

Summary:

Traffic information and driver attention

A study of variable message signs and their effects on driving behaviour

Traffic information comprises many different sources of information from the road environment, which are implemented in order to influence road user behaviour. The aim of the present study is to investigate the relationship between traffic information and indicators of driver attention. More specifically, the following two questions were addressed:

- To what extent do car drivers perceive roadside traffic information and comply with the advices that are given?
- Does traffic information have adverse effects on drivers in terms of distracting them from the driving task, and to what extent can such adverse effects be avoided?

Theoretical background

In order to influence driver behaviour, traffic information must attract the drivers' attention and provide information that corresponds to their information needs. At the same time it should not distract drivers from their primary task of car driving. Irrelevant information should be avoided. Good knowledge about driver information needs, information processing capacities, and limitations is therefore a prerequisite for optimal design and presentation of traffic information.

Driver information needs are related to different driving tasks, commonly grouped into the following three levels: Route choice and navigation (strategic level), choice of speed and specific driving manoeuvres (tactical level), and the continuous regulation of driving parameters, such as maintaining safety margins regarding longitudinal and lateral position (operational level). The sources of information are the vehicle and the traffic environment, including traffic information.

Attention is a precondition for information processing: Detecting the information source, perceiving and processing the information and translating it into action. Attention may be allocated to different sources of information, but conflicts may occur between the demands from different tasks, either because the demands are incompatible or because they overtax the total attention capacity. When task demands exceed attention capacity, the probability of driving errors increases, possibly resulting in elevated risk of conflicts or crashes.

Consequently, traffic information should be easy to perceive without high demands on the drivers' attention capacity, and it should be possible to process the information without increasing driver mental load to such an extent that the safety of driving is jeopardized. If traffic information demands more capacity than is available at the moment, the driver may adapt to this either by increasing her mental effort or by lowering the speed. A different option is to reallocate mental resources between the two tasks of driving (operational or tactical level) and processing traffic information (tactical or strategic level). This may, however, imply a risk of allocating too little attention to one of the tasks and either missing important information or increasing the crash risk.

Method

A field study of the effects of variable message signs (VMS) with text messages was carried out. The VMS signs in question are normally used to warn drivers about road or traffic events and conditions implying reduced traffic flow, and to recommend alternative routes. If a sufficient proportion of drivers comply, the traffic will be more evenly distributed, and the drivers are less likely to get stuck in a traffic jam.

Effects of VMS were studied at two different sites on the trunk road E18 outside Oslo. At one site the message was that the road was closed further downstream, and at the other site that there was construction going on. In both cases alternative routes were recommended. On the road section where the VMS was visible to drivers, speed was measured by four radars at different distances before the VMS and one radar after the VMS. In addition, video recordings were made in order to investigate braking performance. At one of the sites the distribution of traffic between the two alternative routes was recorded from video cameras at Oslo Road Traffic Control Centre.

The data collection at each of the two sites took place during three 15-minute periods with a text message on the sign, each preceded by 15 minutes without a message (black sign). Data were collected from a total of about 4000 vehicles.

Results

About one out of five vehicles in the target group for the traffic information (i.e., drivers who without the message were expected to have continued on the road that was announced to be closed) changed their route in accordance with the recommendation on the VMS. According to observations from the Traffic Control Centre most of the vehicles that continued on the supposedly closed road turned onto some of the other available exits between the VMS and the closed section. Thus, the VMS can be considered to fulfil its purpose of traffic management satisfactorily.

On the other hand, the message turned out to put considerable demands on the drivers' attention. The message resulted in a marked decrease in speed; relative to the periods without text the average speed decreased by 4.7 and 6.0 km/h at the two sites. The proportion of drivers who braked also increased when the message

was on, from 0 to 7 % at one of the sites, and from 3 to 19 % at the other site. The braking is likely to affect the distribution of time headways between successive vehicles, resulting in more cases of very short (and possibly risky) headways. The changes in speed can be considered as behavioural adaptations to the increased demands on driver attention imposed by the VMS message. However, these adaptations are likely to result in increased risk, particularly because some drivers may be so distracted by the traffic information that they are not sufficiently prepared to respond to a braking car ahead.

Conclusions

Traffic information should capture the road users' attention in order to provide relevant information, but without distracting attention from the primary task. To what extent traffic information can be easily detected, perceived and processed depends on positioning, display technology, message layout and the use of text vs. symbols (pictograms). In addition, the demand imposed by road and traffic conditions (e.g. speed limits) obviously has implications for the possibility to detect traffic information.

A general requirement to traffic information is that it should be tailored as far as possible to the road users' information needs and correspond to drivers' expectations. The demands for information processing will increase if form or contents of the messages are unexpected and if no immediate association with relevant actions exists, e.g., because it is necessary to search for additional information on traffic signs or in one's memory.

Concerning the VMS signs used in this study, the legibility at long distances was considered unsatisfactory, and this may have contributed to the considerable speed reductions. In addition, the fact that the message is unexpected (the signs are mostly without a message) may by itself make drivers reduce the speed, apart from the legibility. And finally, it should be pointed out that text messages are not immediately connected to actions in the same way as symbols are; this may also have resulted in speed reductions.

Further research

There is a need for more knowledge about the effects of both VMS signs and other kinds of traffic information on the attention, information processing and behaviour of road users. By increasing the minimum reading distance and thereby providing drivers with more time to read the messages, one could investigate whether it is possible to avoid the large speed decreases found in this study. This could be done by varying letter size, and/or length of the message, and take care that there is a sufficiently long visibility distance before the sign. It should also be investigated whether crash risk is increased at sites with VMS signs. Various groups of drivers may differ in their reactions to the signs. By stopping and interviewing drivers who have passed a VMS one could investigate the relationship between behavioural changes before the sign on the one hand, and the experienced relevance of the sign and other background factors on the other.