Drivers' attitudes towards driver assistance systems

Juliane Haupt, FACTUM OG, Vienna

Abstract

Based on the results of focus group discussions with car drivers a questionnaire was developed that asked for drivers' safety-related attitudes towards driver assistance systems (DAS). 211 drivers participated in the questionnaire survey. As in the focus group discussions, the participants had a DAS experience reaching from almost no up to a high experience. Drivers were asked about their risk-related attitudes towards 29 different systems that are available on the market. Results show, in terms of safety, drivers' evaluate the 29 systems differently. Some were valued positively, others rather neutral or even negatively. The outcomes are discussed in terms of potential contributing factors affecting drivers' attitudes towards DAS: driver characteristics (e.g. gender, DAS experience, level of sensation seeking), time of system introduction on the market and system functionality.

Key Words: *Driver assistance systems, attitudes*

1 Introduction

Driver assistance systems (DAS) are systems that, to a certain degree, automate and help the driver to fulfil the driving task for instance in throttling, braking and steering. Different DAS have different effects on the various personal goals. The success of DAS that intend to improve traffic safety depends not only on the functionality of the system, but also on the willingness of people to use these systems. Thus, attitudes towards DAS are a main factor contributing to the potential positive influence of DAS on traffic safety.

Attitudes can be defined as 'mental position', an evaluation towards a subject of interest. Thereby, attitudes are not necessarily based on reasoned considerations: persons may have attitudes that are belief-based (reasoned evaluation and deliberative cost-benefit analysis) or attitudes that arise automatically (spontaneous evaluation of attitude object as an automatic process). Conscious attitudes have a stronger effect on behaviour.

Two studies were conducted on the one hand to highlight the importance of involving the influence of attitudes when DAS effects on traffic safety are investigated; on the other hand to gain an in-depth view in drivers' attitudes towards DAS.

2 The Pre-Study: Focus group discussions

20 licensed drivers (14 ♂, 6 ♀) with a driving experience of at least 10.000 km and with different levels of experience (from very inexperienced to very experienced) in using DAS participated in four focus group discussions. Participants did not perceive DAS as necessary for themselves but strongly supported that close persons (e.g.: partners, children) should use DAS. This was explained by the fact that close persons were perceived as being more safe when driving cars equipped with DAS, thus the 'vehicle-driver-system' was evaluated as more safely when cars were equipped with DAS. Hence reasoning, the way of imposing the questions to participants seems to have a great influence while judging the safety of DAS. When drivers were asked in general how they perceive DAS they were rather sceptical concerning the safety relevance and mentioned risky effects that the use of DAS may have. But when they were asked if they want closely related persons to use DAS they immediately agreed and argued with the safety relevance of DAS (for more information see [1]).

3 The Questionnaire-Study

3.1 Methods

Based on focus group results a questionnaire was developed. 211 drivers (91 ♀, 120 ♂) participated in the questionnaire survey.

The questionnaire included items asking for participants' attitudes towards DAS and their level of sensation seeking. Further issues were asked within the questionnaire that will not be addressed here.

3.1.1 DAS experience

As presented in Haupt and Risser [2] within the questionnaire, *DAS* experience was determined by three main questions*: (1.) Did you - and if yes, when did you first - used the particular system*?; *(2.) How often do you currently drive with the particular system activated?* and *(3.) How familiar do you feel with the particular DAS?* The questions were asked for the systems listed in table 1.

An index of these three items was built for all systems representing the total DAS experience of participants.

Table 1. List of DAS including added technical support / ADAS (see also [2])

Name	Description
Anti-lock braking system (ABS)	system that reduces the brake pressure in case of a hard braking situation in order to avoid a possible blockade of the wheels
Traction control system (**TCS**), also known as **anti-slip regulation** (**ASR**)	system that prevents wheels from spinning when the driver accelerates
Electronic stability control (**ESC**)	(also includes traction control) a system that counteracts the break out of the vehicle by the specific breaking of the single wheels
Automatic headlamps	system that automatically switches the headlight on and off
Curve light	system that adapts the lighting direction of the headlights in a curve situation according to the curve direction
Advanced front-lighting system (AFS)	adaptive bright-darkness-threshold; a system that illuminates the road scene depending on the traffic situation
Automatic beam switching	system that automatically fades in and dims the high beam
Automotive night vision	optical system that gives the driver a better sight in dark environment
Rain sensor	system that automatically switches the wipers on and off
Head-up-Display (HUD)	display in the drivers glance direction; a front-view-display; display that projects important information in the driver's field of view
Braking Assistance System (BAS)	system that provides the necessary pedal pressure in a braking action
Emergency brake assist	system that in case of danger initiates an automatic emergency brake when recognizing critical situations
Precrash warning system	system that in case of danger that warns when recognizing critical situations
Hill-holder	system, that avoids rolling back while hill-starting
Hill Descent Control	system that provides driving stability while driving downhill
Cruise control	speed regulation system; a system that keeps the speed given by the driver
Adaptive Cruise Control (ACC)	system that automatically keeps the distance to the leading vehicle respectively in case no leading vehicle is present that keeps the speed given by the driver
Navigation system	system, that provides route guide information to the driver in consideration of desired criteria
Blind spot monitor	system that warns the driver of a threatening collision while lane changing
Car-to-Car communication	describes the exchange of information and data between vehicles with the objective to inform the driver in time of critical / hazardous situations
Tire-pressure monitoring system	system that serves to observe the vehicle's wheel pressure in order to avoid any accidents that are caused by defective wheels
Traffic Sign Recognition	system that identifies traffic signs of the driven road and displays this information on a in-vehicle- or head-up-display

Name	Description
Lane Keeping assistance (active)	system that supports the driver actively in keeping the vehicle in the lane by performing automatic steering corrections
Lane Keeping assistance (warning)	system that supports the driver in keeping the vehicle in the driving lane by providing an auditory and/or visual and/or haptical signal when he/she is about to leave the driving lane without indicating
Intelligent Speed Adaptation (active)	system that supports the driver in keeping the current speed limit by adapting the vehicle‘s speed automatically to the given speed limits in the driven section
Intelligent Speed Adaptation (warning)	system that supports the driver in keeping the current speed limit by providing a (auditory and/or visual and or haptical) warning signal and the information about the current speed limit
Parking system (active)	system that automatically steers the vehicle in the parking space
Parking system (warning)	system that supports the driver in parking by providing alarming signals when the driver gets too close to outside objects
Auto transmission	

3.1.2 Attitudes towards DAS

Following 7-steps-Likert-scale-items served to collect drivers' attitudes towards DAS:

> *"Would you wish that closely related persons (parents, children, partner, friends) use the respective system?" (asked for each system listed in table 1)* (answering mode ranging from 1 'no, not at all' to 7 'yes, absolutely')
>
> *"When a child is a passenger in the car, the respective system should be activated in order to be able to inform, warn or intervene if necessary." (asked for each system listed in table 1)* (answering mode ranging from 1 'absolutely not agree' to 7 'absolutely agree')
>
> *"The activation of the respective system so that it can inform, warn or intervene if necessary is dangerous." (asked for each system listed in table 1)* (answering mode ranging from 1 'absolutely not agree' to 7 'absolutely agree')

An index of these three variables was built for each system listed in table 1. For calculating the index, the items were polarized in the same direction.

3.2 Results

The safety-related attitudes towards DAS differed between systems significantly, $F(28,1) = 62{,}151$, $p = .000$, $\eta^2 = .228$. Table 2 gives an overview how safe participants' judged the particular DAS. The DAS are arranged from the DAS perceived as less safely to the ones perceived as most safely.

Table 2. Arranged list of participants' attitudes towards DAS (answers from 1 'not safe' to 7 'safe')

Name	Mean index 'attitudes towards DAS'	Name	Mean index 'attitudes towards DAS'
Head-up-Display (HUD)	4.374	**Lane Keeping assistance (warning)**	5.221
Car-to-Car communication	4.506	**Navigation system**	5.273
Parking system (active)	4.510	**Blind spot monitor**	5.289
Intelligent Speed Adaptation (active)	4.611	**Rain sensor**	5.361
Auto transmission	4.629	**Automotive night vision**	5.365
Traffic Sign Recognition	4.670	**Curve light**	5.368
Hill Descent Control	4.703	**Automatic headlamps**	5.417
Lane Keeping assistance (active)	4.731	**Tire-pressure monitoring system**	5.446
Cruise control	4.762	**Pre-crash warning system**	5.509
Hill-holder	4.902	**Braking Assistance System (BAS)**	5.570
Intelligent Speed Adaptation (passive)	4.994	**Parking system (warning)**	5.578
Adaptive Cruise Control (ACC)	4.998	**Traction control system** (**TCS**), also known as **anti-slip regulation** (**ASR**)	5.885
Emergency brake assist	5.030	**Anti-lock braking system (ABS)**	6.504
Automatic beam switching	5.068	**Electronic stability control** (**ESC**)	6.229
Advanced front-lighting system (AFS)	5.183		

Note: According to Papadakis, the yellow marked system were classified as 'comfort driver assistance systems' and the green ones 'safety-relevant driver assistance systems'; the others were not included in the classification by Papadakis.

3.2.1 Gender differences

Significant gender differences in participants' attitudes towards DAS were found for the *Electronic stability control System* ($t(174.133) = -1.688$, $p = .047$, $d = .256$), the *Head Up Display* ($t(209) = -1.858$, $p = .033$, $d = .257$), the *Hill Descent Control* ($t(209) = -1.700$, $p = .046$, $d = .235$), the *Tire-pressure monitoring System* ($t(209) = -1.828$, $p = .035$, $d = .253$), the *warning Parking System* ($t(209) = -1.947$, $p = .027$, $d = .273$) and the *Auto Transmission* ($t(209) = -4.024$, $p = .000$, $d = .557$). Male participants judged these systems as safer than female participants did. Figure 1 illustrates the gender differences in participants judgements towards the mentioned systems.

No gender differences were found for the other 23 considered systems.

3.2.2 Sensation Seeking

One significant correlation was found for the effect of drivers' level of sensation seeking on attitudes towards a specific DAS. The higher participants scored in 'sensation seeking' the safer they judged the *Traffic Sign Recognition System,* $r = 0.135$, $p = .025$. No further correlations were found for the other 28 considered systems.

3.3.3 DAS Experience

Table 3 shows the correlations found between DAS experience and the safety-related attitudes towards the particular systems.

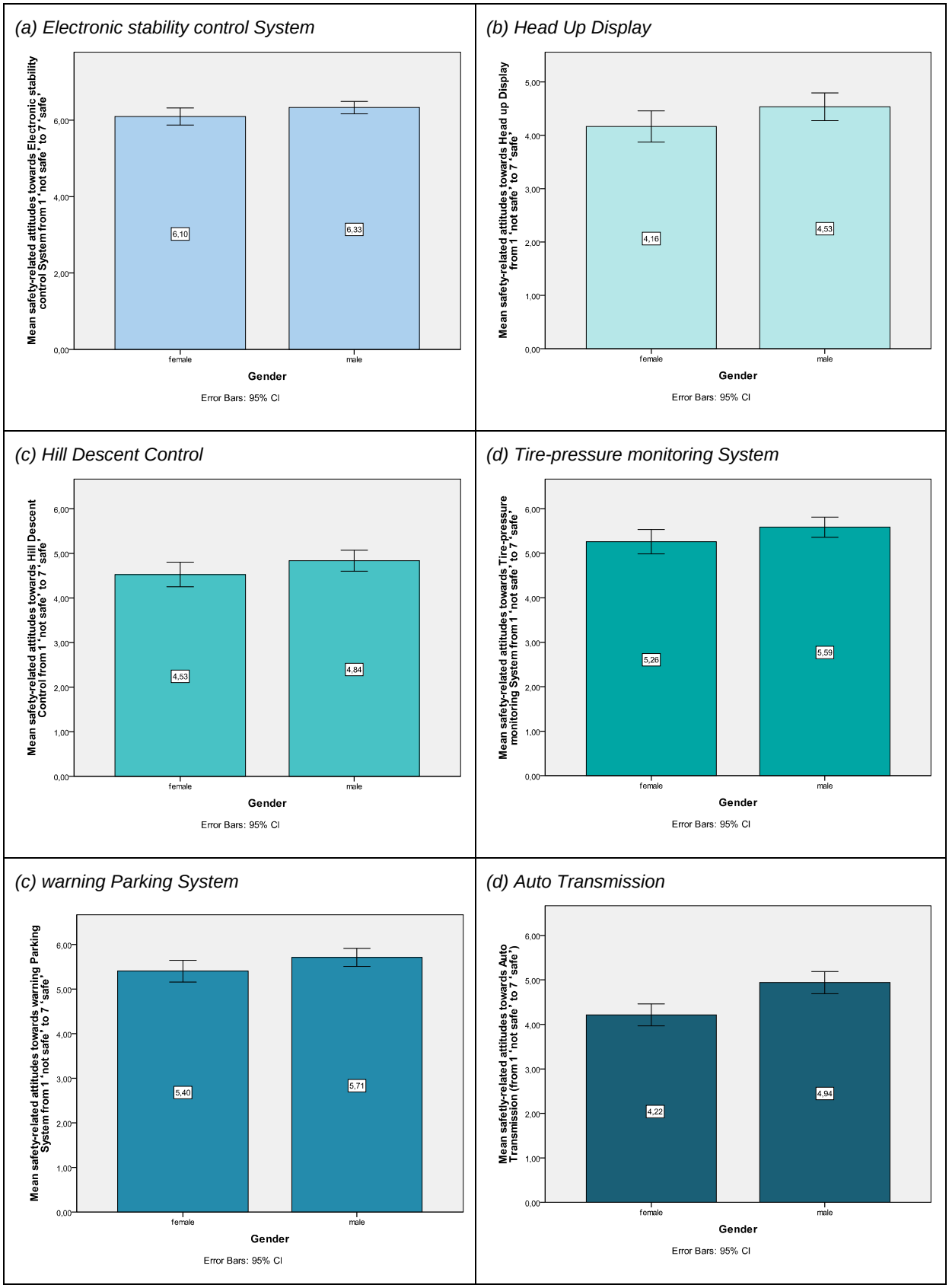

Figure 1. Gender differences in participants attitudes towards DAS.

Table 3. Correlation between attitudes towards DAS and DAS experience

Name	Correlation	Name	Correlation
Anti-lock braking system (ABS)	.214** *p* = .001	**Cruise control**	.180** *p* = .004
Traction control system (**TCS**), also known as **anti-slip regulation** (**ASR**)	.198** *p* = .002	**Adaptive Cruise Control (ACC)**	.120* *p* = .041
Electronic stability control (**ESC**)	.258** *p* = .000	**Navigation system**	.134* *p* = .026
Automatic headlamps	.257** *p* = .000	**Blind spot monitor**	.130* *p* = .030
Curve light	.170** *p* = .000	**Car-to-Car communication**	.056** *p* = .210
Advanced front-lighting system (AFS)	.176** *p* = .006	**Tire-pressure monitoring system**	.222** *p* = .001
Automatic beam switching	.174** *p* = .006	**Traffic Sign Recognition**	.128* *p* = .032
Automotive night vision	.092 *p* = .092	**Lane Keeping assistance (active)**	.101 *p* = .071
Rain sensor	.285** *p* = .000	**Lane Keeping assistance (warning)**	.187** *p* = .003
Head-up-Display (HUD)	.207** *p* = .001	**Intelligent Speed Adaptation (active)**	.063 *p* = .183
Braking Assistance System (BAS)	.252** *p* = .000	**Intelligent Speed Adaptation (warning)**	.075 *p* = .140
Emergency brake assist	.125** *p* = .035	**Parking system (active)**	.049 *p* = .241
Precrash warning system	.085 *p* = .109	**Parking system (warning)**	.268** *p* = .000
Hill-holder	.200** *p* = .002	**Auto transmission**	.349** *p* = .000
Hill Descent Control	.241** *p* = .000		

* Correlation is significant at the 0.05 level
** Correlation is significant at the 0.01 level

4 Conclusion

Results show, in terms of safety, drivers' evaluate the 29 systems differently. Some were valued positively, others rather negatively. When participants were asked for the their safety relevant attitude concerning a system that is available as 'warning'-version and as 'active' intervening version (e.g. lane keeping assistance, ISA), participants evaluated the warning versions as safer than the active versions. As most safely, the ASR, ABS and ESC were assessed. Considering the ranking of the DAS, a potential influencing factor on drivers' safety-related attitudes towards a DAS could be the time how

long a system is available on the market already and to which extend the system is distributed in licensed cars. This statement should be investigated more detailed in future research.

Potential influencing factors on drivers' safety-related attitudes towards DAS that were raised within in the introduced questionnaire survey were: gender, drivers' level of sensation seeking and drivers' experience in using DAS.

Gender differences in participants' judgements on DAS were found for six of the 29 systems: ESC, HuD, Hill Descent Control, Tire-Pressure Monitoring System, warning Parking System and Auto Transmission. Thereby, male participants consistently evaluated those systems as safer than female participants did. The effect was highest for Auto Transmission. As for the majority of considered systems (23 of 29) no gender differences were found, it can be concluded that gender is not a decisive factor influencing if a system is perceived as safe or not.

The same can be concluded for drivers' level of sensation seeking. Only one correlation was found for the effect of participants' level of sensation seeking on attitudes towards a specific DAS. This effect was found for the Traffic Sign Recognition System.

In contrast, for the majority of considered systems (24 of 29) significant correlations with participants' DAS experience were found. No significant correlations were found for the active Lane Keeping Assistance System, the active ISA, the warning ISA, the active Parking System and the Pre-Crash Warning System. The found significant correlations were consistently positive: the more DAS experience participants had the safer they judged the systems. Thus, experiencing DAS and its functionality seem to have a positive influence how drivers judge the safety relevance of DAS. The availability of DAS and to be able to afford (also advanced) driver assistance systems might contribute to a higher DAS experience in general public and consequently to a more distributed positive view on DAS.

5 Acknowledgement

The research leading to these results has received funding from the European Community's Seventh Framework Programmes FP7/2007-2013 under the project INTERACTION (grant agreement no218560) and FP7/2010-2013 under the project ADAPTATION (grant agreement n°238833).

6 References

1 Haupt, J. and Risser, R.: 'A theoretical model of DAS experience and motivational factors determining the engagement in secondary tasks while driving – A qualitative approach', unpublished manuscript, in preparation for submission.

2 Haupt, J. and Risser, R.: ‘What drives us to be engaged in secondary tasks while driving (working title)’, unpublished manuscript, in preparation for submission.

3 Papadakis, I..: ‘Fahrerassistenzsysteme: Überblick und aktuelle Trends’, presentation held on the 7th of April, 2007. http://www.ipd.uni-karlsruhe.de/~damast/seminar/FAS2007/pdfs/FAS2007_Papadakis_Fahrerassistenzsysteme_Vortrag.pdf, assessed March 2014