SESSION 3A :

EFFECTS OF ITS ON DRIVERS’ BEHAVIOUR AND INTERACTION WITH THE SYSTEMS

THE EFFECT OF AUDITORY ROUTE INSTRUCTIONS OF NAVIGATION SYSTEMS ON GLANCE BEHAVIOUR OF DRIVERS DRIVING ON THE MOTORWAY

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ABSTRACT: An increasing number of drivers are using navigation systems in their cars. While these systems may help guide drivers to a specific destination, they also have the potential to visually distract them when looking at the display. Visual distraction is strongly related to crash risk. The current study analysed the effect of auditory route instructions of navigation systems on glance behaviour of drivers. It was found that participants looked longer and more often but with shorter fixations at the navigation device after an auditory instruction was given than before an instruction or than during a baseline period. No differences in glance behaviour between familiar trips and unfamiliar trips were found. It is suggested that when drivers receive an auditory instruction, visual route information is used to support the processing of the auditory information and drivers relate the visual information to the actual driving context for example to relate the next turn indicated on the navigation device with the actual road scene.

1. INTRODUCTION

The advantages of navigation systems to users are quite obvious. It provides drivers with step-by-step instructions how to get to their destination via the fastest and/or shortest route. Handling a navigation system while driving is often associated with risky behaviour because it can distract the driver from the driving task. But apart from handling the navigation system, how much visual attention is drawn to the system while paying attention to the visual and auditory route guidance information? Previous research has shown that visual route information distracts drivers more (both cognitive and visual) than audio information [1]. Visual distraction, especially for long continuous episodes, is known to have a major impact on crash risk [2]. Clear auditory route instructions without the need of additional visual information to process and understand the route instruction would theoretically induce little visual distraction.

The current study investigates the effect of auditory route instructions on glance behaviour while driving on the motorway. The frequency and durations of eyes off the road are relevant for road safety. Understanding drivers' glance behaviour is important for further improving content and timing of the instructions to maximize road safety. Two main research questions were identified: What is the effect of an auditory instruction on duration and frequency of glances at the navigation device? And, is the effect of auditory instructions on glance behaviour different when driving familiar and unfamiliar routes?

Real life driving behaviour has been observed using naturalistic driving data. Glances at the navigation device were examined in three conditions: 1) before an auditory instruction was given 2) after an instruction and 3) during baseline period (no auditory instruction). For each condition, six-second epochs of video data were coded for glances at the navigation device. It was expected that in the baseline condition, drivers will periodically check the navigation system. In the six seconds before the instruction, drivers are expected to anticipate the next instruction and increase glances at the system. During the six-second period after the instruction the duration and frequency of glances was expected to be highest as drivers might use the visual information to aid the processing of the auditory instruction. Finally drivers were expected to look longer and more often at the device when driving an unfamiliar route compared to a familiar one.

2. METHOD

2.1. Design

To compare glance behavior between the different conditions, a within-subjects design was applied. The two within subject factors were familiarity with the route (two levels; unfamiliar and familiar) and time relative to instruction (three levels; before, after and baseline). Three measures were subjected to a repeated measures ANOVA: mean fixation duration, mean fixation frequency and mean glance duration. *Mean fixation duration* is the mean duration of single fixations to the navigation device.*Mean fixation frequency* was computed by dividing the number of fixations per participant in a specific condition by the number of instructions analysed in that specific condition. Subsequently, mean fixation frequencies per condition are computed by averaging the participant means. The *mean glance duration* reflects the mean time glanced to the navigation device (per condition) per instruction and was computed by dividing the sum of fixation durations per participant in a specific condition by the number of instructions analysed in that specific condition. Subsequently, mean glance durations per condition were computed by averaging the participant means. Besides significance of results ($p<.05$), the effect size (Partial èta squared, η2P) was considered with η2P = .01 as a small, η2P =.06 as a medium, and η2P = .14 as a large effect size [3].

2.2. Participants

The current study included data obtained during a five-week period from seven participants (five males) aged from 27 to 44 (M: 31, SD: 5.7). On average participants drove 18 trips with the navigation system (SD: 10), of which 41% (SD: 19) of the routes driven were unfamiliar.

2.3. Procedure

During participant briefing sessions participants were informed about the study. No specific details about the focus of the study were revealed. If participants agreed with all terms and conditions set-up for this study, they signed the participant agreement and were handed over the instrumented vehicle and a nomadic navigation system. Participants were asked to use the vehicle and the navigation system just as they would normally do.

2.4. Materials

2.4.1. Instrumented vehicle

During the study participants drove a Lancia Ypsilon which was instrumented with four cameras: 1) under the rear-view mirror directed at the drivers face, 2) on the right A-pillar recording a full driver view, 3) behind the rear-view mirror recording a forward view and 4) in front of the navigation system recording the screen of the navigation system. The camera's recorded at a frame rate of 12.5 frames per second. Additionally, several sensors, a computer and an additional battery to supply energy to the instrumentation were installed. A GPS sensor was used to record location information and GPS derived measures as speed and time.

2.4.2. Navigation device

The participants received a nomadic navigation device (TomTom Go Live 1005) that they could use for the duration of the study. The navigation device contained adjusted software that enabled logging the auditory instructions participants received during route guidance. Data logged by the navigation device was matched with the data and video recorded by the Data Acquisition System (DAS) with an accuracy of one second.

2.5. Data Coding

Eye glances towards the navigation device were manually coded with an accuracy of 80 milliseconds (duration of one video frame) by an experienced data reductionist using in-house developed software.

Six-second video epochs before and after the participants received an auditory instruction were coded for eye glances towards the navigation system. The definition of glance duration used in this study is consistent with SAE J2396 [4]. One glance is the time looking at the navigation display plus one transition. A glance begins when the participant's eyes leave the road (or another target) and fixate at the navigation system. The glance ends when the eyes leave the device and fixate back at the road (or another target).

To compare eye glance behaviour before and after an instruction with behaviour without auditory instructions, a baseline condition was determined. For the baseline condition randomly sampled six-second video epochs were coded for eye glance behaviour from the same trip. In a baseline epoch no auditory instructions were given six seconds before and twelve seconds after this epoch. Baseline epochs were randomly sampled out of all parts of the trip on the motorway, where no auditory instructions were given for at least three kilometres.

Familiarity of driven routes was determined by asking the participants. After the field trial, participants received a digital map with all routes they had driven with the navigation device switched on. Participants were asked to indicate for each trip if it were for the major part unfamiliar or familiar.

2.5.1. Exclusion criteria

Some epochs were not included in the analyses because they could not be coded or because they were expected to bias the results. Trips that could not be coded were trips driven in the dark and when a driver wore sunglasses. Epochs that could bias the result concern slow traffic (speed < 60 km/h on the motorway), because glance behaviour in slow, congested traffic is likely to be different from flowing traffic. Epochs during which participants were manipulating the navigation system were excluded because glance behaviour is likely to be different when the device is manipulated. Rapid consecutive instructions with overlapping six-second epochs were excluded as well.

3. RESULTS

In total 867 instructions have been analysed for glance behaviour (330 in unfamiliar trips and 537 in familiar trips). An equal number of baseline epochs for familiar and unfamiliar routes have been analysed. A total number of 1048 fixations to the navigation have been observed over all conditions.

3.1. Frequencies of eyes on the device

For individual instructions it was examined if in a specified time sample (with a resolution of 0,1 seconds), a glance to the navigation device was observed. This results in the mean percentage of instructions glanced at the navigation device in a specified time sample (averaged over all participants) that is shown in Figure 1. The graph shows a peak in glance behaviour approximately two seconds after the auditory instruction commenced. Two seconds after the instruction on average 18% of the instructions evoked glances at the navigation device.

Glances to the navigation device in the six seconds before the instruction were observed for 32% of all (867) instructions, after the instruction for 47% of all instructions and glances to the navigation device were observed in 25% of all analysed baseline epochs.

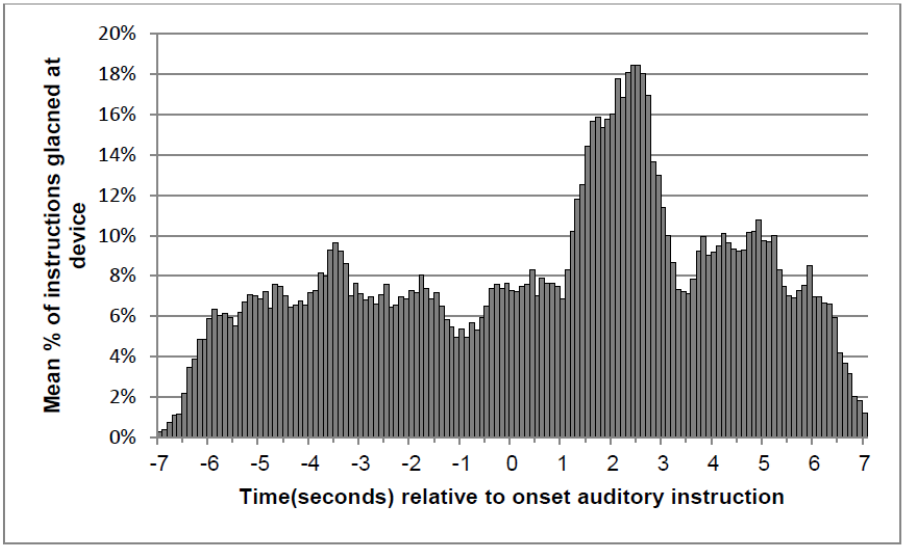

Figure 1 Mean percentage of instructions glanced at the navigation device in a specified time sample

3.2. Repeated measures

The two main factors of the 2x3 repeated measures within subject design are Familiarity (for familiarity of the trips) and Time (for time relative to the instruction). The factor Familiarity consists of two levels: Unfamiliar and Familiar. The factor Time consists of three levels: Before, After and Baseline.

Before the actual testing on significance of differences within subjects ,the sample was tested on the assumptions for parametric testing (normal distribution and homogeneity of variance). The assumption of normal distribution was not met for all conditions, therefore a Log transformation (Log_{10}) was applied to the data. For the measures fixation frequency and glance duration the assumption of homogeneity of variance was violated, therefore degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity. In case significant main effects were found, post hoc tests (t-tests) were performed to compare all pairs of the independent variable. Post hoc tests were adjusted with Bonferroni for multiple comparisons.

3.2.1. Fixation duration

The mean and standard deviations of fixation duration for all conditions are presented in Table 1. A significant main effect for Time on mean fixation duration was found, $F(2, 12)=14.584$, $p<.01$, $\eta_{2P}=.71$. No significant effect for

Familiarity was found. Pairwise comparisons revealed that mean fixation duration Before was significantly longer than mean fixation duration After ($p=.005$) and that mean fixation duration After was significantly shorter than mean fixation duration Baseline ($p=.03$). No interaction effects between Time and Familiarity were observed.

Table 1 Mean fixation duration (seconds)

	Unfamiliar Before M (SD)	After M (SD)	Baseline M (SD)	Familiar Before M (SD)	After M (SD)	Baseline M (SD)
$Fix_{duration}$	0.97 (0.22)	0.82 (0.23)	0.90 (0.19)	0.90 (0.20)	0.84 (0.13)	0.92 (0.21)

3.2.2. Fixation frequency

Fixation frequencies for the different conditions are reported in Table 2. A significant main effect for Time on mean fixation frequency was found, $F(1.13, 6.78)=16.621$, $p<.01$, $\eta_{2P}=.735$. No significant effect was found for Familiarity. A significant interaction effect between Time and familiarity was found, $F(2,12)=4.064$, $p<.05$, $\eta_{2P}=.404$. Pairwise comparisons revealed that mean fixation frequency Before was significantly lower than After (p=.002) and that mean fixation frequency After was significantly higher than Baseline (p=.06).

Table 2 Mean fixation frequencies

	Unfamiliar Before M (SD)	After M (SD)	Baseline M (SD)	Familiar Before M (SD)	After M (SD)	Baseline M (SD)
Frequency	0.46 (0.32)	0.63 (0.40)	0.36 (0.30)	0.46 (0.22)	0.74 (0.30)	0.27 (0.33)

3.2.3. Glance duration

The mean glance durations are presented in Table 3. A significant main effect for Time on average sum of fixation durations was found, $F(1.090, 6.542)=12.721$, $p<.01$, $\eta_{2P}=.680$. No significant effect for Familiarity and no interaction effect between Time and Familiarity were found. Pairwise comparisons revealed that average sum of fixation durations Before was significantly shorter than After (p=.007) and that average sum of fixation durations After was significantly longer than Baseline (p=.013).

Table 3 Mean glance durations (seconds)

	Unfamiliar Before M (SD)	After M (SD)	Baseline M (SD)	Familiar Before M (SD)	After M (SD)	Baseline M (SD)
$SUM_{duration}$	0.45 (0.38)	0.54 (0.44)	0.36 (0.39)	0.43 (0.27)	0.64 (0.37)	0.27 (0.39)

4. CONCLUSION

The results presented support the suggestion that glance behaviour is enhanced after the auditory instruction is given. Participants looked longer and more often but with shorter fixations after the instruction than before the instruction or in the baseline situation. No effects of participants anticipating an instruction before the auditory instructions were found; baseline epochs showed no significant differences from epochs before the instruction. No effects for familiarity of the route have been found. An interaction effect between Time and Familiarity was found for fixation frequency. Participants glanced more often at the device during a familiar trip before and after the instruction than during an unfamiliar trip, however in the baseline situation participants glanced less often in familiar trips than unfamiliar trips.

5. DISCUSSION

Although the results of currents study are based on a limited number of participants, some interesting clues were found. First, the differences in glance behaviour for Time (time relative to the time when the instructions were given), showed major effect sizes. This suggests a robust effect where drivers look longer and more often but with shorter fixations after an auditory instruction is given than before or during the baseline period. It is suggested that when participants receive an auditory instruction, visual information is used to support the processing of the auditory information. Drivers seem to try to relate the visual information from the device to the actual driving context by looking back and forth from the navigation device to the driving context resulting in more and shorter fixations to the device.

No differences in glance behaviour between familiar and unfamiliar trips have been found except for the interaction effect between Time and Familiarity for mean frequency duration. One possible explanation could be that the definition used for familiarity was unable to differentiate appropriately between familiar and unfamiliar trips. A trip was considered unfamiliar when participants indicated that the major part of the trip was unfamiliar but this does not necessarily mean that the analysed epochs on the motorway were unfamiliar. In a quarter of all baseline epochs glances at the navigation device were observed. This suggests that drivers frequently check the navigation device. It is unknown what information is being processed during these periodic glances and if the information processed is route guidance related or not. Other reasons for periodically looking at the navigation device could be to monitor the driving speed or the current speed limit.

Most instructions are part of a chain of instructions announcing the next manoeuvre. Future research could investigate possible differences in glance behaviour for different positions in the instruction chain. This could provide insight to navigation device manufacturers for optimizing the number of instructions per manoeuvre and optimizing the timing of the instructions thereby reducing the visual distraction related to the navigation device. Also, for future research it would be interesting to investigate if similar effects are observed on other road categories.

6. ACKNOWLEDGMENTS

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EVALUATION OF THE DRIVER SUPPORT SYSTEM LISA WITH A SIMULATOR STUDY AND AN INSTRUMENTED VEHICLE

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ABSTRACT: The aim of the present paper was to evaluate a driver support system through a simulator study with truck drivers and a field study with passenger car drivers. The in-vehicle information system LISA (Live In-vehicle Smart Assistant), developed within the project ASSET-Road was assessed concerning acceptance and usability. From the results it can be concluded that a well-integrated and improved smart assistant is considered desirable by passenger car drivers as well as by truck drivers.

1. INTRODUCTION AND BACKGROUND

The present paper reports the evaluation of a driver support system. The evaluation was made through a simulator study with truck drivers and a field study with passenger car drivers. The objective was to investigate the acceptance and usability of the in-vehicle information system LISA (Live In-vehicle Smart Assistant), developed within the project ASSET-Road. The LISA is a system that provides real-time warnings and context dependant advisory information to the driver. The system advices the driver to make strategic driving decisions. The system also provides warnings and relevant information concerning the surrounding traffic situation. For example the LISA would provide the driver with usable information at border crossings or inform about upcoming road works but also provide warnings in case of for example speed violation. Previous research has shown that advisory in-vehicle information in combination with warnings can lead to safer driving in terms of safer distance to vehicle in front and better lane position. It also enhanced user acceptance and drivers felt more aware of traffic surrounding and more alert to potential dangers (Lindgren, Angelelli, Mendoza and Chen, 2008).

2. AIM AND METHOD

The purpose of the ***simulator study*** was twofold; first to receive input on the functionality of LISA from professional truck drivers. The result obtained would found the basis for further development of the LISA system. Second, to investigate how the driver support system, LISA, should work in order to fulfil needs of professional heavy vehicle drivers during their driving task. The purpose was reached by studying truck drivers in a motion based simulator while they were interacting with the LISA system.

The purpose of the ***field study*** was to evaluate the user acceptance and opinions on the LISA system with passenger car drivers and to find out whether a service like LISA could be useful also to passenger car drivers. An additional aim was to assess whether the results were in line with the simulator studies conducted by VTI. In addition, the possible safety effects of a system like LISA were studied.

2.1. Simulator study

The simulator study was performed in Linköping (Sweden), in the VTI moving base Simulator II (with truck cabin) during spring 2011. There were 15 professional heavy vehicle drivers included in the study. The drivers were recruited from VTI's database of volunteer drivers. A number of instruments were used in order to collect as much information and comments as possible from the participants. There were questionnaires, scales and interviews before, during and after the drive. A highway road, comprising three sections, was designed especially for the project. The sections represented roads in Sweden, Germany and France. Each stretch had culture specific features. In all countries the speed limit was set to 90 km/h. In the simulator scenario there was surrounding traffic comprising both passenger cars and trucks. The same simulator environment was used for all participants. The scenario took approximately one hour to drive.

2.2. Field study

The field study was carried out in October 2011 in Espoo (Finland) with VTT's instrumented vehicle. Eleven voluntary drivers participated in the study. The functions used in the field study were speed violation warning, warning of short headway and road work warning. The task of the test drivers was to drive a given route with VTT's instrumented vehicle (Volkswagen Golf Plus with manual transmission). The route was about 40 km long and it took about 60 minutes to drive. All the tests were conducted in the daytime, outside rush hours. The route mainly consisted of sub-urban roads in Espoo, and a short stretch of a motorway. It included two road work sites and road stretches with different speed limits.

3. PROCEDURE

3.1. Simulator study

After arriving at the VTI simulator facilities, the participants were given written and oral instructions. A background questionnaire was filled in and the driver took place in the simulator. The participants were instructed to drive as they normally would in similar traffic circumstances. During the drive they were accompanied in the cabin by an experiment leader while another experiment leader stayed outside the cabin. During the drive, the driver received continuous context relevant information from the LISA system while answering questions from the experiment leader regarding the arisen situations. The driver encountered several scenarios during the drive, including road work, congestions and boarder crossings. When the drive was finished, the participant answered the post-questionnaires and scales.

3.2. Field study

The drivers were instructed to drive as they normally would do when driving alone in their own car. An observer sat in the back seat of the instrumented car. Afterwards, a short interview was conducted.

On the first part of the route, the LISA device was turned off. On the second part of the route, the distance warnings were turned on. In order to make sure that there was a vehicle to follow, another test vehicle was arranged to appear in front of the test vehicle for a short part of the route. The test drivers did not know about this other vehicle. On the third part of the route, distance warnings and speed violation warnings were turned on, and on the last part speed violation warnings and road work warnings were turned on. The screens shown by the device were identical to the original LISA software with the exception of the sanctions and the language: the messages were shown in Finnish. The speed limits and location of road work sites along the test route were programmed into the software.

4. RESULTS

4.1. Simulator study

All the participants of the simulator study were male. Twelve out of fifteen drivers drove four or more days per week and the remaining three drove one day per week. Eleven out of fifteen drove a "Truck with trailer" and four drove "Tow truck with semi-trailer". According to the drivers, they all usually drove on highways and in the countryside. More rarely they drove in cities and even more rarely they drove abroad.

Overall the truck drivers found it relatively easy to interact with the LISA. The two aspects of LISA that received the highest score (very difficult) on the post-driving scale were the location of the LISA screen and the prioritization of warnings. Some concern was also given to the aspects "To find information" and "That LISA show the right stuff at the right time". Many wanted the presented information to be retrievable which was not the case in the present LISA. Several thought that the hierarchy should be changed, for example, information on speed violation was not considered being the most critical information but should be overridden by information on road work, changes in speed limit or accidents.

Concerning upcoming roadwork, the information was considered relevant and useful. The information at border crossings was deemed good. They made numerous suggestions for additional desired information at border crossings, for example information on custom duty; speed regulations for trucks, spot availability, possible restrictions concerning mobile phone use and belt use as well as upcoming gas stations, weather forecast and more. Other than this, the participants also wanted continuous information on changes; suggestions on alternate routes in case of congestion, co-ordination with GPS, information on choice of lane, information on possible congestion, graphics of the construction site as well as current and changing speed limits. The participants wanted to be alerted (blink or bleep) whenever the information on the screen was updated or changed.

The drivers wanted the information on driving time to be integrated with a GPS to make it possible to get information on suitable rest-places. Also, they suggested that the system should have a driver-specific memory for 3-4 weeks which is the time frame they have to compensate for overriding driving time. This would enhance their ability to plan their drive.

4.2. Field study

Of the eleven participants of the passenger car field study, eight were male and three female. The average age was 41 years (range 22–60) and average kilometres driven per year were 25000 (range <10000–50000). Two of the drivers use a navigator regularly when driving. The test route was familiar to four drivers and partly familiar to five drivers.

In general, the drivers reacted positively towards the concept of LISA. They thought that, once developed further, it could be useful to drivers and contribute towards an improvement in traffic safety. Some drivers were concerned that LISA could take too much control of their driving. They still wanted to stay in control themselves and not be forced to read or react to messages.

Drivers understood the messages well and liked the simple setup of the screens. They felt that the reliability and timing of the information needed improvement. The participants were most satisfied with the understandability of the messages and the order of the information on the screen. The messages were well understood by all drivers. The drivers were least satisfied with the reliability and the timing of information.

The distance warning was regarded as being the most useful warning. The correct driving distance is often hard to estimate without support. Speed warnings were also considered useful, but some drivers were concerned that the warnings might be too irritating when used regularly and that the warnings were triggered too easily. The road work site warning was considered least useful. However, drivers said that road work warnings might be more useful on motorways and major roads where speeds are higher and road works can sometimes appear too suddenly. Also, some mentioned that they may like the road work warning when they get used to it, as the warning came quite early which may seem confusing at first.

Due to the small sample size and nature of the study, it is not possible to make any statistical evaluation of the possible effect of LISA on traffic safety. However, a short positive reaction after receiving a message could be observed. After receiving a message about driving too fast, drivers lowered their driving speed at least temporarily. Also, after receiving a warning on low distance to the vehicle in front, they increased the distance.

The drivers drove slower on road stretches with the speed violation warnings enabled than on road stretches with no speed violation warnings, which might indicate that the warnings lead to lower driving speeds in general.

5. DISCUSSION

In the analysis of the truck drivers' interaction with LISA in the simulator study, three main areas of concern arose, namely “Information content and hierarchy”, “Handling of the system” and “Interaction design”. The drivers wanted the system to be even more informative and also integrated with a GPS. In order to handle a larger amount of information, the prioritization of warnings was emphasized. It seems important to walk through the system in the design process, trying to reach a good hierarchy so that warnings and information that are considered important and critical, i.e., information on upcoming roadwork, accidents, change of speed limit and upcoming congestions are given a higher priority and a larger screen area than information ranked less important, such as information on speeding, fine and the picture of LISA, the woman. Desired features were current speed at all time and an alert (beep or bling) when new information appears. Integration with a GPS would give the drivers an opportunity to better plan their driving, for instance choosing an alternate route in case of an upcoming congestion or plan where to stop when it was time for rest.

The general impression of the simulator study at VTI was that the participating truck drivers were interested and willing to elaborate on a new support system for truck drivers, although a few had major concerns about introducing yet another system in the truck. To achieve the highest acceptability amongst drivers it is necessary to take their opinions into account when finalizing the design of LISA.

According to the passenger car drivers' opinions and experience from the field study, the device improves traffic safety by leading the driver to drive according to the rules and regulations. Drivers want to avoid getting many warning messages and being fined. However, drivers do not want to feel that they are being controlled by the device, but rather want to be in control of their own driving. Therefore, LISA should be developed to better assist the driver and attention should be paid to the frequency and nature of messages. The device should encourage drivers to drive safely rather than punish them for breaking the rules.

Passenger car drivers generally regarded the information as useful and desirable. However, improvements regarding usability have to be made and the system has to be enhanced further in order to be accepted by the users. The results obtained in the field study regarding user acceptance and opinions were in line with the results of VTI's truck driver simulation study. Passenger car and truck drivers had similar opinions on the usability of LISA and on how it should be developed.

Regarding safety effects, further investigation is needed to make any notable conclusions. In the field study, the sample size was very small and the setup did not allow statistical analyses. However, concluding from the answers of participants and from the speed and distance data collected from the test drives, it seems that messages on too high speed or too low distance have small positive effects on traffic safety.

5.1. Comparison between studies

Regarding user acceptance, the results obtained in the field study were similar to the results of the VTI simulator test. The passenger car drivers rated LISA slightly less useful and slightly more satisfying than the truck drivers in VTI's test.

Answers regarding strengths, weaknesses and improvements of LISA were similar in both studies. The information in general was regarded useful and the device and messages were easy to understand. Drivers of both groups thought it was good to be prepared by the messages and felt that the device helped them to remember current regulations.

Users in both studies were not satisfied with having to dismiss the messages themselves. Rather, they wished for the messages to disappear after a certain amount of time. They also wished for a beep or other sound when a message appeared so that they would not have to glance at the screen regularly, which distracted them from the driving task. Furthermore, GPS integration or integration with a navigation system was suggested by drivers in both studies. Also, drivers wanted more information integrated into LISA.

Passenger car drivers regarded information on speed violations useful more often than truck drivers. Drivers in both studies mentioned that they would like to know the current speed limit at all times and not having to drive too fast to see it (speed limit information was only triggered in case of speeding). Also information on upcoming changes was wished for by both groups. Information on road works was considered useful by most drivers in both groups. More information on road works was wished for by drivers in both tests, such as information on alternate routes and changed speed limits.

All passenger car drivers in the field test regarded low distance warnings very useful. The truck drivers did not regard them as useful, but in the simulator test, the warning on low distance was triggered differently than in the field test. In the simulator test the warning was triggered only when the truck got closer than 25 m to the vehicle in front, which only occurred while overtaking.

It can be concluded that a well-integrated smart assistant is considered desirable by passenger car drivers as well as by truck drivers. However, there is room for improvement concerning the present version of the Live In-vehicle Smart Assistant.

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