



Links between HMI indices and traffic safety:

Initial analyses of driver behaviour while using an RDS-TMC receiver

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Objectives

- ◆ To identify and quantify the relationships between behavioural indices and traffic safety
- ◆ Behavioural indices:
 - glance behaviour
 - speed
 - steering wheel position
 - brake force
- ◆ Surrogate measures for traffic safety
 - traffic conflicts
 - traffic violations/driver errors
 - mistakes in search for priority road users



Hypotheses

- ◆ Drivers concentrate more on the RDS-TMC device in trials than in control situations and, therefore, the cognitive and especially visual workload is higher, resulting in more errors
- ◆ Workload is higher for elderly drivers
- ◆ Drivers compensate for the higher workload by reducing their speed and by operating the receiver at times of lower workload
- ◆ It is possible to find the links between HMI indices and traffic safety



Method: tasks and site

- ◆ **Two concurrent tasks**
 - **driving**
 - **use of RDS-TMC device**
- ◆ **suburban roads, 2*43 km**
 - **in all 144 (2*72) sites of which**
 - **24 (48) trial sites and (48) 96 control sites**
 - **48 sites were either trial or control sites**
 - **48 sites were control sites during both runs**
 - **6 types of sites**



Method Equipment





Subjects

Driving experience	Young	Old
Inexperienced	15	15
Experienced	15	15



Results: looking behaviour

• All sites	Trial	Control
• Number of glances	5.2 (2.5)	1.4 (1.9)
• Gaze duration, s	5.63 (2.96)	2.55 (2.47)
• trial sites:	Young	Old
• Number of glances	5.7 (2.7)	4.8 (2.3)
• Gaze duration, s	5.83 (2.88)	5.44 (2.91)



Looking behaviour by site type

	Number of glances	Gaze duration, s
• Yield, to the left	4.1	4.51
• Yield, to the right	4.9	5.66
• Major to the left	4.9	5.14
• Major to the right	5.5	5.75
• Traffic signals, straight	5.2	5.83
• Ped crossing, straight	6.3	6.84



Speed behaviour

- ◆ **Effects of messages (trial compared to control) on speed (km/h) in time interval 0 ... 4.8 s after receiving the message**
 - **Yield, right** -2.7
 - **Yield, left** -2.4
 - **Major, right** -2.0
 - **Major, left** -1.8
 - **Traffic signals, straight** -3.4
 - **Ped crossing, straight** -3.2



Steering wheel position and braking

- ◆ **Steering wheel position was examined only in the straight sections**
 - **deviation greater in trial than in control sites**
- ◆ **Braking**
 - **average maximum braking force greater in trial than in control sites**



Safety effects

- ◆ **Conflicts**
 - **In total 36 conflicts, of which**
 - **in the test sites 24, of which**
 - 8 in the trial sites / 16 in the control sites
 - old 17 / young 7
- ◆ **Driving errors/traffic violations**
 - **in total 68 driving errors in the test sites, of which**
 - 28 in the trial sites / 40 in the control sites
 - old 45 / young 23



Safety effects, cont...

- ◆ **Mistakes in search for priority road users**
 - **2.4% of all the test sites**
 - 3.3% of the trial sites
 - 1.9% of the control sites
 - **Young subjects > old subjects**
 - **Experienced subjects > inexperienced subjects**



Links between HMI indices and traffic safety

- ◆ Looking behaviour vs. conflicts
 - subjects looked at the receiver less in the situations involving a conflict
 - secondary task was interrupted

- ◆ Looking behaviour vs. driving errors
 - similar result as above



Links between HMI indices and traffic safety, 2

Mistake in search for other road users	Number of glances	Gaze duration, s
Yes	6.9	7.52
No	5.2	5.48



Discussion

- ◆ **High speeds were linked to conflict and violation involvement.**
- ◆ **High speed and long gaze durations were linked to the mistakes in search for priority road users.**
- ◆ **However, gaze durations were relatively short in situations including driving errors or conflicts.**
- ◆ **Older drivers had more conflicts and violations but fewer search mistakes than young drivers.**



Conclusions

- ◆ **It is apparent that these safety effects reflect various aspects of the complex safety problem.**
- ◆ **Hence, links between HMI indices and traffic safety may be much harder to identify and quantify than expected.**



Conclusions, cont.

- ◆ **RDS-TMC receiver**
 - **complies with EU recommendations**
 - **yet, indications of safety problems, especially for older drivers.**



Thank you for your attention!