

# Are drivers able to assess their driving quality while using an IVIS?

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## Introduction

Transport Telematics or Intelligent Transport Systems (ITS) have been proposed as possible solutions for reducing congestion and improving traffic safety and driver comfort. In-vehicle information systems (IVIS) represent one area of transport telematics and aim to provide drivers with the information on e.g. a favourable route from their starting point to the destination, road weather, road works, crashes and even connection to the Internet. Obviously these systems should be designed so that the users will be able to assimilate and comprehend this information in a timely and efficient manner. In addition, it has been argued that allowing the drivers to interact with devices while driving may be unsafe. However, the state of the art with respect to methodologies for assessing the safety implications of information provision is still problematic (Carsten and Brookhuis 2005).

The European project HASTE (Human machine interface and the safety of traffic in Europe) aimed to develop methodologies and guidelines for the assessment of IVIS (Carsten and Brookhuis 2005). VTT contributed to that project by conducting several field studies.

In the following, the main findings of one additional analysis are summarised. The field study was designed to investigate and compare the potential or sensitivity of the selected assessment methods to reflect the effects of different S-IVIS on driver behaviour in rural and in urban environment. More specifically, (1) the data were collected in real traffic, (2) the drivers included so-called average as well as elderly drivers, (3) the effects of increasing the demand of the visual task and of the cognitive task on driver performance were quantified, and (4) evaluations were based on vehicle data, observations and drivers' reports.

Driving performance is often measured by means of objective measurements such as speed, lane position, and steering frequency. However, because in busy traffic such measures may be affected by various external factors rather than by driver distraction or overload, also a method including subjective observations or ratings by driver has been discussed. In this paper the emphasis is made on the drivers reports i.e. their own estimations of their driving performance while using surrogate IVIS.

## Method

Drivers had two surrogate in-vehicle devices (S-IVIS), the visual (arrows) task and the cognitive (continuous auditory memory) task. Both tasks had three difficulty levels, which drivers had to perform twice in urban and rural traffic environments. The test route was driven three times, with the visual task, with the cognitive task, and as a baseline (normal driving). The order of the environments, tasks and task difficulty levels were balanced across drivers.

The VTT instrumented vehicle used in the experiment was equipped with an unobtrusive PC-based measuring system, differential GPS receiver and a video recording system. The data were transmitted to the videocassette recorder (VCR) and computer in the trunk. The visual task was presented on a monitor located on the right side of the steering wheel.

Drivers participated in the experiment individually. They were informed that the aim of the study was to investigate what kind of task drivers can safely perform while driving. Particularly, the drivers were instructed to drive safely through the test route and perform the S-IVIS task when it was presented to them. In total, the data of 48 drivers were included in final analyses. All were licensed drivers who had volunteered for the study. Twenty-four of these were aged between 25 and 59 and twenty-four were aged 65 years or older. All the drivers owned or regularly drove a vehicle of the same type as the one used in the study.

Since the experiment was conducted in real traffic, an experimenter sat in the front passenger position, where there was an extra brake pedal. He gave directions in order to maintain the correct route. An observer, whom the driver believed to be technical support staff, sat in the back. At no time did the observer interfere with the driving.

In the rural route, speed limit information and the driver's speed behaviour was recorded. Only free-flow traffic situations (in which drivers were able to choose their driving speed) were included in the speed analyses. In order to study mistakes in lateral position of the vehicle, also rapid steering-wheel turns were computed. In the urban route, speed behaviour in straight road sections was recorded. Special attention was directed to areas before zebra crossings. Braking jerks of more than  $8 \text{ m/s}^3$  were counted and these situations analysed.

In addition to measured driver behaviour, the observer coded the driver's performance and the traffic situations with respect to:

- presence of vehicle in front
- presence of oncoming vehicles
- interaction with vehicles in front
- lane keeping behaviour
- speed choice and adaptation
- yielding behaviour
- interaction with pedestrians
- stopping and signalling behaviour at intersections.

Driver's self-reported driving quality was asked after each S-IVIS block and at the same locations during the baseline run. Overall, the effects of S-IVIS type, S-IVIS difficulty and age group were analysed. However, the obtained differences should be viewed only as possible trends as only a few effects-based vehicle or observational data could be tested statistically.

## Results

### Drivers' ability to assess only the driving performance

In order to study what aspects, beside the driving performance itself, affect the drivers' driving performance rating, cases with no driving mistake (e.g. in lateral position, interaction with other road users) or large changes in driving behaviour (e.g. speed) coded by the observer were further analysed. Later on these cases are called appropriate driving.

Both in urban and in rural environment, the secondary task had a statistically significant effect on driving rating although appropriate driving was observed. The difference was significant between the baseline and each secondary task, but not between the two secondary tasks. Also drivers' age had a statistically significant effect on driving rating, with higher scores for average drivers than for elderly drivers. The difference between two age groups was significant in baseline conditions and when driving with audio task. More detailed results are presented in Figure 1.

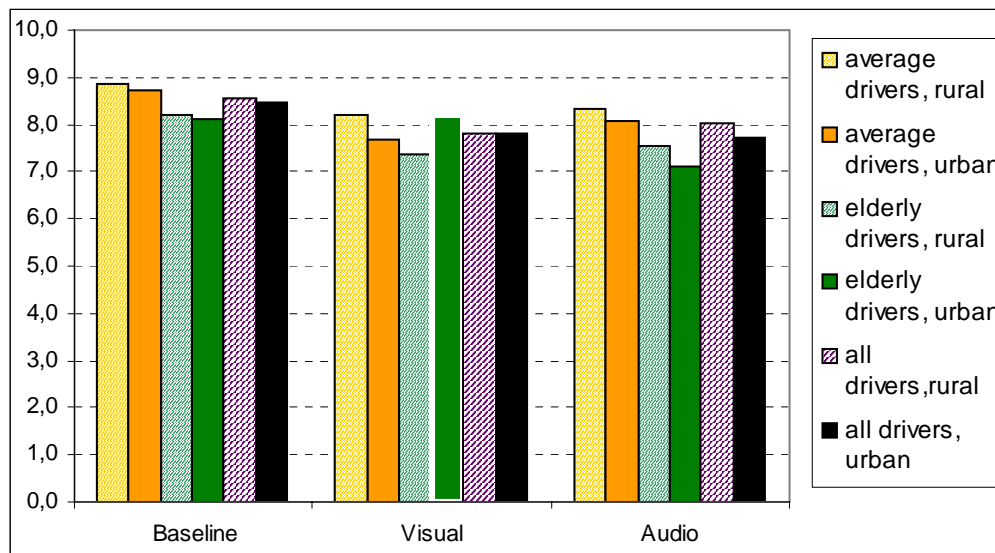


Figure1. Drivers' own assessment of their driving performance (cases where appropriate driving observed) by trial condition, age group and environment.

### Drivers' performance ratings in a case of a mistake

In order to study how observed mistakes affected the drivers' rating of their driving performance, cases where a driving mistake was observed, were further analyzed. Driving mistakes included following mistake types;

- speeding (driving too fast compared to speed limit, rural environment)
- rapid correction moves in lateral position (rural)
- inappropriate interaction with other road users (give-a-way situation in urban)
- dangerous situations (near-accident situation, both environments)

Observed speeding in rural environment caused only small reduction in drivers' own performance ratings. When conducting visual secondary task, the speeding had greater effect on drivers' performance ratings (average drivers -0.25, elderly drivers -0.35) compared the cognitive task (average drivers -0.1, elderly drivers +0.15). .

The mistakes in lateral position (rapid correction moves) happened infrequently. However, 4% of the situations where an elderly driver conducted visual secondary task included such a mistake. Those drivers reduced their rating by 0.3 on average (two and drivers did not lower their rating).

Eight dangerous situations in rural environment took place with elderly drivers and always involved wondering to wrong lane with oncoming vehicles. Driving performance rating was reduced approximately by 0.1 in those situations.

In urban environment the main focus was on interaction with other road users at a give-away intersection. Interaction both with other vehicles and vulnerable road users (VRU) were studied. The results showed that mistakes such as "acceptance of short gap" and "stopping at the intersection area, but no danger" caused quite a large reduction (from 1.3 to 2.1) in drivers' ratings. However, dangerous situations (last second braking to avoid a conflict) resulted in large reduction in driver ratings among average drivers (3.2), but not among elderly drivers (0.1). The results concerning mistakes in interaction with VRU at zebra crossing indicate that elderly drivers tend to stop (even late) and give away to VRU, whereas average drivers more often forced their way. In addition, elderly drivers reduced their driving performance ratings in a case of mistake more compared to average drivers (Figure 2).

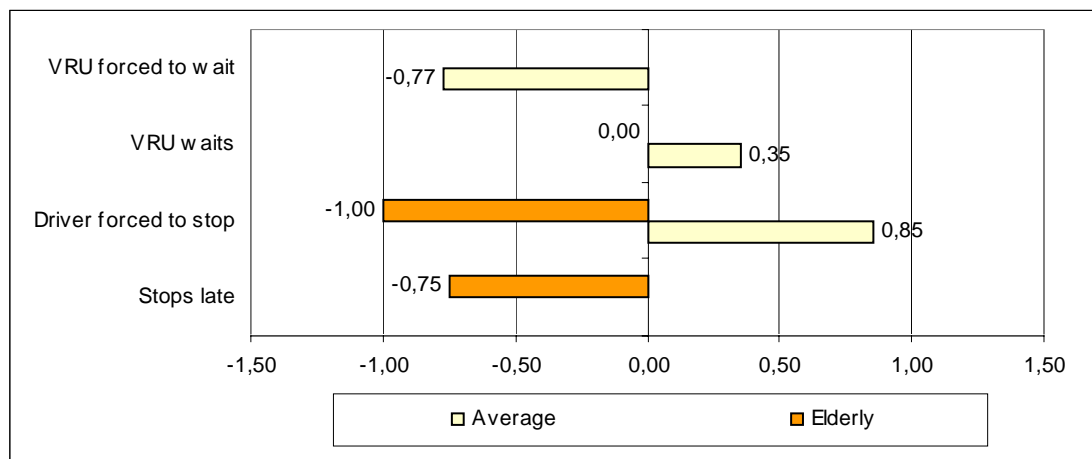


Figure2. Reduction in drivers' own assessment of their driving performance (cases where mistake in interaction with vulnerable road users at zebra crossing was observed) compared to appropriate behaviour by trial age group.

## Conclusions

The main results of this study showed that the drivers rated their driving performance worse on average when performing secondary task. However, the differences were relatively small. In addition, there were differences in self-reported driving quality between average and elderly drivers when considering same kind of behavioural changes. For example, the results suggested that in dangerous situations elderly drivers reduced their ratings very little or not at all. This was also the case with average drivers in inappropriate interaction with VRU. Perhaps the drivers are not aware of all behavioural changes in their driving performance or they do not consider some changes in driving behaviour to be safety related. Consequently, other measures than driver ratings are needed to assess the effects on an IVIS on driving performance and traffic safety.

## References

Carsten, O. and Brookhuis, K. (2005). The relationship between distraction and driving performance: towards a test regime for in-vehicle information systems. *Transportation Research Part F 8*, 75-77.