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ABSTRACT

A variable speed limit system controlled by weather and road condition data has been developed in Finland parallel to seasonally changing speed limits. The effects of variable speed limits has previously been investigated on the motorway section. This study was designed to investigate the effects of the variable speeds limit and messages on single-carriageway roads, a two-lane section and a semi-motorway section.

The total length of the weather controlled road is currently 25 km. All 32 speed limit signs on the section are variable fibre optic signs. In addition there are eight variable message information and warning signs. The speed limits used on the section are 60 km/h, 80 km/h and 100 km/h.

Data on driver behaviour were obtained from one measurement station on the undivided mixed traffic road and one measurement point on the semi-motorway. The data from the undivided mixed traffic road was used as control data for the undivided mixed traffic road in winter and for the semi-motorway in summer. The design was a before-after study with a control road.

In winter 100 km/h variable speed limit was used approximately 9% and the 60 km/h speed limit roughly 1% of the time. At other times the speed limit was 80 km/h. The effects of the variable speed limits on mean speeds were estimated by comparing mean speeds when the fixed 80 km/h speed limit was in force with those when the variable speed limit system was in use. Increasing the speed limit from 80 km/h to 100 km/h increased the mean speed by 3.9 km/h in good road surface conditions (share of total time 5.3%) by 5.4 km/h in moderate road surface conditions (share of total time 3.3%) and by 7.3 km/h in bad road surface conditions (share of total time 0.1%). If the speed limit was kept at 80 km/h but displayed with fibre optic signs (instead of fixed signs), the mean speed decreased by 3.2 km/h in good road surface conditions (share of total time 14.4%) and increased by about 1 km/h in bad and moderate road surface conditions (share of total time 71.1%). If the slippery road warning was displayed the mean speed decreased by 2.5 km/h in bad road conditions and by 1 km/h in moderate conditions. The slippery road sign reduced the proportion of drivers in queues with headways of less than one second by 25%. The 80 km/h variable speed limit without the slippery road sign reduced the proportion of short headways about by 10%. In good road surface conditions the 100 km/h variable speed limit did not significantly affect the proportion of short headways but increased the proportion of short headways in normal road surface conditions by 31%.

In the summertime the 80 km/h variable speed limit was used on the semi-motorway approximately 3% of the time. Decreasing the speed limit from 100 km/h to 80 km/h decreased the mean speed by 3 km/h in bad road surface conditions (share of total time 0.4%), by 3.2 km/h in moderate conditions (share of total time 1.1%) and by 2.4 km/h in good conditions (share of total time 1.4%). The speed limit of 100 km/h displayed with fibre optic signs increased the mean speed by 1.3 km/h in good road surface conditions (share of total time 74.2%), by 1.2 km/h in moderate (share of total time 21.4%) and by 0.6 km/h in bad conditions (share of total time 1.5%). The mean speeds before building the new system, when the speed limit was fixed at 100 km/h, were used as control situations.

Drivers were interviewed on the undivided mixed traffic road near Pyhtää. In total, 327 Finnish drivers were interviewed. Two different variable signs were displayed during the interviews: the "other danger" sign with the text "gusty wind", and the text "keep your distance".

Overall, 95% of the drivers recalled the speed limit shown with the variable sign, 73% of recalled the "other danger" sign and 76.6% the "gusty wind" text. The "keep your distance" text was remembered by 47.4% of the drivers. Fifty-seven per cent of drivers who encountered the "gusty wind" text sign indicated that the sign affected their driving behaviour. The corresponding percentage for "keep your distance" was 45.2%.

Seventy per cent of drivers knew that weather and road condition determinate the speed limits shown. Furthermore, 56% of knew that speed limits are based on real time weather and road surface condition data. Ninety-six per cent of the drivers considered the variable signs based on real time weather and road surface condition data to be worthwhile. The most usual benefits mentioned were increased traffic safety, better traffic flow and increased compliance with speed limits. Fifty-two per cent of the drivers found no disadvantages with the system. Twenty per cent of the drivers thought that the speed limits were not always right. Sixty-seven per cent thought that the system was always or mostly reliable.

The system was generally deemed as good and useful. Knowledge of the control strategies seems to have decreased a little and people are not sufficiently aware of the real-time controls. The percentage of drivers who considered the speed limits too low in good road surface conditions has increased slightly compared with earlier interviews. The variable signs were recalled well. The recall of signs and estimated effect on driver behaviour on the test extension were even better than on the earlier motorway test road.

In conclusion, the effects of the system are as expected if the system is appropriately used. The increase in mean speed improved the fluency in good road conditions, probably with no detrimental side-effects. In adverse road conditions the lowered speed limit decreased the mean speed and headways between vehicles, which is desirable for traffic safety. In addition, the findings suggest that the use of variable speed limits calls for a sophisticated control system. Inadequate speed limits increased the mean speed excessively and decreased the

headways substantially, thereby reducing traffic safety. The drivers accept variable speed limits and rely on the system.

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