, pleasure, fear of apprehension)
- d) Views on speeding and other traffic violations
- e) Car characteristics (make, model year, equipment)

The data consisted of speed measurements combined with interviews with drivers at a stop site.

Vehicles with a time gap of 5 seconds or more to the lead car were stopped by a police officer, and an interviewer from the Institute of Transport Economics asked for the driver's consent to take part in the study. While the driver was interviewed, personnel from NAF (Norwegian Automobile Association) tested the speedometer of the car at four different speeds.

The study included northbound traffic on a section of State Road 4 through the county of Akershus. At the start of the section, spot speeds for all vehicles were measured at a permanent speed measurement point. For identification of the vehicles the traffic at the measurement point was continuously videotaped. The stop site was located 3 km after the measurement point. In addition to the spot speeds, the mean speed of each car over the whole 3-km section from the measurement point to the stop site was measured.

The speed limit was 70 km/h on the first and last parts of the road section, and in the middle there was a 1.1 km part with speed limit 80 km/h.

A total of 218 cars were stopped, and 125 drivers agreed to participate in the study.

About two-thirds of the drivers exceeded the speed limit. It is therefore a reasonable assumption that most drivers considered the road and traffic conditions to be compatible with a higher speed than the posted limit. This was confirmed by the fact that the drivers on the average estimated the highest safe speed to be 15 km/h higher than the speed limit. Further, nine out of ten drivers answered that they would have driven at a higher speed if the speed limit on the studied road section had been higher.

The results indicate that most drivers speeded deliberately; i.e., the speeding violations were not a result of poor knowledge about the speed limit or not paying attention to the speedometer. Nine out of ten drivers knew the speed limit.

Concerning driver background factors, this study confirms previous research showing that speeding is more frequent among younger drivers. Drivers under 40 years had an average mean speed that was 5 km/h higher than that of drivers above 65 years.

Those who considered the speed limit on the studied road to be too low drove on the average 2 km/h faster than those who considered the speed limit as adequate or too high. The few drivers who did not know the speed limit had a smaller difference between spot speed (measured in the 70 km/h zone) and mean speed (both 70 and 80 km/h zones); in other words a smaller speed difference between the different speed limit zones.

The drivers' knowledge and opinions about the magnitude of fines showed no relationship to the driving speeds. On the average, the drivers had reasonably correct knowledge about the size of the fine for driving 20 km/h above the speed limit. There was, however, a slight underestimation of the fine for this violation in 80 km/h zones and an overestimation for 60 km/h zones.

A notable result is that drivers tend to accept larger fines for speeding on roads with lower speed limits. The average "suitable fine" for driving 20 km/h above the speed limit was NOK 2838 for a 60 km/h zone, which is rather close to the actual fine of NOK 3200. For a 80 km/h zone, however, the "suitable fine" for 20 km/h above the speed limit was NOK 1774, which is more than NOK 1000 below the actual fine.

There were no significant relationships between driving speed and trip characteristics. There was, however, a tendency for drivers who considered the driving conditions as poor to drive more slowly than the other drivers. Furthermore, drivers who were close to their destination tended to increase their speed more from the 70 km/h zone to the 80 km/h zone.

Drivers of company or rental cars drove slightly faster in the 70 km/h zone than other drivers. This can be explained by a relationship between time pressure and speed, and the fact that those who were driving in their job or were underway to or from work reported more time pressure. The speed was not related to car make or other car characteristics.

The drivers were asked some hypothetical questions about how they would feel about driving 20 km/h faster or slower than they actually did. Those who agreed that 20 km/h faster would have been more dangerous drove almost 4 km/h faster than the other drivers. This finding may indicate that those drivers drove closer to the speed that they would find to be risky, and that another 20 km/h increase therefore would have been experienced as dangerous.

Those who considered the speed limit to be an important determinant of their speed drove more slowly. The experienced importance of other factors (traffic conditions, safety, pleasure of driving, fear of police, road conditions, habits) regarding speed was not related to actual driving speed.

Almost all the speedometers indicated too high speed. The average error varied from 5.7% at a speedometer reading of 90 km/h to 6.8% at 50 km/h. Two out of three drivers reported that they did not compensate for the speedometer error or did not know about the error. For those drivers the speedometer error accounts for about 12% of the inter-vehicle speed

variability. More exact speedometers (e.g. based on GPS) would presumably reduce platoon formation caused by some drivers driving more slowly than they believe they do. This would probably also reduce the risk of accidents related to platoons and overtaking.

Even though a majority of the drivers exceed the speed limits, the speed in the 70 km/h zones was lower than in the 80 km/h zone, which shows that the drivers after all are influenced by the posted speed limits. There is, however, a large potential for reduced speed

by influencing a larger proportion of the drivers to comply with the speed limits. This study has shown that the drivers' opinions and attitudes regarding speed limits determine the degree of compliance. The beliefs, motives and cognitions lying at the basis of speeding violations are probably difficult to modify, and there are apparently no viable alternatives to increased surveillance or technical systems for speed limitation in order to achieve high compliance with speed limits.