



Driver Support and Information systems - Short term effects

Magnus Hjalmdahl – VTI

Introduction



TOWARDS FUTURE AUTOMOTIVE HMI

AIDE final workshop and exhibition April 15-16, 2008, Gothenburg

- WP 1.2 Behavioural effects of driver assistance systems
 - Task 1.2.2 Assessment of variables: Learning and appropriation phase
 - D1.2.3 Driver support and information systems: Experiments on learning, appropriation and effects of adaptiveness
- The Deliverable describes the experimental work performed in Task 1.2.2
- Six different partners investigated different types of advanced driver assistance systems (ADAS)
 - INRETS
 - Renault
 - CERT/HIT
 - VTI
 - TNO
 - ITS Leeds
- The work is based on input from D1.2.1



www.aide-eu.org

Aim of the work



TOWARDS FUTURE AUTOMOTIVE HMI

AIDE final workshop and exhibition April 15-16, 2008, Gothenburg

- The literature review on the “Behavioural Effects of Driver Assistance Systems” (Deliverable D1.2.1) has highlighted the lack of knowledge about learning processes.
- The aim of this work was study these aspects so as to be able to formulate sound recommendations for the design and development of the AIDE system.
- It further aimed at studying if adaptiveness could improve the safety benefits and the acceptance of a system.
- The purpose of D1.2.3 is to describe the methods and results of the studies that were carried out in WP 1.2.2



www.aide-eu.org

What is the “Learning phase”



TOWARDS FUTURE AUTOMOTIVE HMI

AIDE final workshop and exhibition April 15-16, 2008, Gothenburg

- During the learning phase the driver becomes familiar with a new driving aid.
- During this phase, drivers:
 - discover the system
 - learn how it operates
 - identify the scope and limitations of its capabilities
 - circumscribe its realms of utility, and maybe
 - adjust their behaviour.
- The learning process is assumed to be crucial for the driver's representation of the system, for the confidence he/she has (and ought to have) in it and for ensuring optimal usage of it.
- The learning process depends on the way the system is presented to the driver (instructions for use, as well as information provided on-line), the driver's degree of experience and his familiarity with new technologies.



www.aide-eu.org

The experiments



TOWARDS FUTURE AUTOMOTIVE HMI

AIDE final workshop and exhibition April 15-16, 2008, Gothenburg

- The experiments reported in this deliverable are all experiments on their own, with a common focus on the learning phase of ADAS by drivers.

- The major topics of AIDE are dealt with:
 - Adaptation
 - Integration, and
 - Learning effects

- The experiments are:
 - Learning phase and short term behavioural effect of speed limiter and cruise control systems (INRETS, Renault)
 - Studying learning phases of an ACC through verbal reports (PSA)
 - On-road study on short term effects of ADAS on driving behaviour (CERT/HIT)
 - Driver response to adaptive forward collision warning systems (VTI, TNO, ITS Leeds)



www.aide-eu.org

Experiment 1



TOWARDS FUTURE AUTOMOTIVE HMI

AIDE final workshop and exhibition April 15-16, 2008, Gothenburg

Learning phase and short term behavioural effect of speed limiter and cruise control systems (INRETS, Renault)

The main objectives of the study were to assess short-term behavioural changes when using the support systems and to examine how drivers' knowledge and representations of the systems' operation and drivers understanding of the rules of use of the systems evolved with experience. A specific objective, associated with the characteristics of the systems studied, was to examine the potential transfer of knowledge and rules from one system to the other.

- Method:
 - Interviews + Instrumented vehicle
- Participants:
 - 12 drivers (nine men) who had never used the systems before
- Design:
 - Trials with an instrumented experimental vehicle equipped with a Speed Limiter and Cruise Control (SL/CC).
 - Trials with a non-instrumented vehicle equipped with SL/CC, and lent to participants for a week.



www.aide-eu.org

Experiment 2



TOWARDS FUTURE AUTOMOTIVE HMI

AIDE final workshop and exhibition April 15-16, 2008, Gothenburg

Studying learning phases of an ACC through verbal reports (PSA)

- The objective of the study is to describe and to understand how experienced drivers learn driving with an Adaptive Cruise Control (ACC), as well as the effect of learning on their representation of driving. Changes in representation of the system capabilities as well as changes in environmental relevant cues when driving with the ACC were showed by verbal data produced at different times



- Method:
 - Verbal reports elicited after different duration of exposure
- Participants:
 - 8 experienced drivers (all men) who had never used the system before
- Design:
 - They drive the ACC-car on open roads once a week during four weeks. At the second and the fourth week they make a first ride only with the experimenter and a second where they teach somebody introduced as "the next driver" (who is a different person each time) of the system.



www.aide-eu.org

Experiment 3



TOWARDS FUTURE AUTOMOTIVE HMI

AIDE final workshop and exhibition April 15-16, 2008, Gothenburg

On-road study on short term effects of ADAS on driving behaviour (CERT/HIT)

The objective of the study was:

- To identify the short-term effects on driving behaviour when using stand-alone and a combination of two ADAS (FCW and LDW), and, possibly, to identify a moment when stabilisation of drivers' behaviour is reached (learning phase).
 - To study the possible adaptation of driving behaviour associated with the use of stand-alone and a combination of two ADAS in long-term (after the learning phase has been completed).
 - To study the possible long-term impact on mental effort, due to the use of stand-alone or a combination of ADAS.
 - To study how drivers' acceptance evolves together with short- and long-term use of ADAS.
- Method:
 - Instrumented vehicle
 - Participants:
 - 24 drivers (14 men)
 - Design:
 - Four groups (No system, FCW, LDW, Both systems)
 - 15 experimental rides along a test route (same day, same time for 15 consecutive weeks)



www.aide-eu.org

Experiment 4



Driver response to adaptive forward collision warning systems (VTI, TNO, ITS Leeds)

The purpose of this experiment was to investigate how a Forward Collision Warning system (FCW) could be improved by adapting itself to the road condition, to the driver and to the driver's level of distraction. The study focused on how the various systems affected the driver's behaviour and their subjective opinion on and acceptance of the systems.

- Method:
 - Simulator study (three simulators)
- Participants:
 - 32 + 48 + 45 (almost 50% women)
- Design:
 - 40 kilometre urban road (80-90 km/h)
 - Eight critical events, triggered on TTC
 - Somewhat different design between the three studies. (for instance within/between subjects)



Conclusions on Learning



TOWARDS FUTURE AUTOMOTIVE HMI

AIDE final workshop and exhibition April 15-16, 2008, Gothenburg

- When trying to learn a stand-alone ACC system, knowledge, understanding and anticipation of ACC reactions seem to be available after about 370 km driving with the system. This amount of learning also seems enough to shift the driver's attention from the system back to the traffic
- When learning two separate systems (SL and CC) with an integrated HMI, the learning time takes longer than the total of the two separate systems.
- It was found that the simplest procedures were learned immediately. After 11 hours of driving the short term learning process of both systems with the integrated HMI seems to be over, but, people still discover aspects of the system.
- The experiments also learn us that apart from driver performance or behaviour, driver *interaction* with the system is a good indicator of the learning process.



www.aide-eu.org

Conclusions on Integration



TOWARDS FUTURE AUTOMOTIVE HMI

AIDE final workshop and exhibition April 15-16, 2008, Gothenburg

- The main conclusion with respect to integration is that drivers of the integrated system (FCW and LDW) tend to ignore the warnings of both systems.
- When drivers drive only with either one of those systems active, they adjust their behaviour according to the warnings.
 - This might be caused by the high number warnings drivers receive when driving with both systems active (on average 70 warnings per hour).
- With respect to the learning time of this integrated system, it was concluded that it took drivers five times of one hour exposure time to come to a harmonised driving behaviour.



www.aide-eu.org

Conclusions on Adaptivity



TOWARDS FUTURE AUTOMOTIVE HMI

AIDE final workshop and exhibition April 15-16, 2008, Gothenburg

- Adaptation to road friction (early warning when the road was slippery)
 - a clear improvement in safety because (fewer collisions as well as longer minimum time to collision and minimum headway for the adaptive system.
 - acceptance was however lower than for the non adaptive system.

- Adaptation to personal driver style (drivers with a short reaction time received the warning later than drivers with long reaction time)
 - the purpose of this was to increase the acceptance of the system for aggressive drivers (high sensation seekers, short followers, fast reactors).
 - both systems demonstrated improved safety compared to the baseline to a similar extent
 - drivers rated their acceptance of the adaptive system significantly higher than for the non adaptive system



www.aide-eu.org

Conclusions on Adaptivity



TOWARDS FUTURE AUTOMOTIVE HMI

AIDE final workshop and exhibition April 15-16, 2008, Gothenburg

- Adaptation to distraction did not show any improvements in terms of driving behaviour or acceptance.
 - An explanation may be found in the system design (the warning of this FCW lasted for two seconds and then stopped. The system 'reset' when the distance between the vehicles again exceeded than the warning distance; only then could a new warning be given)

- Overall conclusions FCW/Adaptivity:
 - FCW has benefits in terms of safety
 - by adapting the system to the prevailing road condition the benefits are even greater
 - However, extra care has to be taken to improve the driver's acceptance of the system
 - by adapting the system to personal driving style, the annoying features of the system will be reduced



www.aide-eu.org